INFLATION, GROWTH, AND IMPORT BOTTLENECKS IN THE TURKISH MANUFACTURING SECTOR

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1. Introduction

During the last decade inflation has become a preoccupation for both economists and policy-makers in Turkey. In general, the diagnoses have followed the monetarist approach and identified monetary growth, fueled by excessive public sector deficits, as the source of the problem (Akyüz, 1973; Kızılyallı, 1978; Olgun, 1982; Ertuğrul, 1982). The monetarist model which underlies this explanation is characterized by a dichotomous structure whereby output and employment are determined on the supply side, and price level fluctuates to align aggregate demand with the available output. Output responses to changes in nominal demand are attributed to the unanticipated component of demand shocks and, therefore, judged to be temporary. Thus, the neutrality proposition of classical macroeconomics is essentially left intact. The aggregative nature of this approach has been criticized by the Keynesians and structuralists who draw attention to the sectoral differences in responses of output and price to supply and demand shocks. These alternative paradigms are based on dual economy models in which price and output behavior of the resource-constrained non-industrial sector is in line with the predictions of the monetarist model. In the industrial sector, however, the contribution of cost factors to inflation as well as the real effects of monetary expansion are emphasized. In stark contrast with the monetarist model, the simple mark-up model, a favorite of structuralists and some Keynesians, posits that prices are determined by cost factors and output levels are determined by demand factors in the modern industrial sectors.[1] There exists some econometric evidence in support of the validity of the mark-up model for industrializing countries (Corbo-Lioi, 1974; Ros, 1981; Ize and Salas, 1985). More pertinently, it is also suggested that, in Turkey, non-agricultural sector price level is less responsive to monetary growth than the agricultural sector price (Aksoy, 1982; Bilginsoy, 1990). These findings indicate serious oversights on part of single sector analyses of Turkish inflation in terms of inflationary dynamics and the distribution of the burden of monetary stabilization policies across the sectors.

Our objective here is to provide an analysis of one aspect of this debate by evaluating the relative impact of cost and demand factors on output growth and inflation in the Turkish manufacturing sector. In contrast to the dichotomous structures of the monetarist and the simple mark-up models, we adopt an eclectic approach to pull together wage, inter-

[1] See Sylos-Labini (1984) and Taylor (1983), respectively, for the relevance of such models to the industrialized countries and the Third World countries.

mediate import cost, monetary expansion, and inflationary expectations to explain price and output behavior by appealing to profit maximization in an imperfectly competitive environment. In the last decade, such models based on micro foundations of imperfect competition have become very popular among the 'new-Keynesian' macroeconomists in explaining non-neutrality of money, nominal rigidities and their implications for business cycles.[2] For our purposes such an approach is attractive because it emphasizes the interdependence of the firm's profit maximizing price and output decisions and their joint determination by the cost and demand factors. Since imperfect competition characterizes the industrial sectors of the LDCs, the model can be fruitfully applied to explain the experience of these countries.

An original feature of our approach lies in its recognition of the macroeconomic implications of the recurrent phenomenon of foreign exchange crises. Given the dependence of domestic industry on imported raw materials, intermediate inputs and capital goods, the shortages created by foreign exchange bottlenecks impose serious limitations on capacity utilization and economic growth. On the price side, import price inflation is likely to put upward pressure on the unit cost of production and raise the domestic inflation rate. In the empirical literature, the significance of the supply-side effect of import availability on domestic production and the price level is often evaluated by using import price as an indicator of the degree of import shortage.[3] A probable flaw of this method is that it ignores the quantitative restrictions on trade which often accompany the foreign exchange crises. In many less-developed countries (LDCs), overvalued domestic currency and the consequent foreign exchange shortages frequently lead to the rationing of imports by the government.[4] In this paper, we show that elasticities of output and price with respect to cost and demand factors change when imports/import licenses are allocated by non-market

[2] See Blanchard and Fischer (1989) chapters 8 and 9 for an overview. The model developed in this paper follows Bruno (1979a).

[3] Applications of the monetarist model, for instance, test the relevance of imported input costs (alongside other supply variables such as the wage rate) to the determination of the price level by appending these to the regression equation as explanatory variables and checking statistical significance of their coefficients (see Harberger, 1963; Diaz-Alejandro, 1965; Diz, 1970; Vogel, 1975; Nugent and Glezakos, 1979; Bhalla, 1981). Given the theoretical basis of the monetarist model, however, such eclectic reduced-form equations suffer from lack of theoretical justification, unless one is willing to argue that money demand is a function of input costs. An exception to this approach *ad hoc*kery is Hanson (1985) who incorporates import price into the monetarist inflation equation via the implicit cost function.

[4] On the significance of foreign exchange bottlenecks and quantitative restrictions in LDCs see Bhagwati (1978), and, in the case of Turkey, Krueger (1972), Baysan and Blitzer (1988).

means, and we provide some evidence to this hypothesis on the basis of data from Turkey.

The paper is organized as follows. The theoretical model is laid out in section 2. In sections 3 and 4, a set of hypotheses regarding impact of cost and demand factors on output and price movements under alternative assumptions of imported input market adjustment are derived. In section 5, we carry out an econometric study of the short-run output and price determination in the Turkish manufacturing sector for the 1952-1980 period, and conclude that the monetarist results of aggregate empirical studies of Turkish inflation are not validated at the sectoral level. Instead, the data lend qualified support to the structuralist/Keynesian predictions.

2. The Model

2.A. The Supply Side

The analysis is rooted in profit maximizing behavior of firms operating within a monopolistically competitive environment. We assume that firm j makes use of three inputs in the production process: labor (L_j), imported inputs (R_j) and capital (K_j). Capital stock is assumed to remain fixed in the short-run, and firms can vary their production only by changing labor and imported inputs. With respect to imported materials, we assume that each firm faces an upper bound ($\bar{R}_j$), which is determined by the aggregate import constraint and the import rationing scheme. The firm is assumed to be a price taker in the input markets. The output and pricing decisions are made at the beginning of the production period. We assume that input costs are determined by previous contracts and therefore known by the firm with certainty. Let us suppose the firm's planned level of output is given by x_j^*. The short-run problem of the firm is then to minimize variable cost subject to the production function and the import constraint:

$$\begin{aligned} min_{L_j,R_j} \quad & C_j = WL_j + P_R R_j \\ s.t. \quad & x^* = f(L_j, R_j, \bar{K}_j), \\ & R_j \leq \bar{R}_j \end{aligned}$$

where W is the nominal wage rate and P_R is the price of the imported input in domestic currency. It is assumed that the production function is well-behaved with positive first-order and negative second-order partial derivatives. Derivation of the firm's input demand functions is straightforward. The Lagrangean of this minimization problem is:

$$\mathbf{L} = WL_j + P_R R_j + \lambda(x_j^* - f(L_j, R_j, \bar{K}_j)) + \delta(\bar{R}_j - R_j),$$

from which the first-order conditions are derived as:

$$\begin{aligned}
\frac{\partial \mathbf{L}}{\partial L} &= W - \lambda f_L = 0 \\
\frac{\partial \mathbf{L}}{\partial R} &= P_R - \lambda f_R - \delta \geq 0 \\
R\frac{\partial \mathbf{L}}{\partial R} &= R_j(P_R - \lambda f_R - \delta) = 0 \\
\frac{\partial \mathbf{L}}{\partial \lambda} &= x_j^* - f(L_j, R_j, \bar{K}_j) = 0 \\
\frac{\partial \mathbf{L}}{\partial \delta} &= \bar{R}_j - R_j \leq 0 \\
\delta\frac{\partial \mathbf{L}}{\partial \delta} &= \delta(\bar{R}_j - R_j) = 0 \\
&L_j, R_j, \lambda, \delta \geq 0.
\end{aligned}$$

The first-order conditions imply that marginal rate of technical substitution among the variable inputs is equal to the input price ratios except when the import constraint holds as an equality. In the latter case:

$$\frac{W}{P_R} = \frac{f_L}{f_R + \delta/\lambda} < \frac{f_L}{f_R}$$

where f_L and f_R stand for marginal productivities of labor and imported input. When the imported input becomes a constraining factor, given P_R, δ is greater than zero and consequently the marginal rate of technical substitution between labor and the imported input is smaller than it would otherwise be.

The role played by the import rationing mechanism in determination of the short-run price and output decisions can be seen by deriving the short-run cost function under alternative assumptions. We consider below three possible scenarios. First, suppose that there is no foreign exchange bottleneck, and that import demands are satisfied at the prevailing market price. In this case, the solution of the minimization problem yields the cost function:

$$C_j = C(x_j^*, W, P_R, \bar{K}_j). \tag{1}$$

where P_R is the customs clearance price determined by the world price of the imported commodity, the official exchange rate, and the customs duty.

In the second and the third cases we consider the situation of officially-determined and overvalued exchange rate. Suppose that the government responds to the excess demand for foreign exchange by rationing imports/import licenses. We identify two polar rationing schemes and, adopting the terminology of Derviş *et al.* (1982, pp. 292–295), call them *premium* and *fix-price* rationing. In premium rationing import licenses are rationed by the market. Possible mechanisms are auctioning of the licenses or trading of licenses/imported goods in secondary markets. The import constraint becomes "ineffective" by definition, because, similar to the previous case, price adjustment clears the market. The cost function is again given by (1) but with one critical difference. P_R is higher than the customs clearance price by the amount of the premium that imports/import licenses command in the market.[5] Yet, this distinction is hardly ever drawn in econometric studies and import premia are ignored in calculating import prices. This practice is attributable, most probably, to the lack of reliable time series data.

The third scenario we consider is the case of fix-price rationing whereby imports or import licenses are allocated to the firms by the government and their trading is prohibited. Assume that each firm is issued a non-transferable import license of the amount $\bar{R}_j$. Firms will now be off their import demand curves and the cost of production becomes a function of the supply-constrained quantity of imported inputs. The cost function has the following form:

$$C_j' = C'(x_j^*, W, \bar{R}_j, \bar{K}_j). \tag{2}$$

Cost of production is a function of the import bottleneck instead of the import price because the import price no longer adjusts to eliminate excess demand.

2.B. The Demand Side

On the demand side, we assume that the representative firm is located in a monopolistically competitive market and that its product is sold domestically and exported.[6] Each

[5] The unit price of imported input in domestic currency is now given by:

$$P_R = (1 + \tau + \rho)eP_R^*$$

where e is the exchange rate, P_R^* is the price of imports in foreign currency, τ is the import duty and ρ is the premium on imports/import licenses. In the absence of bottlenecks (the first scenario) ρ is zero.

[6] In line with the experience of many countries that have adopted import substitution strategy, we assume that the domestic industry is protected from international competition to some degree. Given the restrictions on international trade, it is unlikely that the domestic price is dictated exclusively by the world

firm's perceived demand is a decreasing function of its own price relative to the expected price level in this period (i.e., the expected weighted average of the prices of its domestic competitors) and the expected real exchange rate, and an increasing function of the level of aggregate demand.

We will express the demand function faced by firm j as:

$$x_j^d = x_j^d\left(\frac{p_j}{P^e}, \frac{p_j}{P_W}, \frac{M_j^e}{P^e}\right), \tag{3}$$

where p_j is the price of firm j's product, P^e is the expected sector-wide price level, P_W is world price of the product in domestic currency, and M^e is the expected nominal money stock. This demand function states that the firm cannot raise its own price without losing its market share unless the average price level (domestic or international) is expected to rise proportionately. Aggregate demand fluctuations are represented here with fluctuations in the money stock. For the purposes of this paper we chose this simplification because it permits a direct comparison with monetarist studies of inflation regarding the empirical significance of monetary expansion for inflation. Otherwise, the model can easily be expanded to incorporate other sources of sectoral and economy-wide demand shocks.[7] Finally, we note that money stock enters the demand function as its expectation because according to our model the firm makes its production and price decisions at the beginning of the production period, when the actual value of the money stock is not likely to be known with certainty.

The difference between the perfectly competitive and monopolistically competitive solutions is standard and most easily observed in the case of long-run equilibrium, where the expected price level is equal to the actual and relative price is equal to one. Given nominal money stock and input prices, the perfectly competitive firm produces a larger quantity at a lower price.

3. *The Solution of the Model*

Since the firm faces a downward sloping demand schedule, profit maximization requires

price.

[7] It may be desirable to include the budget deficit as a source of demand shock. In the case of Turkey, this figure should include the deficits of the central government as well as those of the State Economic Enterprises. Due to the lack of reliable time series data on these, we decided not to use budget deficit as an explanatory variable in the econometric section of this paper. Furthermore, to the extent that the deficit is monetized, money stock variable can also be interpreted as an proxy for fiscal policy.

adjustment of the levels of both price and output. In order to analyze these adjustment processes we proceed to derive the marginal revenue and cost functions.

Marginal revenue is derived directly from equation (3) as:

$$MR = (P^e)^{\frac{\eta}{\eta+\gamma}} P_W^{\frac{\gamma}{\eta+\gamma}} p\left(x_j, \frac{M_j^e}{P^e}\right)(1+(\eta+\gamma)^{-1}), \qquad \eta,\gamma \ < \ 0 \tag{4}$$

where $p(x_j, \frac{M_j^e}{P^e})$ is the inverse demand function, and η and γ are the elasticities of demand with respect to the domestic relative price and the real exchange rate, respectively. We assume that these are constants and that their sum is greater than unity (in absolute value).

Following the discussion of the last section, the shape of the marginal cost function and, therefore, profit maximizing price and output levels depend on the import rationing scheme. The model is solved for the cases of premium and fix-price rationing as follows:

Case 1–Premium Rationing: If import licenses are auctioned or imported goods are freely traded in the domestic market, then the relevant cost function is given by equation (1). Marginal cost can be expressed as the product of average cost and the elasticity of cost with respect to output.

$$MC = \frac{C_j}{x_j}\frac{1}{l+r},$$

where l and r are the output elasticities of labor and imported inputs, respectively, and $1/(l+r) \equiv \phi$ is the elasticity of variable costs with respect to output. Let k be the output elasticity of capital and $\psi(>0)$ be the elasticity of demand with respect to real balances. Firm's profit maximizing output and price are then obtained by equating marginal revenue and marginal cost, which yields (in rate of growth form):

$$\hat{x}_j = \frac{\phi}{\Delta}\left(-l(\hat{W}-\hat{P}^e) - r(\hat{P}_R - \hat{P}^e) + k\hat{\bar{K}}_j - \frac{\psi}{\phi(\eta+\gamma)}(\hat{M}_j^e - \hat{P}^e) + \frac{\gamma}{\phi(\eta+\gamma)}(\hat{P}_W - \hat{P}^e)\right), \tag{5}$$

$$\hat{p}_j = -\frac{1}{\Delta(\eta+\gamma)}\left(\phi(l\hat{W} + r\hat{P}_R - k\hat{\bar{K}}_j) + (\phi-1)\psi\hat{M}_j^e - (\phi-1)(\eta+\psi)\hat{P}^e - (\phi-1)\gamma\hat{P}_W\right), \tag{6}$$

where $\Delta \equiv (\phi-1) - (\eta+\gamma)^{-1}(>0)$ and the circumflex denotes percentage rate of change.[8]

[8] For the derivation of equations (5) and (6) see the appendix.

Note that $\phi - 1 (\equiv d\ln MC/d\ln x)$ is the output elasticity of the marginal cost curve. If $\phi > 1$, then the output elasticity of the marginal cost curve would be positive.

Case 2–Fix-price Rationing: Now suppose that import licenses are allocated to each firm, perhaps *pro rata* to their capacity or previous levels of production, and that they are not permitted to trade these in secondary markets. The relevant cost function of the representative firm is then given by equation (2) and marginal cost is:

$$MC' = \frac{C_j'}{x_j l}.$$

Let $\phi' \equiv 1/l$. Since $\phi' > \phi$, marginal cost under this rationing scheme is steeper. This, in turn, affects the impact of changes in input prices and demand conditions on price and output. Price and output adjustment equations are as follows:

$$\hat{x}_j' = \frac{\phi'}{\Delta'}\left(-l(\hat{W} - \hat{P}^e) + r\hat{\bar{R}}_j + k\hat{\bar{K}}_j - \frac{\psi}{\phi'(\eta+\gamma)}(\hat{M}_j^e - \hat{P}^e) + \frac{\gamma}{\phi'(\eta+\gamma)}(\hat{P}_W - \hat{P}^e)\right), \tag{7}$$

$$\hat{p}_j' = -\frac{1}{\Delta'(\eta+\gamma)}\left(\phi'(l\hat{W} - r\hat{\bar{R}}_j - k\hat{\bar{K}}_j) + (\phi'-1)\psi\hat{M}_j - (\phi'-1)(\eta+\psi)\hat{P}^e - (\phi'-1)\gamma\hat{P}_W\right), \tag{8}$$

where $\Delta' \equiv (\phi' - 1) - (\eta + \gamma)^{-1}$.

The pairs of adjustment equations (5)-(6) and (7)-(8) state that output and price growth are functions of both the cost and demand factors. On the cost side, the expected rates of growth of real input prices affect output growth adversely. Increases in monetary growth in excess of the expected rate of inflation, on the other hand, cause output growth to rise. Due to the assumed homogeneity of the demand function, the output equation is homogenous of degree zero in $\hat{M}_j$, $\hat{W}$, $\hat{P}^e$, $\hat{P}_W$ and, under premium rationing, $\hat{P}_R$. Thus, output growth remains unchanged when there is a proportional increase in nominal variables. Note that in the steady state, where the expected rate of inflation is equal to the actual and where all nominal variables grow at the same rate, money is neutral. Put differently, in this case the demand function reduces to the quantity equation. Starting from such a long-run equilibrium point, only *un*anticipated changes in the rate of monetary expansion can influence output. Similarly, ignoring productivity changes, input price inflation affects output growth only to the extent that it deviates from the expected rate of inflation in the output market. Thus, in the stedy state the predictions of the model are not different from those of the standard new-classical market-clearing macro model.[9]

The rate of inflation is affected directly by the rates of growth of wage, import price, money stock, and the world price of exportables. The coefficient of the expected rate of inflation has an ambiguous sign. An increase in $\hat{P}^e$ has a direct effect of raising demand and the rate of inflation; in addition, however, this also reduces the perceived real money stock and, therefore, depresses demand. The net effect would be positive provided that the price elasticity of demand is large enough, or specifically $\eta + \psi < 0$. We also observe that the inflation rate is linearly homogenous in nominal variables. As expected, increases in capital stock and loosening of the import bottleneck put downward pressure on the rate of inflation.

The shape of the marginal cost curve is critical in determining the relative impact of demand and cost factors on output growth and inflation. The relevant information is embodied in the parameter ϕ (or ϕ'). Recall that $\phi - 1$ measures the elasticity of marginal cost. It is positive provided that there are diminishing returns to variable inputs. The larger is the value of ϕ, the larger is the effect of the demand variables on the inflation rate. Conversely, if $\phi = 1$, the elasticity of marginal cost would be zero and a horizontal supply curve implies that demand factors play no role in price determination *a la* the fixed mark-up model: nominal money stock growth, the expected rate of inflation and world price of exports drop out of the price equation and we are left with the condition that the rate of price growth is equal to the sum of the input price growth rates weighted by their output elasticities. In response to a demand shock the producer keeps the relative price constant and varies the output level. The impact of demand factors on output growth varies inversely with the value of ϕ. Output response to a demand change grows weaker for higher values of elasticity of marginal cost. The parameter ϕ thus demonstrates a theoretical basis for the behavior of the mark-up in the price equation: the higher the elasticity of the marginal cost curve the more the increase in prices in response to increases in demand.

The second parameter determining the relative impact of cost and demand factors on

[9] We should also mention that we are not exploiting fully the implications of the assumption of imperfect competition. If there are menu costs of price adjustment, for instance, money becomes non-neutral even when real costs remain constant and the expected rate of inflation is equal to the actual. For a survey of such sources of non-neutrality, see Rotemberg (1987). Due to such considerations, in the empirical section of this paper tested the homogeneity conditions instead of imposing them on the regression equations.

price and output is the price elasticity of the demand curve, η. As η approaches (negative) infinity, approximating perfect competition, $\hat{M}_j - \hat{P}^e$ and $\hat{P}_W - \hat{P}^e$ drop out of the output equation and output growth is determined by real costs and capital stock growth. Under these conditions, price changes proportionately with the expected price level. The firm becomes a price-taker in the output market. Conversely, the smaller is the value of η, the greater are the price and output responsiveness to cost and demand changes.

The two versions of output and price responses summarized by equations (5)-(6) and (7)-(8) differ in two respects. First, under fix-price rationing, $\bar{R}$ replaces P_R. If the import price is not allowed to adjust in response to excess demand, it is no longer relevant to decision making. Instead, the rate of change of the import constraint determines output and price behavior. Secondly, the responsiveness of output growth and inflation to the explanatory variables are altered under fix-price rationing because the latter affect the cost function directly. Since the elasticity of marginal cost is relatively larger in under fix-price rationing ($\phi < \phi'$), a change in demand has a smaller effect on output and a larger effect on prices under such conditions.[10] By the same token, input price elasticities of output and price are smaller (in absolute terms) under fix-price rationing.

In order to apply the analysis of the previous sections empirically we write the aggregate versions of the output and price equations. Assuming all firms face the same input prices, aggregate price ($\hat{P}$) and output ($\hat{X}$) adjustment are obtained by summing up price and output responses of individual firms.[11] We also assume that the capital stock is given by $K = K_0 e^{\kappa t}$ where K_0 is the initial stock of capital, κ is a positive constant measuring the trend growth rate of capital stock, and t is the time index. Under these asumptions, the intercept terms of the aggregative equations measure the impact of trend growth on output and price growth.[12]

If there are no foreign exchange bottlenecks or if import licenses/imports are freely traded, then the aggregate adjustment equations, after imposition of the homogeneity properties, are derived from equations (5) and (6) as:

[10] This prediction is in conformity with the positive correlation between the mark-ups and import limitations observed in Turkish manufacturing sector. (Aksoy, 1982, p. 91).

[11] For the analysis of aggregation of individual price and output responses, see Bruno (1979a).

[12] It is likely that the trend growth itself is influenced by the foreign exchange bottlenecks. We consider this possibility explicitly in empirical application.

$$\hat{X} = a_0 - a_1(\hat{W} - \hat{P}^e) - a_2(\hat{P}_R - \hat{P}^e) + a_4(\hat{M}^e - \hat{P}^e) + a_5(\hat{P}_W - \hat{P}^e) \tag{9}$$

$$\hat{P} = b_0 + b_1\hat{W} + b_2\hat{P}_R + b_4\hat{M}^e + b_5\hat{P}_W + (1 - b_1 - b_2 - b_4 - b_5)\hat{P}^e. \tag{10}$$

where $\hat{X}$ and $\hat{P}$ are weighted averages of the rates of change of individual firm output and prices, respectively, and $\hat{M}$ is the nominal money growth. The a and b coefficients measure aggregate elasticities and are the weighted averages of firm coefficients expressed in equations (5) and (6).

If import bottlenecks are effective and imports/import licenses are non-tradable domestically, equations (7) and (8) yield the following:

$$\hat{X} = a'_0 - a'_1(\hat{W} - \hat{P}^e) + a'_3\hat{\bar{R}} + a'_4(\hat{M} - \hat{P}^e) + a'_5(\hat{P}_W - \hat{P}^e) \tag{11}$$

$$\hat{P} = b'_0 + b'_1\hat{W} + b'_3\hat{\bar{R}} + b'_4\hat{M}^e + b'_5\hat{P}_W + (1 - b'_1 - b'_4 - b'_5)\hat{P}^e. \tag{12}$$

where $\hat{\bar{R}}$ measures the aggregate import constraint, and a' and b' coefficients are weighted averages of firms coefficients from (7) and (8).

Given that $\phi < \phi'$ and $\Delta < \Delta'$, the real cost variables are expected to have a smaller negative impact on output growth and the demand-shift factors are expected to have a smaller positive impact on output growth under import restriction *cum* non-tradable imports/import licenses: $a_1 > a'_1$, $a_4 > a'_4$, $a_5 > a'_5$. On the price side, elasticities with respect to input costs decline and elasticities with respect to demand factors rise under import bottlenecks: $b_1 > b'_1$, $b_4 < b'_4$, $b_5 < b'_5$.

5. *Price and Output Responses in Turkish Manufacturing Sector*

In this section, we test the hypotheses developed in the foregoing analysis econometrically by using annual data from the Turkish manufacturing sector over the 1952-1980 period. Our objectives are to assess the relative effects of wage, intermediate input cost, real exchange rate and monetary growth on price and output adjustment, and to investigate whether these effects vary with the state of import limitations. Although it is more appropriate to use quarterly data to analyze short-term price and output movements, data at this frequency are not available for many of the variables. As usual, the availability and quality of data present serious obstacles to empirical analysis, necessitating a number of approximations and compromises.

The first difficulty we face in application of the model is the high collinearity between price of imported inputs and the world price of manufactured goods. Therefore, we are forced to drop one of these variables, P_W, from the price and output equations. It will be noted that since P_R now serves as a proxy for the world price of manufactured product in addition to measuring intermediate import cost, identification of the supply and demand-side effects of international prices on the domestic output and price are precluded. To clarify this point consider the impact of domestic currency devaluation: on the supply side, import prices will increase, raising inflation and lowering output growth; on the demand side, both domestic inflation and output growth rise as domestic commodities become more competitive in the international markets. The supply and demand-side effects are reinforcing in price determination and offsetting in output determination. In other words, the anticipated sign of P_R is positive in the price equation, but ambiguous in the output equation. Henceforth, we will refer to P_R, in brevity, as the world price. Changes in this variable may come from devaluation of domestic currency or changes in world price level measured in foreign currency.[13]

Secondly, as we have emphasized in sections 2 and 3, output and price determination vary with import constraints and the prevalent regime of import rationing. In testing the hypotheses, we follow Krueger (1974) and Aksoy (1982) and classify 1954-1958, 1964-1970, and 1977-1979 as periods of foreign exchange crisis, and the remaining periods as years of relative foreign exchange ease.[14] We also assume that the firms were not allowed to

[13] The figures for unit import price are adapted from Aksoy (1982) and World Bank *World Tables*. Some data for reconstruction of improved import price series exist but they are incomplete. Krueger (1974) calculates nominal effective exchange rates (adjusted for tariffs and taxes) for capital, intermediate and consumer good imports and import substitutes for the 1954-1969 period (1974, pp. 172, 278ff.) Baysan and Blitzer calculate the effective exchange rates for total and manufactured imports for the 1969-1973 period (forthcoming, Chapter 3). Similarly, import price index series calculated by Yağcı cover only the 1962-1980 period.

[14] Such a binary distinction between the periods of foreign exchange shortage and ease overlooks the degree of crisis and, therefore, presents a simplistic description of the reality. Given the lack of indices measuring import availability and import requirements, however, we chose to make such a delineation and treat it as a first approximation. We do have some idea about the severity of these crises, however. On the basis of her interviews with Turkish officials and civil servants, Krueger reports that import premia ranged from 600 to 900 percent of the c.i.f. cost of imports between 1955 and 1958, and from 40 to 100 percent between 1964 and 1968 (Krueger, 1974, p. 174). The black-market premium on the US dollar averaged 42 percent in 1969 and 53 percent in the first two quarters of 1970. Annual average black-market premia were 17 percent in 1977, 20 percent in 1978 and 57 percent in 1979 (cited in Celasun and Rodrik, 1990, p. 790).

trade their imports/import licenses. Actual import allocation practices in Turkey varied over time between the two extreme regimes of tradable and non-tradable licenses. Krueger (1974, pp. 36–7, 158, 168) reports variations in the restrictiveness of import licensing in Turkey over the 1950-1968 period, which were closely correlated with declines in the foreign exchange inflow. Nevertheless, there is agreement among the students of the Turkish economy that Turkish experience is better approximated by the fix-price rationing regime (Derviş, *et al.*, 1984, Ch. 10).

Thirdly, we do not have direct observations of expected inflation rate and money stock growth. By appealing to the rational expectations hypothesis, we express the expectations terms as:

$$\hat{P}^e = \hat{P} + \nu_P, \qquad \hat{M}^e = \hat{M} + \nu_M,$$

where ν_P and ν_M are white noise error terms. We can then use the actual values of P and M as right-hand side variables with the proviso that this procedure requires implementation of instrumental variables in estimation due to the correlation of these explanatory variables with the error term in the price and output equations.

The estimated regression equation is:

$$\hat{X} = \alpha_0 + \alpha_{01} D_F + \alpha_1 \hat{W} + \alpha_{11} D_F \hat{W} + \alpha_2 \hat{P}_R + \alpha_{21} D_F \hat{P}_R + \alpha_3 \hat{M} + \alpha_{31} D_F \hat{M} + \alpha_4 \hat{P} + \alpha_{41} D_F \hat{P} + \xi_X \quad (13)$$

$$\hat{P} = \beta_0 + \beta_{01} D_F + \beta_1 \hat{W} + \beta_{11} D_F \hat{W} + \beta_2 \hat{P}_R + \beta_{21} D_F \hat{P}_R + \beta_3 \hat{M} + \beta_{31} D_F \hat{M} + \xi_P, \quad (14)$$

(14)

where D_F is a dummy variable taking the value 1 during periods of foreign exchange crisis and 0 otherwise, and ξ_X and ξ_P are error terms. We anticipate output growth to change inversely with the rate of growth of real wage and directly with the rate of growth of real money stock. During periods of foreign exchange crisis, output responsiveness to either one of these is expected to become weaker. The anticipated sign of world inflation is ambiguous for the reasons discussed above. If the supply-side effect dominates the demand-side effect, the sign is expected to be negative. Whichever effect dominates, however, its magnitude is expected to be lower under foreign exchange bottlenecks. On the price side, inflation rate is positively related to wage inflation, world inflation and monetary expansion. During bottlenecks, the impact of wage inflation declines and the impact of monetary expansion rises. Again, we cannot ascertain how the elasticity of price with respect to world inflation is going to be affected by bottlenecks because we cannot identify between the supply and demand-side effects. The intercept terms are interpreted to measure the impact of trend capital growth, and therefore, they are expected to be positive in the output and negative in the price equation. Since a significant proportion of the imports of LDCs are capital goods, foreign exchange bottlenecks may be expected to lower the trend growth and an import crisis may lead to a decline in the rate of capital accumulation. However, it may also be argued that such periods lead to rising import substitution and higher levels of investment, which cause trend growth to rise.[15] Thus, the signs of the intercept dummies depends on which effect prevails. To summarize, the expected signs of the regression coefficients are:

$$\alpha_0,\ \alpha_{11},\ \alpha_3,\ \beta_1,\ \beta_2,\ \beta_3,\ \beta_{31},\ >\ 0,$$

$$\alpha_1,\ \alpha_{31},\ \beta_0,\ \beta_{11},\ <\ 0,$$

$$\alpha_{01},\ \alpha_2,\ \alpha_{21},\ \beta_{01},\ \beta_{21} \gtrless 0.$$

If output equation is homogenous of degree zero, then $\alpha_1 + \alpha_2 + \alpha_3 = -\alpha_4$ and $\alpha_1 + \alpha_{11} + \alpha_2 + \alpha_{21} + \alpha_3 + \alpha_{31} = -(\alpha_4 + \alpha_{41})$. Similarly, first degree homogeneity of price equation implies that $\beta_1 + \beta_2 + \beta_3 = 1$ and $\beta_1 + \beta_{11} + \beta_2 + \beta_{21} + \beta_3 + \beta_{31} = 1$.

Regression Results:

In estimating equations (13) and (14) we initially ignored the effects of import limitations and restricted the coefficients of all slope dummies to zero. Although it may lead to biased estimates due to misspecification, we adopt this procedure because it serves as a reference point for the subsequent estimations. Since we assume that the expectations are formed rationally, monetary growth and inflation rate, in the output equation, and monetary growth, in the price equation are not orthogonal to the corresponding error terms.

[15] For a Keynesian model along these lines see Ocampo (1987).

Therefore, it is appropriate to use instrumental variables (IV) technique. For purposes of comparison, however, we also provide the ordinary least squares (OLS) estimates.

Columns 1 and 2 of Table 2 summarize the OLS and IV estimations of the output equation.[16] These estimations are hardly satisfactory. The adjusted coefficient of determination indicates that less than 30 percent of the variation of output growth is explained in IV estimation. The positive sign of α_2 indicates that the demand-side effect of in world inflation dominates than the supply-side effect and expands output, albeit by a very small magnitude: the estimated elasticity is 0.10. Money stock growth seemingly has a much stronger impact on output growth but it also turns out to be only marginally significant in the case of IV estimation.

Price equation estimates fare much better. OLS and IV estimates of equation (14) are reported in the first two columns of Table 3. The interesting aspect of these results is the importance of the cost factors relative to monetary growth in explaining the inflation rate. Contrary to the findings of aggregative studies of Turkish inflation, manufacturing sector inflation is to be explained primarily by wage and imported input costs, with respective elasticities of 0.7 and 0.2. Money stock variable is not significant in the case of instrumental variable estimation. Overall, these results are supportive of the Keynesian-structuralist interpretation of price and output determination in the industrial sector. Cost factors explain price changes and demand factors explain the output changes. Yet, we observe that this conclusion is premature once we conduct test for structural stability of the regression coefficients under import bottlenecks. Removal of the restrictions on the dummies offers quite a different picture.

Estimates of the output equation are, reported in columns 3 and 4 of Table 2. We reject the hypothesis that all dummies are significantly different from zero. The relevant F-test is significant only at the 25 percent level. Yet some of the individual dummies alter our earlier conclusions significantly. The most interesting finding is that once the periods of import limitation and ease are delineated, we find a much stronger impact of monetary expansion on output growth. The estimated elasticity jumps from 0.5 to 0.6 and its statistical significance rises from 10 to 1 percent level. Furthermore, the positive output response to monetary growth is offset fully when there are import limitations. We cannot reject the hypothesis that the elasticity of output with respect to monetary growth is

[16] Once and twice-lagged values of explanatory variables are used as instruments in IV estimations.

significantly different from zero in the crisis periods: the t-value of the hypothesis that $\alpha_3 + \alpha_{31} = 0$ is found to be only 0.53. In a resource constrained economy, expanding demand does not have any positive influence on output. These results support the contention that the "marginal cost" curve of the economy under resource constraints is steeper. Price equation estimates provide more evidence in this direction. As seen in columns 3 and 4 of Table 3, inflation rate is not responsive to changes in money stock in the absence of bottlenecks. The magnitude as well as the statistical significance of estimate of the coefficient β_3 are lower relative to those obtained under the assumption of zero slope dummies. In the presence of bottlenecks, however, the elasticity of inflation with respect to monetary expansion rises to almost 2. Thus, we observe a very "classical" response under import bottlenecks. Monetary growth is inflationary when there are import constaints, but growth promoting when they are absent.

Another interesting result pertains to the intercept terms. As seen in columns 3 and 4 of Table 2, the intercept term of the output equation is now highly significant, with a value somewhat smaller than the period's average rate of growth of 8.3 percent (Table 1). The intercept dummy is also statistically significant (at the 10 percent level) and has the positive sign, which indicates that trend growth increases during import crises. This suggest that import substitution more than offsets negative effect of declining capital imports. The highly significant intercept dummy of the price equation is also supportive of this finding. The deflationary effect of trend growth deepens during periods of crises. Also noticable is the finding that wage rate does not have any significant impact on price or output growth, although the signs of the estimates are all in the right direction.

Finally, we should mention the world inflation. We observe from Table 3 that the price response to world inflation grows stronger, although we cannot gauge the relative importance of cost and demand effects. Output response to world inflation, on the other hand, declines significantly during periods of foreign exchange crisis, which suggest that cost-push effects dominate the demand-pull effect.

6. Conclusion

This paper presented and estimated a model to explain price changes and short-term output fluctuations in the modern sectors of semi-industrialized economies. Its central arguments are: (1) price and output are jointly determined by cost and demand factors and therefore cannot be dichotomized on an *a priori* basis; and (2) import bottlenecks and accompanying quantitative restrictions have significant effects on the behavior of price and output levels. The theoretical model predicts that the output level varies directly with real balances and inversely with relative input costs. Changes in input prices and nominal demand, on the other hand, affect the price level directly. Under import bottlenecks with restrictions on import/import-license trading, the negative impact of relative input costs on output and the positive impact of monetary growth on output weaken. Instead, monetary expansion becomes inflationary under such circumstances.

The results of the estimation are interesting in two respects. First, previous applications of the monetarist model to Turkey uniformly reached the conclusion that monetary growth is the culprit of inflationary pressures. This mold was broken only by Aksoy (1982), who applies the Harberger equation to the agricultural and non-agricultural sectors separately and demonstrates that monetary shocks are less inflationary in the non-agricultural sector. Focusing on the manufacturing sector, we further extend Aksoy's results and show that variations in the inflation rate cannot be attributed to monetary factors. Output fluctuations, in turn, are explained by monetary growth in excess of the expected rate of inflation. Secondly, we offer evidence regarding the relevance of foreign exchange bottlenecks to price and output determination which supports our claim that the empirical studies of inflation which overlook import bottlenecks are misspecified. The predictions of the monetarist model are found to be valid when there are foreign exchange bottlenecks, and the predictions of Keynesian/structuralist model are found to be valid when the bottlenecks do not exist. Sharper results on the effect of foreign exchange bottlenecks on price and output determination, however, await better measures of import requirements and availability.

The validity of our conclusions can be scrutinized by applying the model to other countries which have similar development patterns. The theoretical model presented here can also be expanded in several directions. One argument which has attracted a great deal of attention in recent years is the impact of working capital costs on inflation and growth. Following this line of reasoning, interest rates can be included among the determinants of unit cost of production.[17] Secondly, the assumption of the exogeneity of money supply is suspect. It is often suggested that the money stock in inflationary economies is endogenous,

[17] See, for instance, Bruno (1979b), and Taylor (1983, Ch. 5). It might be difficult to capture the empirical significance of working capital cost using annual data.

either through self-generating inflation mechanisms or accommodative policies pursued by the monetary authority. A fuller understanding of the inflationary process requires incorporation of such mechanisms into the model. Thirdly, the industrial sector of many LDCs is composed of private and state enterprises. Further disaggregation may be called for if the public sector is not as responsive to market forces as the private sector. Finally, the model should be interpreted as a component of a larger multi-sectoral model of the economy including the agricultural and the services sectors. Only in the context of such a structuralist macro model, can the questions of sectoral interactions in the determination of sectoral and aggregate output and price levels be fully addressed.

TABLE 1: SUMMARY STATISTICS

	Mean	Standard Deviation
Rate of Output Growth ($\hat{X}$)	0.082	0.055
Rate of Price Inflation ($\hat{P}$)	0.206	0.277
Rate of Wage Inflation ($\hat{W}$)	0.215	0.183
Rate of Import Price Inflation ($\hat{P}_R$)	0.244	0.398
Rate of Monetary Growth ($\hat{M}$)	0.240	0.143

DATA DESCRIPTION AND SOURCES

X: Manufacturing sector value added (State Institute of Statistics (SIS), *Annual Yearbook*, various issues)

P: Manufacturing sector deflator (SIS, *Annual Yearbook*, various issues)

P_R: Import price index (Aksoy (1980); World Bank)

W: Annual labor income in the manufacturing sector (SIS, *Annual Yearbook*, various issues)

M: Currency in circulation + demand deposits + time deposits (Turkish Central Bank, *Annual Reports*, *Monthly Reports*, various issues)

TABLE 2: OUTPUT EQUATION

$$\hat{X} = \alpha_0 + \alpha_{01} D_F + \alpha_1 \hat{W} + \alpha_{11} D_F \hat{W} + \alpha_2 \hat{P}_R + \alpha_{21} D_F \hat{P}_R + \alpha_3 \hat{M} + \alpha_{31} D_F \hat{M} + \alpha_4 \hat{P} + \alpha_{41} D_F \hat{P} + \xi_X$$

	(1)[1]	(2)[2]	(3)[1]	(4)[2]
α_0	0.081	0.043	0.070	0.054
	(5.00)***	(1.20)	(3.85)***	(2.38)**
α_{01}			0.073	0.125
			(1.81)*	(1.93)*
α_1	–0.194	0.067	–0.333	–0.315
	(1.92)*	(0.32)	(2.11)*	(1.27)
α_{11}			0.219	0.161
			(1.08)	(0.42)
α_2	0.032	0.096	0.068	0.127
	(1.11)	(1.76)*	(1.12)	(1.64)
α_{21}			–0.078	–0.168
			(1.08)	(1.81)*
α_3	0.311	0.451	0.462	0.594
	(3.22)***	(2.04)*	(3.99)***	(3.06)***
α_{31}			–0.525	–0.839
			(2.37)**	(2.01)*
α_4	–0.193	–0.519	–0.233	–0.393
	(2.58)**	(2.46)**	(2.03)*	(2.21)**
α_{41}			0.190	0.481
			(1.17)	(1.77)*
R^2	0.67	0.39	0.70	0.70
$\bar{R}^2$	0.61	0.28	0.63	0.55
DW	2.21	2.10	2.16	2.00
F^3	0.58	0.57	1.88	1.47
F^4			1.337	1.399

NOTES: t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively (two-tailed tests).

Variables: D_F: Dummy which takes the value of 1 during foreign exchange bottleneck years; W: Wage rate; P_R: Imported intermediate good price; M: Money stock; P: Manufacturing sector price level.

[1]Estimated by ordinary least squares.

[2]Estimated by instrumental variables.

[3]F-test for zero-degree homogeneity of output equation in nominal variables. Null hypothesis: $\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 = 0$ and $\alpha_1 + \alpha_{11} + \alpha_2 + \alpha_{21} + \alpha_3 + \alpha_{31} + \alpha_4 + \alpha_{41} = 0$. Degrees of freedom are (1,23) in regressions 1 and 2, (2,18) in regressions 3 and 4.

[4]Null hypothesis: $\alpha_{01} = \alpha_{11} = \alpha_{21} = \alpha_{31} = \alpha_{41} = 0$. Degrees of freedom are (5,18).

TABLE 3: PRICE EQUATION

$$\hat{P} = \beta_0 + \beta_{01}D_F + \beta_1\hat{W} + \beta_{11}D_F\hat{W} + \beta_2\hat{P}_R + \beta_{21}D_F\hat{P}_R + \beta_3\hat{M} + \beta_{31}D_F\hat{M} + \xi_P$$

	(1)[1]	(2)[2]	(3)[3]	(4)[4]
β_0	−0.124 (3.40)***	−0.134 (2.63)**	−0.051 (1.19)	−0.034 (0.75)
β_{01}			−0.238 (3.03)***	−0.341 (3.49)***
β_1	0.753 (3.29)***	0.676 (1.87)*	0.389 (1.05)	0.398 (0.91)
β_{11}			−0.056 (0.12)	−0.518 (0.88)
β_2	0.202 (3.05)***	0.207 (3.00)***	0.336 (2.43)**	0.341 (2.23)**
β_{21}			−0.096 (0.56)	−0.048 (0.25)
β_3	0.492 (2.02)*	0.597 (1.32)	0.383 (1.28)	0.245 (0.69)
β_{31}			1.060 (2.09)*	1.902 (2.74)**
$AR(1)$			−0.399 (1.38)	−0.597 (1.85)*
R^2	0.90	0.90	0.92	0.92
$\bar{R}^2$	0.88	0.88	0.89	0.87
DW	2.00	2.05	1.74	1.75
F^5	11.85***	7.44**	12.94***	13.59***
F^6			2.33*	3.11**

NOTES: t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively (two-tailed tests). For definition of variables see notes to Table 2.

[1]Estimated by ordinary least squares

[2]Estimated by instrumental variables.

[3]First-order autocorrelation corrected by Cochrane- Orcutt method.

[4]Estimated by instrumental variables using Fair's method.

[5]F-test for first degree homogeneity of price equation in nominal variables. Null hypothesis: $\beta_1+\beta_2+\beta_3=0$ and $\beta_1+\beta_{11}+\beta_2+\beta_{21}+\beta_3+\beta_{31}=0$. Degrees of freedom are (1,24) for regressions 1 in 2, and (2,18) in regressions 3 and 4.

[6]Null hypothesis: $\beta_{01}=\beta_{11}=\beta_{21}=\beta_{31}=0$. Degrees of freedom are (4,18).

APPENDIX: DERIVATION OF EQUATIONS (5) AND (6)

Profit maximizating firm equates its marginal cost to marginal revenue (firm subscript j is omitted for the sake of notational simplicity):

$$\frac{C}{x}\frac{1}{l+r} = (P^e)^{\frac{\eta}{\eta+\gamma}} P_W^{\frac{\gamma}{\eta+\gamma}} p\left(x, \frac{M^e}{P^e}\right)(1+(\eta+\gamma)^{-1}),$$

which, alternatively, can be stated in rates of change form as:

$$\hat{C} - \hat{x} + \hat{\phi} = (\eta+\gamma)^{-1}\hat{x} - (\eta+\gamma)^{-1}\psi(\hat{M}^e - \hat{P}^e) + \eta(\eta+\gamma)^{-1}\hat{P}^e + \gamma(\eta+\gamma)^{-1}\hat{P}_W$$

where $\phi \equiv 1/(l+r)$. In order to interpret the equilibrium condition we first find an expression for $\hat{x}$ by logarithmic differentation of the production function:

$$\hat{x} = l\hat{L} + r\hat{R} + k\hat{\hat{K}},$$

where k is the output elasticity of capital. Similarly, $\hat{C}$ can be obtained by logarithmic differentiation of the cost function, and substituting for $\hat{x}$:

$$\hat{C} = \phi(\hat{x} + l\hat{W} + r\hat{P}_R - k\hat{\hat{K}}).$$

Assuming ϕ remains constant over time and substituting for $\hat{C}$ and $\hat{x}$ into the equilibrium condition we obtain:

$$(\phi - 1)\hat{x} + \phi(l\hat{W} + r\hat{P}_R - k\hat{\hat{K}}) = (\eta+\gamma)^{-1}\hat{x} - (\eta+\gamma)^{-1}\psi(\hat{M} - \hat{P}^e) + \eta(\eta+\gamma)^{-1}\hat{P}^e + \gamma(\eta+\gamma)^{-1}\hat{P}_W$$

Solving this expression for x we obtain equation (5). Substitution of (5) into the demand function and rearranging yields (6). Equations (7) and (8) are derived similarly.

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