Inflation and Endogenous Technological Growth

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Abstract

The paper develops a Romer-type growth model with a research sector, a manufacturing sector, and a financial sector and shows that inflation has an adverse effect on economic growth. Higher inflation increases the incentives for agents to use money substitutes through financial services in an attempt to reduce inflation tax. This increases the size of the financial sector and shifts resources out of other sectors of the economy including research, the engine of growth, into the financial sector. As a consequence, the economy-wide growth rate declines. The paper examines the empirical evidence using panel data of 17 countries which have experienced medium or high inflation. The results strongly support the hypothesis of the expansionary effect of inflation on the size of the financial sector and the negative effect of inflation on growth.

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1. Introduction

The importance of price stability and the adverse effect of large and sustained inflation on long-term economic growth have been the focus of economic research for many decades. The common wisdom among both the public and economists is that high and persistent inflation will slow down economic growth[1] However, most of the theoretical models discussing the effect of inflation on output are either static or use a neoclassical exogenous growth framework. For example, Cooley and Hansen (1989, 1991) use a cash-in-advance constraint in a general equilibrium model to show that inflation has a negative affect on output. In their model, inflation acts as a tax on consumption. Therefore, higher inflation decreases employment, consumption, and investment as agents substitute leisure for consumption. Dotsey and Ireland (1995) extend the approach of Cooley and Hansen by using the argument of Karni (1974) and Wicksell (1978) according to which higher inflation increases the use of costly credit. Finally, in a recent paper, Frenkel and Mehrez (1996) develop a static model with two sectors - a manufacturing sector and a financial sector - and show that higher inflation shifts resources from the manufacturing sector to the financial sector as agents try to avoid the inflation tax by increasing the use of financial services, which allows them to reduce their money holdings.

A common characteristic of all models mentioned above is that, even though inflation affects the level of output, the long-run growth rate is independent of the inflation rate. The reason is that the models are either static or embedded in a neoclassical growth framework in which the growth rate is determined exogenously by the rate of technological change as in Solow

[1]See Shiller (1992) for a survey of the public perception about inflation.

(1956). Inflation can have an effect on long term economic growth only in a dynamic model with endogenous growth. De Gregorio (1993) presents one of the few models which includes an endogenous growth argument. He uses a linear production function in capital and shows that, due to the assumed requirement of cash in investment, inflation exerts a negative effect on investment and, thereby reduces long-term growth.

In this paper we take a different approach. We follow the argument of Romer (1990) that technological growth is determined by innovations and, therefore, by the amount of resources allocated to research activities in response to market incentives. In such a framework, any change in market incentives to undertake research on new technologies would affect the long-term growth. This paper discusses the effect of inflation on the amount of resources allocated to research and development of new technology and hence on long-term growth.

We extend Romer's (1990) model by distinguishing three sectors of the economy, a research sector inventing designs for new capital goods, a manufacturing sector producing consumption goods and intermediate capital goods, and a financial sector producing money management services. The balanced growth rate of this economy is determined by the amount of labor allocated to research activities, which in turn depends on developments in the other two sectors. We show that higher inflation increases the return of producing financial services and decreases the market incentives to produce manufacturing output or develop new capital goods designs. As a result, higher inflation causes a shift of labor to the production of financial sector output. Since this leads to a decline in research activities, an increase in inflation exerts a negative effect on the steady state growth rate. To support our hypothesis, we construct a data set of 17 countries which have experienced medium or high inflation. The empirical analysis suggests two results. First, higher inflation causes an increase in the size of the financial sector. Second, inflation has adverse effects on growth. The latter result also confirms the findings of Bruno and Easterly (1995, 1996).

The rest of the paper is structured as follows. Section 2 presents the model. Section 3 discusses features of the balanced growth path and the effects of inflation on growth. Section 4 presents the empirical analysis, and section 5 contains some conclusions.

2. The model

Similar to Romer (1990), we consider an economy with three basic inputs: labor, L, different types of intermediate capital goods, x(i), and aggregate knowledge reflecting the level of technology. In our model, there are three sectors compared to two sectors in Romer (1990): a research sector inventing new designs for capital goods, a manufacturing sector producing final consumption goods and intermediate capital goods, and a sector producing financial services. The basic setup of the model is as following. Entrepreneurs in the research sector produce designs for innovative capital goods. The new designs are sold to monopolists who use the new designs to produce new capital goods which are then sold to producers of consumption goods and producers of financial services. Consumption goods producers operate in perfect competitive markets and use capital and labor to produce homogenous consumption goods. Financial goods producers also operate in perfect competitive markets and use capital and labor to produce financial services which allow agents (producers and consumers) to reduce their money holdings (e.g., use costly credit instead of cash).

More specifically, the research sector produces new designs (blueprints) using labor and available knowledge. The production of new designs ($\underline{A}$) depends on the level of knowledge in manufacturing designs (A) and on the amount of labor in the research sector (L_A):

Install Equation Editor and double-click here to view equation. Here, δ_A represents a productivity parameter.

Output in the manufacturing sector is produced with labor and intermediate capital goods and can be used for consumption purposes. Denoting manufacturing output by Y, labor in the manufacturing sector by L_Y, and the quantity of a distinct intermediate capital good i used in the manufacturing sector by $x_Y(i)$, the production function is given by

Install Equation Editor and double-click here to view equation. The production function exhibits constant returns to scale in labor and intermediate capital goods, given the stock of available designs. This implies diminishing marginal productivity of capital for a given number of designs. However, the production function exhibits constant returns in capital when the stock of capital increases along the designs dimension.

The production function available to financial unit producers has a similar structure as in the manufacturing sector:

Install Equation Editor and double-click here to view equation. where F denotes financial sector output, L_F is employment in the final financial service production, and $x_F(i)$ is the quantity of the distinct intermediate good i used in the production of financial units. For simplicity, we assume that the capital goods used in the financial sector are the same as in the manufacturing sector.

An important element in our analysis of the effect of inflation on growth is captured by the the production elasticities in the two sectors. If

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then, for given factor prices, the capital labor ratio in the manufacturing sector is greater than the capital labor ratio in the financial service sector.

Money holdings in the economy are assumed to depend on manufacturing output. That is, producers (consumers) are faced with a cash in advance constraint proportional to output (consumption). However, agents can reduce their money holdings for any given level of output, by using financial services. In other words, money management services allow agents to substitute cash balances by other means of payments such as credit, or they can increase the velocity of money. Specifically, we assume the following the money demand function:

Install Equation Editor and double-click here to view equation. where m and φ denote real money holdings and a technology parameter, respectively. The term Y/F represents the reciprocal of the intensity of financial service usage. The higher the income level and the lower the intensity of the use of financial services, the higher is money demand in the economy.

The demand for financial services can be derived by examining the costs of money holdings. These costs comprise two components which are the inflation tax and money management costs. Denoting the inflation rate by π and the price of the financial service in units of manufacturing output by γ, total costs of money holdings are Install Equation Editor and double-click here to view equation.

The first order condition yields the demand for financial services

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Thus, the demand for financial services depends on manufacturing output, the price of the financial services, and the inflation rate. Equation (7) can also be rearranged to derive an expression for the price of the financial service:

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This implies that on a balance growth path, i.e., when the manufacturing sector and the financial sector grow at the same rate, and with constant inflation, the price of a financial unit is constant.

We now turn to the allocation of labor among the different sectors which determines the level of output and the growth rate over time. The endowment of labor is fixed and is set equal to unity. It is assumed that labor is mobile between the different sectors of the economy so that

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Wage flexibility and labor mobility ensures wage equality among the different sectors. The wage rate in each sector is given by the marginal productivity of labor. Let P_A be the price of a new design or patent in units of manufacturing output. Wages in the research sector can be expressed as

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To derive the wage rate in manufacturing, note that the production function for manufacturers implies symmetry of capital goods, i.e., it is optimal to employ all distinct types of capital in the same quantity, given that their price is the same. Thus, denoting the amount of each capital good by x_Y, manufacturing wages are equal to

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Defining the capital good labor ratio in the manufacturing sector as θ_Y so that

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allows us to rewrite equation (11) as

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Likewise, the wage rate in the financial sector, expressed in units of manufacturing output, can be written as

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We use a similar definition for the capital goods labor ratio in the financial sector as in the manufacturing sector and denote it by θ_F:

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Similar to equation (13), we can express the wage rate as a function of the capital goods labor ratio:

Install Equation Editor and double-click here to view equation. Combining equations (13) and (16) yields an expression for the price of the financial good in terms of the capital goods labor ratio

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The demand for capital goods by the manufacturing sector depends on their marginal productivity. Thus, assuming that no depreciation occurs, the production function (2) yields the inverse demand for capital goods Install Equation Editor and double-click here to view equation.

where p_x denotes the rental price of capital goods. Using the capital good labor ratio definition, equation (12), the capital goods labor ratio can be expressed as

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Similarly, the inverse demand function for capital goods in the financial sector is

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The price of financial services appears in equation (20) because the rental price p_x is expressed in units of manufacturing output. Using the definition in equation (15), the capital goods labor ratio in the financial sector is

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The capital goods labor ratio in each sector as well as the wage rate and the price of a financial unit depend on the price of an intermediate good. To solve for the price of an intermediate good we follow Romer (1990) and assume that capital goods can be produced by foregoing a certain amount of manufacturing output, i.e. consumer goods. Specifically assume that producers have to forego η units of consumption goods for the production of each unit of capital goods. Thus their periodical marginal costs are the opportunity costs on foregone output which are given by rη, where r is the real interest rate. If there were no financial sector capital goods demand would only stem from producers of manufacturing output. Then, given that the demand elasticity is -1/α, the optimal rental price capital goods producers would charge would be $p_{X}=r\eta/(1-\alpha)$. By contrast, if capital goods were only used in the financial sector, the optimal price would be $p_{X}=r\eta/(1-\beta)$, which, given our assumption that $\alpha<\beta$, is higher that in the case with a manufacturing sector only. With both sectors using capital goods and no price discrimination it can be shown that the price of capital goods is a weighted average of the two prices:

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In equation (22), the weight ω is a function of the size of the production sector relative to the financial sector. When the size of the financial sector is equal to zero then ω=1, and the price is the simple monopoly price that takes into account only the demand of the manufacturing sector. When the size of the manufacturing sector is equal to zero then ω=0, and the price is the simple monopoly price that takes into account only the demand of the financial sector. Thus, the greater the relative size of the financial sector is, the smaller is ω and the greater is p_x.

In innovation-driven endogenous growth models of the Romer type, the real interest rate is determined endogenously by technology and preferences. In our model, we assume, for simplicity, that the interest rate is constant. However, this assumption has no effect on the qualitative results of our analysis.[2] In the analysis in the next section, we point out the implications if the interest rate is variable.

3. Balanced growth and the effects of inflation

Along the balanced growth path, all sectors of the economy and, thus, the number of new designs or patents, output of consumption goods and the stock of capital grow at the same rate. As in

[2] This is the case because, as long as preferences are unchanged, growth is positively correlated with the real interest rate. This, in turn, would only dampen the allocation effects which we derive in section 3 below.

Romer(1990), the growth engine in our model is the research sector. From the production function of the research sector, we can derive the following expression for the growth rate (g):

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Thus, the growth rate depends on the allocation of labor between the different sectors of the economy or, more specifically, on the amount of labor in the research sector. In this section we examine how inflation affects the balanced growth path. Inflation has a negative effect on economic growth if higher inflation reduces the amount of labor used in the research sector, that is if $\partial L_A / \partial\pi < 0$ which implies that $\partial(L_Y + L_F) / \partial\pi > 0$.

We show the effect of inflation on growth by arguing in three steps. First, recall from equation (22) that the price of an intermediate good increases with the size of the financial sector relative to output. Thus, if λ is defined as the labor input in the financial sector relative to the labor input in the manufacturing sector

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our discussion of equation (22) implies that

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As the second step, we show that inflation increases labor input in the financial sector relative to manufacturing. We use the definitions of θ_Y and θ_F in equations (12) and (15) to rewrite the production function of the manufacturing and the financial sector as

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Employing these output functions in equation (7) gives

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Substituting for the price of the financial service γ, equation (17) yields a function of the labor input ratio λ in the inflation rate:

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We now differentiate the labor input ratio λ with respect to the inflation rate taking into account that θ_Y and θ_F are functions of the relative size of the financial sector. This yields

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The first partial derivative on the right hand side of equation (30) is

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This partial derivative, which we denote by -ρ, is smaller than zero if our assumption $\alpha<\beta$ applies. Using this in equation (30) and solving for $\partial\lambda/\partial\pi$ yields

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The sign of $\partial\lambda/\partial\pi$ is unambiguously positive since the values of $\partial p_x/\partial\lambda$ as shown in equation (3), ξ, and ρ are all positive. Thus, an increase in inflation increases the input of labor in the financial sector relative to the manufacturing sector.

Having shown that higher inflation raises both the price of capital goods and relative labor input in the financial sector, we examine, as a third and last step, whether these effects are accompanied by a shift of labor out of research. This would demonstrate the growth-decreasing effect of inflation. We begin examining the labor allocation by noting that the price of a new design (P_A), is determined by the monopolistic profits of capital goods producers:

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The first term on the right hand side represents the profits of capital goods producers from selling capital goods to the manufacturing sector. Likewise, the second term represents profits from sales to the financial sector. Substituting the above equation in the wage rate in the research equation, equation(10), yields

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Combining this wage function with equations (12) and (15) we can derive the wage as a function of the production sector, the financial sector, and the price of an intermediate good:

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Rearranging equations (13) and (16) for $\theta_Y=w_Y\theta_Y^{\alpha}/\alpha A$ and $\theta_F=w_F\theta_F^{\beta}/\gamma\beta A$ and substituting them in equation (35) yields

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We now replace the capital goods labor ratio by equations (19) and (21) and take into account that labor market equilibrium requires $w_A=w_Y=w_F$. After using the definition of the labor input ratio λ and rearranging we get

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Since the term on the right hand side of equation (37) reflects the profits of the capital goods producers, its derivative with respect to the price of the capital good equals zero. As we want to examine the effect of a change in the relative labor input λ on the combined labor input in manufacturing and financial sector we take the derivative of (37) with respect to λ:

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Finally, solving for the effect of λ on the combined labor input in manufacturing and in the financial sector yields

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This derivative is greater than zero as long as $\alpha<\beta$. We have thus shown that the increase in λ, i.e., the labor input in the financial sector relative to the labor input in manufacturing, is accompanied by an increase in the combined labor input in these two sectors. This implies that labor shifts out of research when λ rises:

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We are now able to complete the analysis of the inflation effects in our model. When inflation increases agents are faced with higher inflation tax. In response to these costs of money holdings, they try to avoid inflation by economizing on their cash balances through the purchase of financial services. Thus, the size of the financial sector relative to manufacturing increases ($\partial\lambda/\partial\pi>0$). Since the demand for capital goods by the financial sector is less elastic than the demand by manufacturing producers ($\alpha<\beta$), the price of capital goods increases ($\partial p_x/\partial\lambda>0$). Simultaneously, since the financial sector is less capital intensive than the manufacturing sector. The demand for labor increases, and hence labor is pulled out of research ($\partial L_A/\partial\lambda<0$).[3]

The described effects imply that there are considerable costs of inflation: inasmuch as

[3] Note that if $\alpha>\beta$, our results suggest that inflation leads to an increase in the growth rate. Hence, there is the theoretical possibility that inflation can be growth-enhancing.

resources are pulled out of research, the rate of innovation declines. As a consequence, economic growth decreases. Thus, the analysis shows an important channel through which inflation can have adverse effects on growth. In addition to the growth effect, there is a level effect of inflation on output. As resources are also pulled out of manufacturing, consumption opportunities decline. Financial services only serve to minimize costs of money holdings and, hence, resources are absorbed in an activity which is optimal to undertake for each agent but which reduces overall consumption.

This result even holds if we do not use the assumption of a constant real interest rate. In the Romer (1990) model, given preferences imply a decline in the real interest rate when growth declines. In our model this would only reduce the extent to which resources shift out of research. This is the case because a lower interest rate reduces the cost of capital and increases the demand for capital goods. This, in turn, increases the returns for research. However, since this is a second-order effect, it only changes the quantitative effect, but inflation still exerts a growth-reducing effect.[4]

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[4]We have shown that an increase in inflation leads to a reallocation of resources between the three sectors of the economy. Nevertheless, once the adjustment is completed, the economy is again on a balanced growth path. Then, the size of the sectors has changed with the financial sector being larger than before. The growth rate of new designs, manufacturing output and the production of financial services is unambiguously smaller along the new growth path. These effects constitute real effects of inflation.

4. Empirical evidence

To investigate the empirical evidence on the effects of inflation on economic growth and the allocation of resources, we use data from 17 countries between 1960 and 1992. Since we think that the model discussed in the previous sections fits mainly situations of medium and high inflation, the empirical study focuses on countries that have experienced a period of significant inflation. The countries included in our data set comprise eight countries which experienced annual inflation rates of close to or more than 100 percent for some time and nine industrial countries that had inflation rates between 10 and 30 percent per year for several years. More specifically, the group of high inflation countries consists of six Latin American countries (Argentina, Bolivia, Brazil, Mexico, Peru, and Venezuela), Israel, and Turkey. The group of medium inflation countries includes Australia, Greece, Iceland, Ireland, Italy, New Zealand, Portugal, Spain, and the United Kingdom. In most countries the share of the financial sector in total output amounts to 5 to 15 percent. Not surprisingly, more advanced economies exhibit a higher share of the financial sector. However, in virtually all countries the share shows significant fluctuations and a strong positive time trend as countries grow.

We carry out the empirical investigation in two steps. We first test whether inflation indeed influences growth. Subsequently, we test whether inflation affects employment in the financial sector. Since reliable data on employment in research is not available we concentrate on the reallocation effects of inflation on the manufacturing and the financial sector in the countries we study.

We estimate the effect of inflation on growth using a panel data analysis. The dependent variable is the growth rate of per capita GDP and the independent variables are the natural logarithm of inflation, the investment share in GDP, per capita GDP in 1961, and time (period) dummies. To avoid contemporaneous correlation, we follow the standard practice in the literature (e.g., Barro, 1995; De Gregorio, 1992; Islam, 1995) and use a six year average of each variable. We apply four different specifications and present the results in Table 1. The effect of inflation on growth is negative and significant. The semi-elasticity of inflation is -0.0055 when we control for period dummies (column 2) and -0.007 when we do not control for the period dummies (column 1). That implies that doubling the inflation rate would reduce growth by 0.6 to 0.7 percentage points. These results are consistent with the result of De Gregorio (1992) who uses a panel of 12 Latin American countries from 1960 to 1985 and estimates the semi-elasticity of inflation to be -0.008. Our results, however, suggest that controlling for period dummies reduces the endogeneity of inflation and, hence, reduces the upward bias.

Insert Table 1 here

As an alternative to the specifications presented in columns 1 and 2, we also use fixed effects for the constant for the different countries included in the regressions. The results are presented in columns 3 and 4 of Table 1. The semi-elasticity of inflation is nearly the same for the case in which we do not control for period dummies and is slightly smaller (-0.0045) in the case in which period dummies are included in the specification.

Next, we study the effects of inflation on the size of the financial sector measured by the number of employees or, where sectoral employment data are not *available, by the sectoral contribution to GDP. Our theoretical analysis implies that a rise in inflation increases both the share of workers employed in the financial sector and the share of this sector in total production of the economy.*

Frenkel and Mehrez (1996) estimate the effect of inflation on the financial sector for individual countries separately and find evidence that inflation increases the size of the financial sector. Here, we take a different route and employ a panel data approach employing again six year averages. The dependent variable is the relative share of the financial sector and the independent variables are the inflation rate (in natural logarithm), per capita GDP, and period dummies. The latter two variables are used to capture the income and the time effect, respectively. For reasons of data availability, we employ data for the period 1970-92. Table 2 presents the results. The effect of inflation on the relative size of the financial sector is positive and significant implying that an increase in inflation shifts employment or, more generally, economic activity to the financial sector. This confirms the result of our theoretical analysis.

The estimated effect of inflation on financial sector employment as shown in Table 2 is 0.04 to 0.05. This means that doubling the inflation rate induces a rise in the share of the financial sector by about four to five percent. Considering that the data do not include changes in the relative size of the financial departments in nonfinancial enterprises, where similar effects as described above can be expected, the total resource shift between different activities in the economy can be expected to be significantly higher. The only other similar empirical estimation that we are aware of is English (1997) who finds similar effects of inflation.

Insert Table 2 here

5. Summary and conclusions

The analysis in this paper highlights an important channel through which inflation can exert adverse effects on economic growth. So far, most theoretical models addressing the effect of inflation on output have been either static or have used a neoclassical exogenous growth framework. However, the analysis of the dynamic effects of inflation on resource allocation and growth appears to be particularly interesting. Using a two-sector endogenous growth model in which research activities are the growth engine, our analysis shows that inflation affects growth through its effect on the allocation of resources in the economy. More specifically, inflation increases the incentives of agents to use more money management services, i.e., financial services, in order to reduce the burden of the inflation tax. This leads to an increase in the amount of resources used in the financial sector relative to the manufacturing sector. Simultaneously, it shifts resources out of research activities and thus reduces the rate of innovation in the economy. This result holds if the manufacturing sector is more capital intensive that the financial sector. As a consequence, higher inflation increases the size of the financial sector and reduces the long-run growth rate of the economy.

Our empirical analysis uses panel data of 17 countries which have experienced medium or high inflation over several years between 1961 and 1992. We find strong support for the hypothesis that inflation has a negative effect on economic growth and that inflation increases the relative size of the financial sector.

In the long run, the negative growth effect of higher inflation is quantitatively considerably more important than the negative static effects emphasized by several other studies. *Thus, the real costs of inflation, which often seem to be hard to identify, should be seen in a dynamic context.*

References

Barro, R. J. (1995), "Inflation and Economic Growth," *Bank of England Quarterly Bulletin* May: 166-76.

Bruno, M., and W. Easterly, (1995), "Inflation Crises and Long-Run Growth," NBER Working Paper No. 5209.

Bruno, M., and W. Easterly, (1996), "Inflation and Growth: In Search of a Stable Relationship," Federal Reserve Bank of St, Louis Review, May-June: 139-46

Cooley, T. F., and G. D. Hansen (1989), "The Inflation Tax in a Real Business Cycle," *American Economic Review*, Vol. 79, 733-748.

Cooley, T. F., and G. D. Hansen (1991), "The Welfare Cost of Moderate Inflations," *Journal of Money Credit, and Banking*, Vol. 23, 482-503.

De Gregorio, J., (1992), "The Effects of Inflation on Economic Growth," *European Economic Review* 36 (2-3): 417-24.

Dotsey, M., and P. Ireland, (1996), "The Welfare Cost of Inflation in General Equilibrium," *Journal of Monetary Economics*, Vol. 37, 29-47.

Englisch, W.B. (1996), "Inflation and Financial Sector Size," Federal Reserve Board, Washington, mimeo.

Fischer, S. (1993), "The Role of Macroeconomic Factor in Economic Growth," *Journal of Monetary Economics*, (Dec): 485-512.

Frenkel, M., and G. Mehrez (1996), "Inflation and the Misallocation of Resources," Georgetown University, Department of Economics, Working Paper #96-20.

Gillman, M., (1993), "The Welfare Cost of Inflation in a Cash-in-Advance Economy with Costly Credit," *Journal of Monetary Economics*, Vol. 31, 97-115.

Islam, N., (1995), "Growth Empirics: A Panel data Approach," *Quarterly Journal of Economics*, 110:1127-1170

Karni, E., (1974), "The Value of Time and the Demand for Money," *Journal of Money, Credit, and Banking*, Vol. 6, 45-64.

Romer, P.M. (1990), "Endogenous Technological Change," *Journal of Political Economy*, Vol. 98, 71-102.

Romer, P.M. (1986), "Increasing Returns and Long-Run Gowth," *Journal of Political Economy*, Vol. 94, 1002-1037.

Shiller R. J., (1996), " Why Do People Dislike Inflation?" NBER Working Paper No. 5539.

Solow, R.M. (1956), "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*, Vol. 70, 65-94.

Summers, R., and A. Heston (1991), "The Penn World Table: An Expanded Set of International Comparisons," 1950-1988, *Quarterly Journal of Economics*, Vol. 106, 327-368.

Table 1: The Effects of Inflation on Growth

Dependent variable: Growth rate of per capita GDP (six year average)				
Specification	*(1)*	*(2)*	*(3)*	*(4)*
Constant	*0.029* *(2.30)*	*0.022* *(1.76)*	*Fixed Effects*	*Fixed Effects*
Inflation (log)	*-0.0070* *(-4.52)*	*-0.0055* *(-3.35)*	*-0.0071* *(-3.68)*	*-0.0045* *(-2.13)*
Investment ratio	*0.0015* *(3.42)*	*0.0017* *(3.81)*	*0.0018* *(2.63)*	*0.0023* *(3.15)*
Per capita GDP in 1961	*-4.49 e-06* *(-4.13)*	*-4.19 e-06* *(-4.19)*		
Subperiod dummies				
73-79		*-0.0057* *(-0.95)*		*-0.0089* *(-1.33)*
79-85		*-0.0164* *(-2.77)*		*-0.0179* *(-2.86)*
R^2	*0.36*	*0.41*	*0.43*	*0.48*

Note: panel data for 17 countries (Argentina, Australia, Bolivia, Brazil, Greece, Iceland, Ireland, Israel, Italy, Mexico, New Zealand, Peru, Portugal, Spain,Turkey, United Kingdom, and Venezuela) for the period 1960-92; in total 97 observations; t statistics are in parentheses.
Data sources: GDP and investment share data are from Summers and Heston (1991); inflation data are from Bruno and Easterly (1995) and, for New Zealand, Australia and Ireland, from the International Financial Statistics of the IMF.

Table 2: The Effects of Inflation on the Relative Size of the Financial Sector

Dependent variable: Relative employment in the financial sector (log) (six year averages)		
Specification	(1)	(2)
	Fixed Effects	Fixed Effects
Inflation (log)	0.042 (1.59)	0.050 (2.63)
GDP per capita (log)	0.97 (6.59)	0.93 (8.81)
Subperiod dummies		
73-79		-0.29 (-6.75)
79-85		-0.12 (-3.02)
R^2	0.96	0.98

Note: panel data for 17 countries (Argentina, Australia, Bolivia, Brazil, Greece, Iceland, Ireland, Israel, Italy, Mexico, New Zealand, Peru, Portugal, Spain,Turkey, United Kingdom, and Venezuela) for the period 1970-92; in total 64 observations; t statistics are in parentheses.
Data sources: OECD, The International Sectoral Database; World Bank, Country Studies; International Labor Office, Year book International Labour Statistics; and Economist Intelligence Unit, various issues of Country Profile and Country Reports; in cases for which no sectoral employment data were available, sectoral production data was used. GDP and investment share data are from Summers and Heston (1991); inflation data are from Bruno and Easterly (1995) and, for New Zealand, Australia and Ireland, from the International Financial Statistics of the IMF.