The Misallocation of Resources of Anticipated Inflation

Michael Frenkel*

Gil Mehrez**

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Abstract

This paper analyzes the effects of anticipated inflation on the resource allocations between production and financial services. We develop a model with heterogeneous workers and two sectors economy. A manufacturing sector producing a final composite good and a financial sector providing monetary management services for manufacturers. Workers in this economy are heterogeneous in their productivity and are free to move between the two sectors. Hence workers with high productivity in the financial sector choose to work in the financial sector, where they can earn high wages, while workers with low productivity prefer to work in the manufacturing sector. In equilibrium, the allocation of workers between the two sectors, i.e., the size of each sector depends, among other factors, on the inflation rate. Higher inflation increases the marginal revenues of financial workers and decrease the marginal revenues of production workers. As a consequence, resources are shifted from the manufacturing sector to the financial sector. That is, the share of the financial services in output increases and production (output) decreases. The resulting decline in manufacturing sector output reduces consumption opportunities and represents costs of inflation.

To estimate the change in the production structure and, thus, the costs of inflation we analyze data from 28 countries which had some notable inflation history during the period 1972-1995. We find strong support for the hypothesis that higher inflation increases the share of the financial sector output and employment relative to the manufacturing sector.

* WHU - Koblenz School of Corporate Management (Burgplatz 2, 56179 Vallendar, Germany, Email: mfrenkel@whu-koblenz.de)

** Department of Economics, Georgetown University, Washington, D.C., USA, Email:mehrezg@gusun.georgetown.edu

1. Introduction

In the analysis of the real effects of inflation - the costs of inflation, it is widely accepted that these effects depend on the source of the inflation, whether the inflation is anticipated or unanticipated and whether the institutional structures have been adjusted to neutralize the consequences of inflation resulting from a rigid tax system or inadequate financial markets (see Fischer and Modigliani (1978)). This paper investigates the effects of stable and anticipated inflation in a fully escalated economy. Several papers have concentrated on the effect of inflation on consumers attempts to avoid the inflation tax. Bailey (1956) in his seminal work emphasizes the "shoe leather effect" as consumer concentrate their shopping closer to the receipt of income and shops decrease their inventories. Fischer (1981) extends Bailey (1956) work by discussing the effect of inflation on the savings and portfolio choice of consumers. As inflation increases consumers shifts their savings from money to bonds as the price of holding money is higher and hence face higher transaction costs. Cooley and Hansen (1989) follow a Lucas and Stockey (1983) cash-in-advance model where consumers decision of time allocation between consumption and leisure depends on the inflation rate. Inflation distorts the efficient allocation between consumption and leisure as it distorts the price of producing from the price of consuming. Gillman (1993) discusses the welfare costs of inflation in an economy where consumers substitute between cash and costly credit.

This paper investigates the effect of anticipated inflation on the structure of the economy, i.e., the effect of inflation on the resources allocation among the different sectors of the economy. We develop a model with heterogeneous agents and two sectors, a production sector and a financial sector. In equilibrium the resources allocation between the production sector and the financial sector is determined endogenously and depends on, among other factors, the inflation rate. As we show, inflation increases the relative size of the financial sector as firms find it optimal to devote more resources to managing their monetary assets. In addition, higher inflation decreases the wages in the production sector and the financial sector and increases the wage differential between the financial sector and the production sector.

These results are supported by the empirical findings that the relative size of the banking

sector expands during hyperinflation and shrink after stabilization. To further support it and to estimate the costs of inflation, that is, the relative increase in the financial sector due to higher inflation we analyze data from 28 countries which had some notable inflation history during the past two decades and for which appropriate sectoral production or employment information is available. We find strong support for the hypothesis that higher inflation increases the financial sector relative to the production sector. Our estimates suggest that an increase in the annual inflation rate from 5 to 10 percent would increase an initial financial sector share of 20 percent by close to one percentage point leading to the same decline in the manufacturing sector.

The paper is structured as follows. In section 2, we develop the model analyzing the effect of inflation on the structure of the economy. Section 3 discusses comparative statics. Section 4 presents the empirical analysis of inflation effects on the sectoral structure. Finally, section 5 concludes and discusses possible extensions of the analysis.

2. The model

This section develops a model in which the allocation of resources between different sectors of the economy is determined endogenously and depends on the inflation rate. There are two sectors in the economy, a manufacturing sector producing a final good and a financial sector providing monetary management services for manufacturing goods producers. Both sectors use labor as the only factor of production. Labor is mobile between the two sectors. However, workers differ in their relative productivity in the financial sector. As a result, wages in the financial sectors are heterogeneous. Workers with high productivity in the financial sector choose to work in the financial sector, where they can earn high wages, while workers with low productivity prefer to work in the manufacturing sector where wages are homogeneous and are higher than their wage in the financial sector. Hence, given the wage in the manufacturing sector and the costs of a financial unit, the size of each sector can be determined from the distribution of the workers' productivity. Inflation affects this allocation as it decreases the marginal revenues of workers in the production sector (due to the higher inflation tax) and increases the marginal

revenue of workers in the financial sector.

Our focus is on the structural effects of inflation. The effect of a fully anticipated and stable inflation on the long term equilibrium allocation of resources in the economy. That is, stabilization and dynamics issues are excluded from our analysis. In other words, we consider a static model and examine the effect of inflation on the long term equilibrium.

2.1 Labor supply

There are L heterogeneous workers in the economy. Each worker supplies one unit of labor inelastically. Workers get the same utility from working in each sector and hence each worker chooses to work in the sector that pays her the highest wage rate. Workers are heterogeneous in their productivity in the financial sector, but have the same productivity in the manufacturing sector.[1] Some workers are particulary productive in the financial sector, either because of talent or because they acquired skills through education and experience. More formally, let β^i be the productivity of worker i in the financial sector. That is, worker i produces one unit of output if employed in the manufacturing sector and β^i units of financial services if employed in the financial sector. The productivity characteristics of workers in the financial sector, β^i, is exogenous and is distributed uniformly between zero and one across workers:

$$\beta^i \sim \textit{uniform}\ [0,1]\ . \qquad \textbf{(1)}$$

Competition in the labor market implies that the wage of worker i in the financial sector is such that the cost of a financial unit is independent of the worker supplying it. This implies that the wage of worker i depends on her productivity and on the costs of a financial unit. As a result, workers with high productivity enjoy high wages in the financial sector while workers with low productivity enjoy low wages in this sector. In contrast to the heterogeneity of workers and wages in the financial sector, workers' productivity and hence wages in the manufacturing sector

[1]Thus, the financial sector productivity can be interpreted as the productivity level relative to the manufacturing sector.

are homogenous. Therefore, there is a critical level of productivity, β^n, at which the wage offered in the financial sector to a worker with this productivity is equal to the wage in the manufacturing sector. We refer to this worker as the marginal worker. All workers, whose productivity is higher than β^n, choose to work in the financial sector and all workers, whose productivity is below this level, choose to work in the manufacturing sector. The critical level, β^n, together with the price of a financial unit ($1/\gamma$) determines the wage paid to worker n (in both sectors) expressed in units of manufacturing goods:

$$W_F^n = \frac{\beta^n}{\gamma} = W_Y \ . \qquad \textbf{(2)}$$

Here, W_F^n and W_Y denote the wage of worker n in the financial sector and the wage paid in the manufacturing sector, respectively.

The supply of labor in each sector depends on the wage rate paid in the manufacturing sector and the cost of a financial unit, i.e., the wage structure in the financial sector. In addition the supply of labor must be equal to total employment:

$$L_Y + L_F = L \ , \qquad \textbf{(3)}$$

where L_Y and L_F denote labor in the manufacturing sector and in the financial sector, respectively.

Figure 1

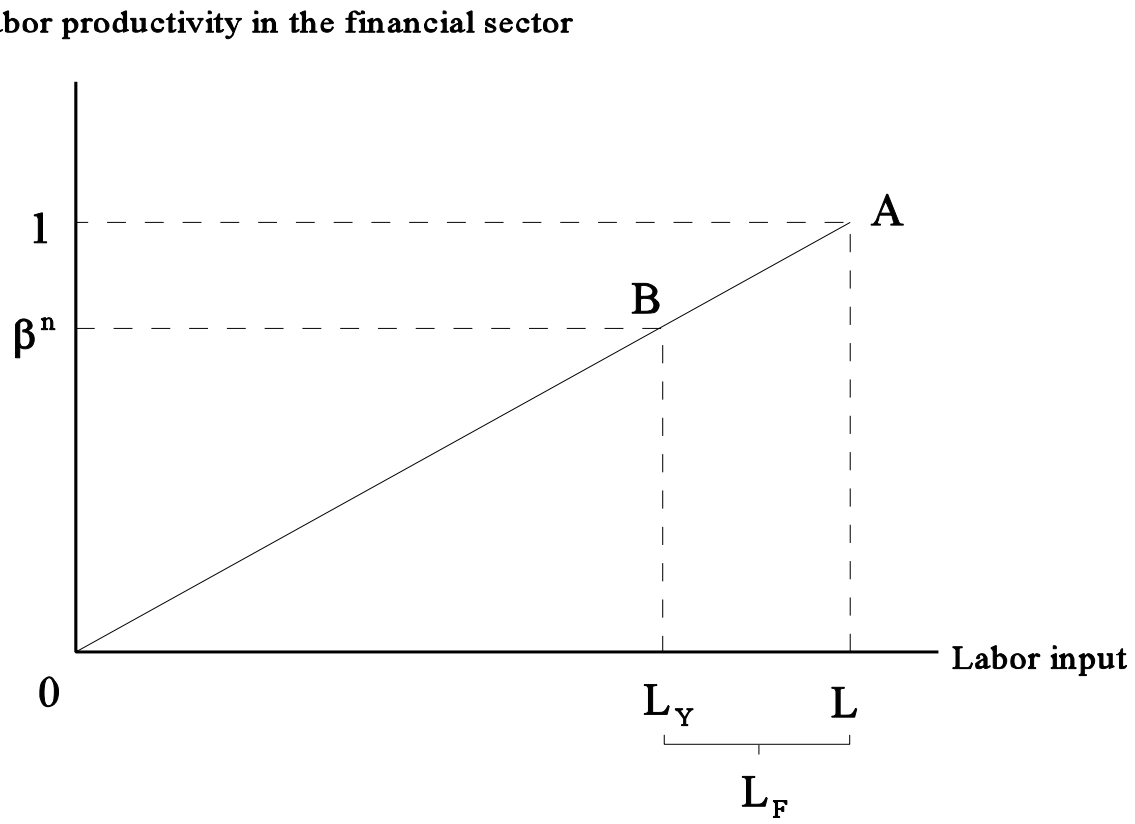

Figure 1 illustrates the distribution of labor productivity in the financial sector and the allocation of labor between the two sectors of the economy. For a given wage in the manufacturing sector and cost of a financial unit, the critical productivity level is β^n. The labor force in the manufacturing sector comprises all workers with lower productivity than β^n and, thus,

amounts to $L_Y=L\beta^n$. The rest of the labor force, $(L(1-\beta^n) =L_F)$, is employed in the financial sector of the economy.

2.2 Production and labor demand

Of the two sectors in the economy (manufacturing sector and financial sector), only the manufacturing sector produces a final good. The financial sector sells monetary managements services for the manufacturing good producer. The final good produced in the manufacturing sector is a composite good which, assuming that there is no investment, is used for consumption purposes only. Let Y be total output of the manufacturing sector and let the price of the consumption good be the numeraire. Production takes place in a perfect competition environment where the production function of each manufacturing firm is linear in the amount of labor (L_Y) and where the input coefficient is assumed to be unity. For the economy as a whole, this yields

$$Y = L_Y \, . \tag{4}$$

Each firm in the manufacturing sector has to hold money in order to facilitate sales and to pay suppliers and workers. The amount of money each firm holds depends on its total output and on the intensity with which it uses services purchased from the financial sector to manage its monetary assets.[2] Even though output does not depend on the amount of financial services used, profits depend on the extent to which financial services are used. Specifically, we assume the following money demand function:

$$m = \alpha \frac{Y}{F} Y, \tag{5}$$

[2]The setup of the model also allows the interpretation of the financial sector as the financial department of the manufacturing firms. In this case, the financial services are produced by the manufacturing good producers themselves.

where m is money demand, α is a coefficient representing the monetary technology and F denotes the quantity of financial services. Money holdings depend positively on the production level of the firm and negatively on the ratio of financial services to output. The more financial services a manufacturer uses, given its output level, the less money she needs to hold. In order to focus on the allocation effects of inflation between the two sectors, the model assumes that the only purpose of using financial services is to reduce the inflation tax of a manufacturer.

Output in the financial sector is given by the total productivity of all workers employed in this sector. Since all workers with productivity greater than β^n are employed in the financial sector, total output of financial services is

$$F = L \int_{\beta^n}^{1} \beta \, d\beta \ . \tag{6}$$

Using the production function (4) and the money constraint (5), profit maximization of a manufacturing good producer can be expressed as

$$\begin{aligned} \max \Psi &= Y - \left(L_Y W_Y + \alpha\pi \frac{Y}{F} Y + \frac{1}{\gamma} F\right) \\ s.t. \quad & Y = L_Y, \end{aligned} \tag{7}$$

where Ψ denotes profits and π is the inflation rate. Profits are the difference between total manufacturing output (Y) and total costs which are given by the expression in parentheses on the right hand side of equation (7). Costs comprise labor costs, the cost of money holdings and the costs of financial services. Since the cost of money holdings in this model consist only of the inflation tax, it is the product of the inflation rate and the real money holdings given by the demand function (5).

The optimal resources per unit of output spent on financial services, i.e., $(F/\gamma)/Y$, can be derived from the first order condition of the profit function (7) with respect to the financial sector, (F/γ). This yields:

$$\frac{F/\gamma}{Y} = \sqrt{\frac{\alpha\pi}{\gamma}} \qquad or \qquad \frac{F}{Y} = \sqrt{\alpha\pi\gamma} \ . \tag{8}$$

Equation (8) implies that the optimal ratio of the financial services to manufacturing output is independent of manufacturing output. In other words, the optimal level of the financial sector is a constant share of the production of manufacturing goods.[3] The optimal share of the financial sector increases with the inflation rate and decreases with the costs of a financial unit. Intuitively, the manufacturing sector purchases financial services until the marginal costs of an additional unit, $1/\gamma$, is equal to marginal benefits, $\alpha\pi(Y/F)^2$. When inflation rises, the marginal benefits of financial services increase. Consequently, the production of financial services and the demand for labor in the financial sector rise.

The wage in the manufacturing sector is equal to the workers marginal productivity less the marginal inflation tax and the financial costs of managing the increase in output. Since the size of the financial sector affects the financial costs it implies that the size of the financial sector affects the wage in the production sector. More formally, because profits are homogeneous of degree one in F and Y, profits of each firm must be zero in order to sustain finite positive equilibrium. To derive the wage in the production sector as a function of the costs of a financial unit and the inflation rate, we substitute the optimal share of the financial sector in the firm's profit function (7) which, after rearranging, gives the firm's profits as a function of the inflation rate, the price of a financial unit and the wage in the manufacturing sector:

$$\Psi = L_Y\left(1 - 2\cdot\sqrt{\frac{\alpha\pi}{\gamma}} - W_Y\right) \ . \tag{9}$$

The first order condition with respect to the input of labor in the manufacturing sector yields the equilibrium wage rate in the manufacturing sector (the zero profits conditions):

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[3]This result is due to the fact that the profit function is homogeneous of degree one in L_Y and F. This can be derived from equation (7).

$$W_Y = 1 - 2\cdot\sqrt{\frac{\alpha\pi}{\gamma}} \ . \qquad \textbf{(10)}$$

The intuition for equation (10) is as follows: in equilibrium, marginal revenue in the manufacturing sector (i.e., one unit of the consumption good) equals marginal costs, which, in turn, are the sum of wage costs in the production sector and the marginal costs of managing money (the financial costs plus the inflation tax). Hence, the wage in the production sector is given by one less the marginal costs associated with money management.

2.3 Government

We assume that government expenditure, G, is exogenous. The government has two sources of revenues, income tax and seigniorage. Income tax revenue is generated on the basis of a flat income tax rate τ. Since the model does not include growth in the steady state, seignoiorage here consists only of inflation tax. It is the product of money holdings given by equation (5) and the equilibruim inflation rate[4]. The government budget constraint is

$$G = \tau(L_Y W_Y + L_F W_F) + m\pi \ . \qquad \textbf{(11)}$$

The first term on the right hand side reflects income tax revenue and comprises wage taxes in both sectors of the economy.

2.4 Equilibrium

Equilibrium in this economy is determined by the wage in the production sector, the unit

[4]Since the focus of our analysis is the production structure of the economy, we neglect money holdings of private households and do not explicitely take into account money holdings of the financial sector. However, this simplification has no qualitative effect on our results.

costs of financial services and the inflation rate such that the labor markets and the goods market clear and the government budget constraint is satisfied.

Consider first the simple case in which inflation is zero. In this situation, the financial sector has no role in this economy.[5] Hence, labor demand in the financial sector is nil and all workers are employed in the manufacturing sector so that L_Y=L, W_Y=1, and β^n=1. As a consequence, output is equal to L and consumption is equal to L-G. The budget constraint shows that this situation is the equilibrium if the income tax rate, τ, is equal to G/L.

Now consider the situation in which inflation is greater than zero. This is the case if the income tax rate is less than G/L and, hence, income tax revenue is not sufficient to pay for government expenditure. As a result, the government has to rely on inflation tax. If inflation increases the demand for financial services rises and resources are shifted to the financial sector. This implies that total output of the manufacturing sector and, thus, consumption opportunities, decline. In other words, inflation causes an efficiency loss which is reflected in the number of workers who shift from the manufacturing sector to the financial sector. Hence, these real effects are the costs of inflation.

More formally, equilibrium in the labor market, expressed as a function of the inflation rate is determined by two conditions: First, the wage of the marginal worker in the financial sector (i.e., the worker with productivity β^n) has to be equal to her wage in the production sector:

$$W_Y = W_F^n \quad <=> \quad 1 - 2\cdot\sqrt{\frac{\alpha\pi}{\gamma}} = \frac{\beta^n}{\gamma} \; . \qquad \textbf{(12)}$$

Second, the demand for financial services (equation 8) has to be equal to the production of financial services (equation 6):

$$L_Y\sqrt{\alpha\pi\gamma} = F = L\int_{\beta^n}^{1}\beta \; d\beta \; . \qquad \textbf{(13)}$$

[5]Note that this would be different if the model took into account interest bearing assets, which would add foregone interest earnings as an additional cost element of money holdings.

Since $L_Y=\beta^n L$, which can be verified from Figure 1, we can eliminate L_Y in equation (13) and, thus, get

$$\beta^n L\sqrt{\alpha\pi\gamma} \;=\; L\int_{\beta^n}^{1}\beta\; d\beta \;. \qquad \textbf{(14)}$$

The right hand side of equation (14) can be expressed as a function of the critical value β^n. Since labor productivity in the financial sector is distributed uniformly between zero and one, total production of financial services is[6]:

$$L\int_{\beta=\beta^n}^{1}\beta\; d\beta \;=\; \frac{L}{2}(1-\beta^{n^2}) \;. \qquad \textbf{(15)}$$

Using equation (15) in (14) yields:

$$\frac{1-\beta^{n^2}}{\beta^n} \;=\; 2\cdot\sqrt{\alpha\pi\gamma} \;. \qquad \textbf{(16)}$$

Multiplying equations (12) by γ and using the left hand side of equation (16) in order to replace the square root gives

$$\gamma \;=\; \frac{1}{\beta^n} \;, \qquad \textbf{(17)}$$

which can be used in equation (16) to derive an expression for the size of the two sectors as a function of the inflation rate:

$$\frac{1-\beta^{n^2}}{\sqrt{\beta^n}} \;=\; 2\cdot\sqrt{\alpha\pi} \;. \qquad \textbf{(18)}$$

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[6]This can be seen in Figure 1 as the area ABL_YL.

Equation (18) states that the higher the inflation rate, the lower is the equilibrium productivity of the marginal worker (β^n), i.e., the larger is the financial sector. Equation (17) states that the larger the financial sector (lower β^n), the lower is the price of a financial unit. This result can be explained as follows. As inflation increases, the inflation tax causes the wage in the manufacturing sector to decline more than the productivity of the marginal worker in the financial sector. Thus, the wage of the marginal worker in the financial sector falls by more than the productivity of the marginal worker. This can also be seen by using equation (17) in equation (12) which yields

$$W_Y = W_F^n = \beta^{n^2} . \qquad \textbf{(19)}$$

Thus, the wage of the marginal worker in the financial sector, expressed in unit of the consumption good, changes by more than her productivity (β^2 versus β).

The equilibrium inflation rate and the size of the financial sector are determined by equations (17), (18), and the government budget constraint (11). We can derive the following expression which determines the resource allocations (β^n) and the inflation rate as a function of the income tax and the monetary technology, α :[7]

$$G = \beta^n L \left(\tau + (1-\tau)\cdot\sqrt{\alpha\pi\beta^n}\right) , \qquad \textbf{(20)}$$

where the relationship between β and π is given by equation (18). The equilibrium shows that inflation, which is caused by government expenditure in excess of the income tax, creates demand for financial services which, in turn, reduces consumption possibilities of the economy. The economy would be better off if all decided not to use any financial services. Inflation taxes would be higher but total output and consumption would also be higher as more resources can be used in the manufacturing sector.

We have shown that a rise in inflation causes a shift of resources from the manufacturing sector to the financial sector, but it also leads to a decline in the price for financial services. It can be shown

[7]We present an approximation of the solution in the appendix.

that, despite this price decline, a rise in inflation increases the value of output of the financial sector relative to manufacturing. Squaring equation (18) and solving for the inflation rate yields

$$\pi = \frac{(1-\beta^{n^2})^2}{4\alpha\beta^n} \quad . \tag{21}$$

Using equation (21) together with $\gamma=1/\beta^n$ in equation (8) gives the value of financial services (expressed in units of consumption goods) as a ratio of manufacturing output

$$\frac{F/\gamma}{Y} = \frac{1-\beta^{n^2}}{2} \quad . \tag{22}$$

This expression implies that a rise in inflation (i.e., a decline in β^n) increases the share of financial sector output in overall production. This is a testable hypothesis which we will examine in section 4.

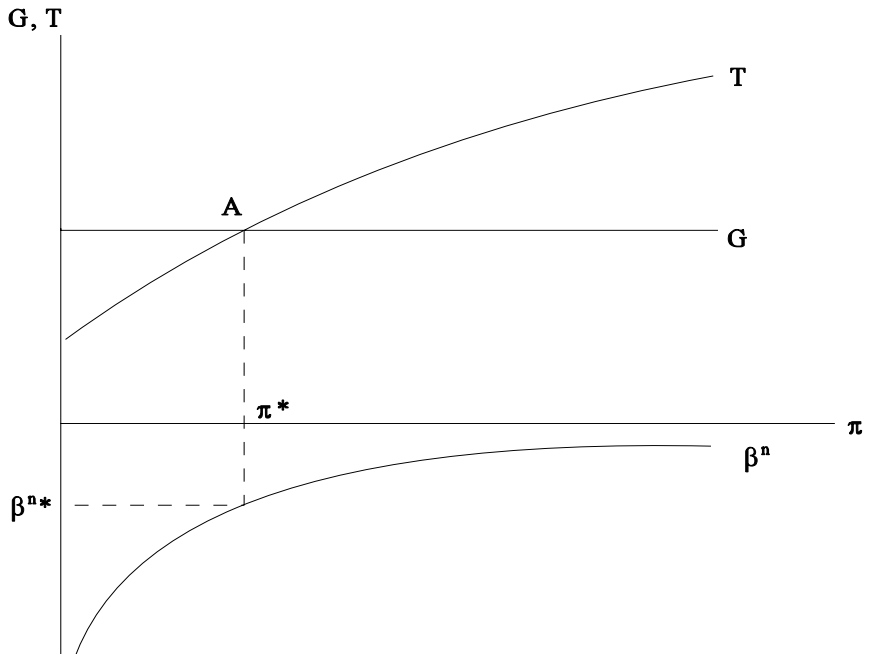
How does inflation affect the ratio of average wages paid in the two sectors, i.e., relative wages? Wages in the manufacturing sector (W_Y) are the same for each worker and are equal to $(\beta^n)^2$. To derive an expression for the average wage in the financial sector, we devide the total output of financial services by the number of workers employed in this sector. Multiplying equation (22) by Y (=βL) gives total output of the financial sector, expressed in units of consumption goods. The number of workers in the financial sector is $(1-\beta^n)$L. Therefore, the average wage paid in the financial sector ($\bar{w}_F$) relative to the wage in the manufacturing sector is:

$$\frac{\bar{w}_F}{W_Y} = \frac{1-\beta^2}{2(\beta-\beta^2)} \quad . \tag{23}$$

This expression implies that an increase in inflation (a decrease in β^n) leads to an increase in the relative wage rate of the financial sector. This testable hypothesis will be examined in section 4.

Figure 2 gives a graphical presentation of the model. Government expenditure is given by a horizontal line (G), because it is considered exogenous and, thus, does not depend on inflation.

Figure 2

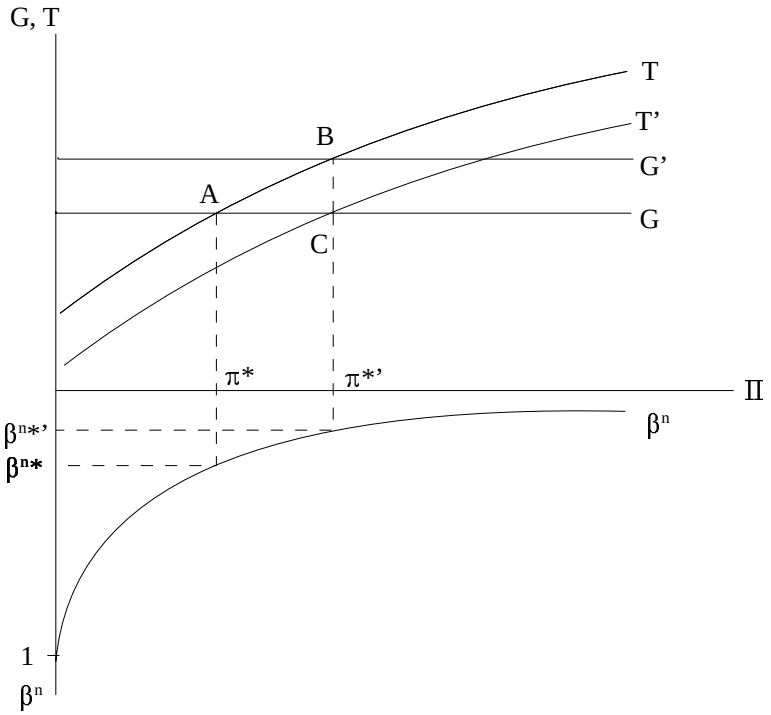


The government revenue curve (T) is upward sloping, since higher inflation generates more inflation tax which more than offsets the decline in income tax revenue caused by the drop in output (wage income). The budget constraint requires that government expenditure equals revenue which is given by the intersection of the G and the T curve. The lower diagram in Figure 2 shows the size of the financial sector, reflected by the productivity of the marginal worker (β^n), as a function of the inflation rate. This curve depicts equation (18). The higher the inflation rate, the lower is β^n, i.e., the larger is the financial sector and the smaller is the manufacturing sector. The equilibrium size of the financial sector and the equilibrium inflation are determined simultaneously by the two diagrams.

3. Comparative statics

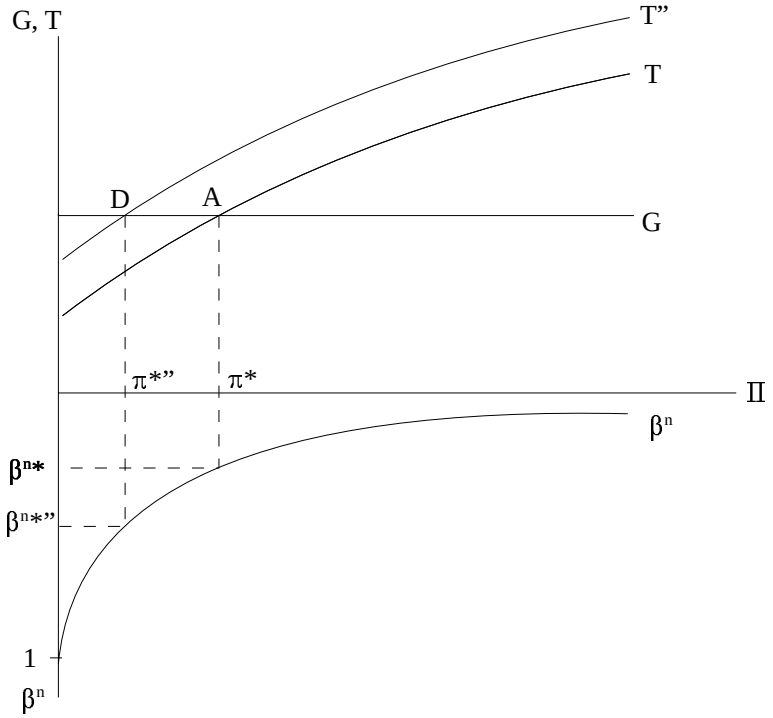
In order to demonstrate how changes in exogenous variables affect the equilibrium resource allocation, we examine in this section three shocks. Consider first an increase in government expenditure. In Figure 3, the initial equilibrium is given by point A. The increase in government expenditure shifts the G curve to G'. A higher expenditure level requires more revenue which, with a given income tax rate, can only be generated by higher inflation. The latter increases the incentives of firms to avoid the inflation tax by reducing their money holdings. This requires the purchase of financial services which increases the financial sector. The new equilibrium in B shows that the equilibrium inflation rate π^* increases to $\pi^{*\prime}$ and value for β^n declines from β^{n*} to $\beta^{n*\prime}$.

A similar effect is induced by a cut in the income tax rate. Starting from the same initial equilibrium as before, a cut in income taxes shifts the revenue curve from T downwards to T'.



Thus, at the initial equilibrium inflation rate, government expenditures are greater than its income inflation rises and hence the financial sector increases. The equilibrium shifts from A to C and the decline in β^n reflects again the expansion of the financial sector. Both an increase in government

Figure 4



expenditure and a cut in the income tax rate reduce the size of the manufacturing sector and, thereby, consumption opportunities. This reduction reflects the costs of inflation. Higher inflation simply requires the use of more financial resources for managing nominal assets. This use of resources, in turn, is at the origin of the inflation costs which could also be interpreted as an inefficiency of the system caused by inflation. A further implication is that the structure of the tax system affects the consumption possibilities of the private sector. In the case of a cut in the income tax rate, private consumption declines, although no budgetary expansion occurs.

Consider finally a rise in α, the monetary technology parameter. This has two effects on the government budget. First, at a given inflation rate and resource allocation, it reduces inflation tax revenue because of lower money holdings. Second, since inflation tax is lower, the incentives to purchase financial services decline too. This frees up resources, which can be used in manufacturing leading to higher manufacturing output and, thus, higher income tax and consumption possibilities. Equation (16) shows that an increase α leads to an increase in increase in β^n. Equation (20) shows that, when β^n and α increase government revenues rise. This shifts the

T curve in Figure 4 upwards to T" and the equilibrium from A to D. That is, the equilibrium inflation declines from π^* to $\pi^{*"}$ which is accompanied by a decline in the financial sector, the equilibrium value of β^n decreases from $\beta^{n}*$ to $\beta^{n"}$.

4. Empirical evidence

To investigate whether inflation affects the allocation of resources between the manufacturing sector and the financial sector we use employment and wage data from 17 individuals countries and additional pooled data from 11 transition economies. In order to examine the empirical evidence for the effects described in the previous sections, we focus on countries that have had a period of significant inflation since 1970. We first investigate whether the inflation rate affects the size of the financial sector measured by the number of employees or, where sectoral employment data are not available, by contribution to GDP. The model discussed in the previous sections implies that a rise in inflation increases the share of workers employed in the financial sector and also the share of production of this sector (equation (22)). Although the financial sector is defined differently in different countries, we believe it is a good proxy for financial activities in an economy.

We first categorize countries into two groups according to their inflation rate:

I. countries with a history of high inflation and
II. countries with a history of significant but modest inflation.

The first group of countries consists of eight countries examined individually and pooled data for eleven countries. The individually analyzed countries comprise six countries from Latin America (Argentina, Bolivia, Brazil, Mexico, Peru, and Venezuela) as well as Israel and Turkey. All of these countries experienced periods of annual inflation rate of close to or more than 100 percent for some time. The pool of countries which is also examined as part of the first group comprises a number of formerly centralized economies which have gone through dramatic political and economic changes and which have experienced relatively high rates of inflation. We pool the data for these countries because of the relatively short time series available for these countries. The

second group of countries comprises nine industrial countries that had inflation rates between 10 and 30 percent per year for several years during the 1970s and or thereafter. These countries comprise Australia, Greece, Iceland, Ireland, Italy, New Zealand, Portugal, Spain, and the United Kingdom.

We apply OLS estimates on annual data and regress the share of financial sector employment on the inflation rate. In cases, for which data on employment is not available we use the contribution of the financial sector to GDP. Since the period since the early 1970s is characterized in most countries by a rise in the importance of financial transaction and, thus, financial institutionas, we take into account time trend in the regressions. This leads to the estimated equation

$$RE_t = c + \alpha_1 \pi_t + \alpha_2 T_t + \varepsilon_t ,$$

where RE, π, T, and ε denote relative employment of the financial sector, inflation, a time trend, and the error term, respectively. For countries with high inflation we apply the above specification in log form to capture the nonlinearity in the effects of inflation on the size of the financial sector. Table 1 reports the results for the group of countries with periods of high inflation. In some cases, we include a dummy variable to capture a structural changes in the data or to correct for high serial correlation in the error terms[8]. We estimated the pooled data of the group of transition economies in two different ways. First we estimated, using an equal weights to each country. Second we estimated a generalized least square were the weighted were calculated from the error terms from a preliminary regressions with equal weights. For all countries examined individually and for the pool of transition economies, the results show a significant positive value for α_1. This means that an increase in inflation shifts employment or, more generally, economic activity to the financial sector which confirms the result of our theoretical analysis. With the exception of the case of Turkey all estimates of α_1 are significant at the 95 percent level. The estimated value of α_1, i.e., the effect of inflation on the financial sector employment, differs between countries

[8]This was the case for Bolivia, Australia and United Kingdom were including a dummy did not change the results but improve the Durbin Watson statistics

reflecting the diffrences in each country development and rates of inflation. The average value for the significant estimates amounting to around 0.03. If, for example, inflation stands at 20 percent and the financial sector share is 10 percent an increase in the inflation rate from 20 to 40 percent would increae the share of the financial sector to 13 percent. Assuming that this reflects the deadweight loss of inflation emphasized by our theoretical analysis, the order of magnitude of this type of inflation cost is not negligible.

Insert Table 1

We estimate the same equation as for the high inflation countries also to the second group of countries which includes countries with a significant but, by comparison, modest inflation history. For some countries we ran the regressions without logs. The results are shown in Table 2. Again, there is a significant positive trend in all countries reflecting the growing importance of the financial sector over the period studied here. In addition, we find a positive value for α_1 in all cases with the exception of the United Kingdom, New Zealand and Australia where α_1 is insignificant.

Insert Table 2

The statistical properties as captured by the Durbin Watson statistic reported in Table 2 are fairly poor for New Zealand and the United Kingdom. Given the indication of serial correlation we include an AR(1) process and the lagged inflation rate as an explanatory variable. As Table 3 shows this leads to acceptable results with respect to the Durbin Watson statistics and also considerably changes the significance level of the estimates for α_1. The results for the modest inflation countries can also be regarded as supporting the view that a rise in inflation shifts labor and economic activity from the nonfinancial to the financial sector.

Insert Table 3

In addition to the shift of factors of production from the nonfinancial to the financial sector of an economy, another important implications of the model is that inflation leads to a rise in the relative wage rate paid for worker in financial services (equation (23)). In examining the empirical evidence for this effect, a considerable problem is the fact that in a number of countries studied above sectoral wage data are not available. However, where data were available, we regressed relative wages on inflation and a trend variable and, thus, estimated the equation

$$RW_t = c + \alpha_3 \pi_t + \alpha_4 T_t + \varepsilon_t ,$$

where RW denotes wages paid in the financial sector relative to the average wage rate paid in the economy. Partly we took into account a dummy variable where this was warranted. Table 4 reports the results. They show a positive sign of the estimated coefficient α_3 which implies that an increase in inflation leads to an increase in relative wages of the financial sector which again is in line with our model. However, the significance level varies across countries and is below the 80 percent level in two out of eight cases. On average, the estimates imply that an increase in inflation from, say, 10 percent to 20 percent increases relative financial sector wages by 15 percent.

Insert Table 4

5. Conclusions

We developed a simple model in which inflation affects the structure of the economy. Specifically, a rise in inflation causes a shift of resources from the manufacturing sector to the financial sector. As a result, both output and private consumption decline. In addition, average wages of the financial sector relative to the manufacturing sector rise. The shift in resources causes costs of inflation because private consumption is forced to decline.

The examination of data for 17 countries and, in addition, for a pool of 11 countries, provides strong support for the model. On average, an increase in the annual inflation rate from

20 percent to 40 percent would decrease employment in the manufacturing sector by about 3 percent.

The model can be extended in several ways. Two should be briefly highlighted here. First, a growth component could be incorporated into the model in order to provide further insight into the effects of inflation on long-run growth and the dynamics of stabilization programs. Second, the model could take into account that the qualification of workers in the financial sector is not exogenous. Rather, it can be assumed that a rise in inflation and the induced increase in average wages paid in the financial sector creates incentives to acquire more qualifications for this sector.

Table 1: Estimated Inflation Effects on Relative Employment of the Financial Sector in Countries with High Inflation

Country	Period	Dependent variable *	Constant	Inflation	Trend	R^2	D.W.
Argentina	1982-1993	log RE	1.92 (52.03)	0.015 (2.92)	0.008 [1)] (3.31) 0.068 (8.45)	0.93	1.54
Bolivia	1973-1989	log RE	-1.84 (-13.55)	0.054 (2.17)	0.084 [2)] (8.35)	0.89	1.67
Brazil	1982-1996	log RE	1.58 (29.39)	0.016 (2.23)	0.009 [1)] (2.23) 0.022 (3.63)	0.59	1.60
Israel	1973-1989	log RE	1.59 (54.99)	0.038 (6.17)	0.033 (27.79)	0.98	1.82
Mexico	1980-1990	log RE	2.01 (40.26)	0.033 (3.32)	0.013 (6.21)	0.87	2.21
Peru	1973-1993	log RE	3.06 (138.02)	0.015 (2.37)	0.011 [3)] (7.96)	0.91	1.40
Turkey	1978-1993	log RE	-1.76 (-1.12)	0.473 (1.20)	0.158 [1)] (3.80) 0.421 (3.37)	0.64	1.19
Venezuela	1978-1992	log RE	1.32 (21.03)	0.053 (2.17)	0.021[1)4)] (5.02) 0.078 (4.27)	0.87	2.11
Pooled Data for Transition Economies [5)]	1989-1994	log RE log RE (cross section weights)	country specific country specific	0.017 (1.73) 0.013 (2.07)	0.053 (3.88) 0.051 (7.05)	0.99 0.99	1.65 1.75

t atatistics are in parentheses.

* RE denotes relative employment or, where data are not available, production of the financial sector.

[1)] Two trend variables were included. The first coefficient refers to a trend variable for the 1980s, the second to a trend variable for the 1990s. Due to a break in the data series, an additional dummy variable was included for 1990.

[2)] A dummy variable was included for 1981.

[3)] Due to a break in the data series, an additional dummy variable was included for 1990.

[4)] Due to a break in the data series, an additional dummy variable was included for 1989.

[5)] The pool comprizes Armenia, Azerbaijan, Belarus, Estonia, Georgia, Hungary, Kazakstan,Kyrgyzistan, Moldova, Ukraine, and Uzbekistan.

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.

Table 2: Estimated Inflation Effects on Relative Employment of the Financial Sector in Countries with Modest Inflation

Country	Period	Dependent variable *	Constant	Inflation	Trend	R^2	D.W.
Australia	1973-1993	RE	5.33 (8.86)	0.039 (1.32)	0.026 (10.32)	0.98	1.53
Greece	1972-1988	log RE	1.01 (16.79)	0.047 (2.20)	0.038 [1)] (11.67)	0.92	1.62
Iceland	1972-1991	log RE	1.37 (14.53)	0.071 (2.67)	0.051 [2)] (10.95) 0.410 (10.52)	0.92	2.05
Ireland	1972-1991	log RE	0.94 (12.62)	0.098 (4.53)	0.064 (24.04)	0.99	1.80
Italy	1975-1988	log RE	-0.23 (-1.49)	0.154 (4.83)	0.058 [3)] (6.52)	0.97	2.20
New Zealand	1973-1995	log RE	1.69 (20.59)	-0.002 (-0.10)	0.0269 (9.49)	0.91	1.05
Portugal	1974-1993	log RE	0.49 (1.93)	0.151 (1.92)	0.067 [2)4)] (8.36 0.366 (11.88)	0.96	1.43
Spain	1980-1993	RE	1.41 (13.16)	0.063 (6.62)	0.022 [5)] (2.17)	0.80	2.14
United Kingdom	1976-1986	RE	5.11 (5.35)	-0.041 (-1.19)	0.471 (8.75)	0.97	0.63

t atatistics are in parentheses.

* RE denotes relative employment or, where data are not available, production of the financial sector.

[1)] Trend starting after 1980.

[2)] Two trend variables were included. The first coefficient refers to a trend variable for the 1980s, the second to a trend variable for the 1990s.

[3)] Two trend variables were included. The first coefficient refers to a trend variable for the 1970s, the second to a trend variable for the 1980s.

[4)] Due to a break in the data series, an additional dummy variable was included for 1990.

[5)] Trend for the 1980s.

Data source: OECD, The International Sectoral Database 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.

Table 3: Alternative Estimates of the Inflation Effects on Relative Financial Sector Employment for New Zealand and the U.K.

Country	Period	Dependent variable	Constant	Inflation(-1)	Trend	AR(1)	R^2	D.W.
New Zealand	1973-1995	log RE	1.31 (8.12)	0.087 (3.24)	0.038 (5.75)	0.61 (3.51)	0.95	1.93
United Kingdom	1976-1986	RE	1.06 (0.56)	0.013 (1.34)	0.708 (6.72)	0.72 (6.42)	0.99	1.93
				0.012 (1.38)	0.764 (50.11)	0.78 (21.76)	0.99	1.94

t atatistics are in parentheses.

Table 4: Estimated Inflation Effects on Relative Wages Paid in the Financial Sector

Country	Period	Dependent variable *	Constant	Inflation	Trend	R^2	D.W.
Australia [1)]	1975-1989	RW	0.98 (29.68)	0.009 (2.74)		0.60	1.52
New Zealand	1986-1991	log RW	0.03 (1.16)	0.106 (0.79)	0.065 (1.38)	0.52	1.43
Italy	1970-1983	log RW	1.10 (13.81)	0.119 (2.99)	-0.046 (-9.33)	0.91	1.90
Portugal	1984-1991	RW	0.13 (0.66)	0.007 (2.20)	0.130 (15.10)	0.99	2.40
Spain	1980-1986	RW	0.31 (0.15)	0.072 (1.03)	0.224 (2.50)	0.93	1.85
United Kingdom [2)]	1975-1986	RW	1.01 (16.06)	0.003 (1.43)	0.019 (5.25)	0.93	2.29
Pooled Data for Transition Economies [3)]	1989-1994	log RW	country specific	0.023 (0.61)	0.146 (4.07)	0.73	2.91
		log RW (cross section weights)	country specific	0.019 (1.31)	0.113 (5.32)	0.85	2.75

t atatistics are in parentheses.

* RW denotes wages paid in the financial sector relative to the average wage in the economy.

[1)] Dummy variables were taken into account for the years 1982 and 1989.

[2)] A dummy variable was taken into account for 1978.

[3)] The pool comprizes Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakstan,Kyrgyzistan, Moldova, Ukraine, and Uzbekistan.

Data source: OECD, The International Sectoral Database, International Labor Office, Year book International Labour Statistics, and Economist Intelligence Unit, various issues of Country Profile and Country Reports.

Appendix

To approximate the resource allocation, β^n, as a function of the inflation rate we apply a linear approximation to (18) around $\beta^n=1$,

$$\frac{1-\beta^{n^2}}{\sqrt{\beta^n}} \approx 2(1-\beta^n) \qquad \textbf{(1)}$$

which implies that

$$\beta^n \approx 1-\sqrt{\alpha\pi} \ . \qquad \textbf{(2)}$$

That is, the larger the inflation rate the lower β^n, the size of the manufacturing sector.

The equilibrium resource allocation, β^n, and the equilibrium inflation rate can be approximated from (20) using a linear approximation around $\beta^n=1$:

$$\beta^n \approx \frac{\frac{G}{L}-(1-\tau)}{2-\tau} \ . \qquad \textbf{(3)}$$

That is, the larger the income taxes the higher β^n, the size of the manufacturing sector. For example when income taxes are equal to G/L then the inflation is zero and all workers are employed in the manufacturing sector. When taxes decrease below G/L then inflation increases and the manufacturing sector declines.

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