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ABSTRACT

We analyze the dynamics of inflation in an economy characterized by a forward-looking, staggered, price and wage determination process, and by monetary accommodation. In our model, inflation reconciles the conflicting claims of workers and firms. The model is capable of generating a positive association between real wages and inflation, of the type that has been observed in some high-inflation countries. It generates a price-wage spiral but does not result in inflationary inertia.

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1. Introduction

The notion that inflation includes an important predetermined component, referred to as inflationary inertia, has influenced the design of recent disinflation policies in Argentina, Brazil, and Israel. It was argued that conventional policies are not likely to succeed unless this inertia, which is mainly attributed to the coexistence of a wage-price spiral and monetary accommodation, is eliminated (see, for example, Bruno (1986) and Dornbusch and Simonsen (1987)).

While the role of monetary accommodation in enhancing persistence of inflation does not seem to be controversial, the role of inertia is controversial. There are at least two ways of dealing with the wage-price spiral. The first stresses the interaction between backward-looking wage indexation and staggered wage and price setting. Since typically such indexation does not provide full compensation for past inflation, this mechanism implies an inverse relation between movements in real wages and inflation; i.e., declining real wages in periods of high and accelerating inflation and rising real wages in periods of disinflation. There exists evidence for high-inflation countries that does not conform to these implications. In particular, there were substantial increases in real wages preceding and during major episodes of high and accelerating inflation in Israel and Argentina (see Helpman and Leiderman (1988)). Specifically, it is seen in Chart 1 that the rise of inflation in Israel from about 10-20 percent a year in the early 1970s to around 100 percent in the early 1980s was accompanied by a real wage increase of more than 20 percent, and the further acceleration of inflation to close to 400 percent in 1984 was accompanied by a further rise in real wages of about 16 percent.[1] In the case of Argentina, real wage increases of more than 40 percent between 1972 and 1974 preceded the acceleration of inflation from less than 50 percent in 1974 to more than 400 percent in 1976, marked real wage decreases between 1974 and 1977 preceded the more than halving of the inflation rate that occurred between 1976 and 1977/78, and further real wage increases have accompanied the upsurge of inflation in the early 1980's.

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[1] In the chart the real wage corresponds to the yearly average per employee post, and inflation is measured by the percentage change in the CPI. The source for these series are various issues of the Annual Report by the Bank of Israel.

The foregoing evidence implies that longer term wage developments have been governed to a large extent by factors other than backward-looking wage indexation. This observation provides the motivation for focusing our analysis on forward-looking wage and price determinations. We develop a model that embodies a wage-price spiral and monetary accommodation, and use it to investigate inflationary dynamics. We show that inflationary inertia need not be a characteristic of this type of an economy, despite the fact that the data it produces may be mistakenly interpreted as exhibiting inflationary inertia. We explain how the model accounts for the positive association between real wages and inflation, and how it is possible to disinflate an economy with these characteristics.

For the purpose of this study we develop a modified version of Blanchard's (1986) model, in which there is monopolistic competition and nonsynchronized decision making by firms and workers about price and wage changes.[2] In particular, we allow for autonomous changes in real wages, positive discounting, and use exact functional forms. In order to concentrate on the mechanism that generates the positive comovement of real wages and inflation, we abstract from backward-looking wage indexation.

In our model there is a staggering in the setting of wages and prices and monetary accommodation. The emerging time pattern of inflation depends on a set of fundamentals that includes the level of real wages, the markup, the real interest rate, and real spending. When these parameters are constant,

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[2] Zeira (1986) has used a differently modified version of Blanchard's model in order to describe inflationary inertia. He also dealt with different issues.

perfect foresight leads to a constant rate of inflation, implying that there is no inflationary inertia. That is, despite the existence of a wage-price spiral and monetary accommodation current inflation is not affected by past inflation. To the extent that fundamentals change over time, the model implies that steady state inflation is higher the higher are real wages, the markup, and real spending, or the lower is the real interest rate. Moreover, rising real wages over a given time interval imply a rising rate of inflation.

Models of price-wage spirals (Blanchard's model not withstanding) build on competing claims by workers and firms for the economy's output. These claims are usually reconciled by means of employment adjustments with inflation playing at most a temporary role. We underline the possibility that inflation can be a permanently reconciling factor. Namely, even with complete real wage rigidity the competing claims of workers and firms can be reconciled with a finite level of inflation. This, however, requires positive discounting of the future. In fact, we show that the range of real wages within which inflation is bounded depends on the real discount rate. This point is of independent interest.

The paper is organized as follows. Section 2 describes the basic model. Section 3 derives its implications for disinflation, for the comovement of inflation and real wages, and for inflationary inertia. This analysis is restricted to partial equilibrium. A general equilibrium underpinning is provided in Section 4. Section 5 concludes by pointing out some limitations of recent empirical tests of inflationary inertia in view of our analysis and by discussing possible extensions.

2. Wages and Prices

In this section we develop our model of staggered wages and prices. Prices are set in even periods for a two-period time interval and nominal wages are set at odd periods for a two-period time interval. Labor is the only variable input in production. Let $d_t(p)$ be the demand curve faced by a representative firm in period t, where p is the price it charges for its product, and let $\phi(a)$ be its labor requirement for producing output a (i.e., the inverse of the production function). Then if w_t stands for the nominal wage rate set by workers in period t odd, and β_t stands for the one-period nominal discount factor in period t, the representative firm's decision problem can be written as:

$$(1) \quad \max_{p_t} \; p_t d_t(p_t) - w_{t-1}\phi[d_t(p_t)] + \beta_t\Big[p_t d_{t+1}(p_t) - w_{t+1}\phi[d_{t+1}(p_t)]\Big], \quad t \text{ even}$$

We assume oligopolistic competition amongst firms producing differentiated products. Preferences are of the Spence-Dixit-Stiglitz type with a constant elasticity of substitution σ. Hence, the demand function is

$$(1a) \qquad d_t(p) = \left[\frac{p}{P_t}\right]^{-\sigma} a_t \;, \quad \text{all } t,$$

where P_t is a price index of the available varieties and a_t is real aggregate spending per-firm (see Appendix). Every firm has an identical demand and cost structure. Therefore, in a symmetrical equilibrium $P_t = p_t$, and the above described pricing decision implies:[3]

[3] We employ a standard Nash equilibrium concept. If the problem was formulated as a repeated game other equilibria would be possible.

(2) $p_t = \frac{R}{1+\beta_t a_{t+1}/a_t} [w_{t-1}\phi(a_t) + \beta_t(a_{t+1}/a_t)w_{t+1}\phi(a_{t+1})]$, for t even,

where $R=1/(1-1/\sigma)$ is the markup factor and $\phi(\cdot)$ is the derivative of $\Phi(\cdot)$, thereby representing marginal labor requirement. Marginal labor requirement is rising with output if and only if marginal costs are rising with output.

We assume that the nominal wage rate is set for a two-period time interval such that the present value of two-period wages equals a predetermined present value of real purchasing power ω_t. Since the latter is taken as exogeneous to the model, the analysis embodies a form of real wage rigidity. Specifically, the wage rule is:[4]

(3) $w_t + \beta_t w_t = \omega_t(p_{t-1} + \beta_t p_{t+1})$, for t odd.

Equations (2)-(3) describe the basic wage-price spiral model. It can be seen that past and future wages are taken into account by firms when setting prices, and similarly past and future prices are taken into account by workers when setting wages. Although the processes of wage-price determination are not derived here from first principles,[5] they capture what is believed to be an observed nonsynchronization of these variables and enable us to analyze in a tractable framework the effects of changes in key parameters, such as

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[4]In this formulation workers require nominal wages that are equivalent over the two-period horizon of the contract to receiving ω_t in real terms in each one of the two periods. Alternatively, it could have been assumed (as suggested by a referee) that the fixed parameter is not ω_t but rather the discounted present value of real wages over the two periods. Both formulations yield similar results, except for the effect of the real interest rate on inflation.

[5]It is possible to generalize the wage rule so as to incorporate also backward looking elements, such as in Taylor (1980). However, it is convenient to concentrate on the simplified version for current purposes.

autonomous shifts in real wages, on the inflationary process. The consistency of the present formulation with general equilibrium considerations is discussed in Section 4.

3. Inflation Dynamics

Now assume that the real interest rate is positive and constant, and let ρ, $0 < \rho < 1$, be the real discount factor (equal to one over one plus the real interest rate). Then $\beta_t = \rho P_t / P_{t+1}$. Since $p_t = p_{t+1}$ for t even, we obtain:

$$\beta_t = \begin{cases} \rho & \text{for } t \text{ even,} \\ \rho p_{t-1}/p_{t+1} & \text{for } t \text{ odd.} \end{cases}$$

Combining this with (2)-(3) yields:

$$(4) \qquad 1 = R \, \frac{1+\rho}{1+\alpha_t \rho} \left[\frac{w_{t-1}\phi(a_t)}{x_t + \rho} + \alpha_t \rho \, \frac{w_{t+1}\phi(a_{t+1}) x_{t+2}}{x_{t+2} + \rho} \right],$$

where $\alpha_t = a_{t+1}/a_t$ is the growth factor of demand per-firm and $x_t = p_t/p_{t-2}$ is one plus the two-period inflation rate. This equation describes the determination of current (period t) inflation as an implicit function of the markup, the real interest rate, the evolution of real wages, the evolution of demand, and expected future inflation.[6]

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[6]Equation (4) implicitly describes the rate of inflation that reconciles the competing claims by workers in (3) and firms in (2). Inflation can assume this role because wages and prices are set in different time periods. Alternative timing conventions for setting prices and wages will assign inflation different reconciling roles.

In order to study inflation dynamics, we specialize the model at this point by assuming that real wages ω_t and real demand per-firm a_t are constant over time (the case of rising real wages is discussed in the sequel). In this case (4) reduces to:

$$(5) \qquad 1 = R\omega\phi(a) \left[\frac{1}{x_t + \rho} + \frac{\rho x_{t+2}}{x_{t+2} + \rho} \right] \qquad \text{for } t \text{ even.}$$

It is useful to begin the discussion with the case of a constant rate of inflation; i.e., $x_t = x$ for all t even. This is applicable to steady states, but it may also apply to situations in which the economy is not in a steady state, as we explain in Section 4. In this case (5) implies:

$$(6) \qquad R\omega\phi(a) = \frac{x + \rho}{\rho x + 1} .$$

It is easy to see that in (6) x is an increasing function of $R\omega\phi$ if and only if $\rho < 1$. Hence, if the real interest rate is positive, higher values of the real wage rate, the markup, or the marginal labor requirement are associated with higher constant inflation rates. It is also straightforward to see from (6) that for a given value of $R\omega\phi$ the rate of inflation is a decreasing function of the real interest rate (an increasing function of ρ) if the real interest rate and the inflation rate are positive.[7]

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[7] The partial derivative of x with respect to ρ that is implied by (6) is $(x^2 - 1)/(1 - \rho^2)$.

Equation (6) is highly nonlinear. It implies that small changes in the real wage rate, the markup, or marginal labor reqirement may bring about large changes in the rate of inflation. To see this point, consider the case in which prices are adjusted every six months, so that the elementary time unit is one quarter. Let the quarterly real interest rate be 1.5%. Then, if $R\omega\phi=1$ there is price stability, and if, say, the real wage rate increases by one tenth of one percent the rate of inflation increases to 14.4% per half year. A further increase in the real wage rate or marginal labor requirement by one tenth of one percent increases the rate of inflation to 31% per half year. This shows clearly the high elasticity of the inflation rate with respect to costs.

In what follows we consider the case in which

$$\rho < R\omega\phi < 1/\rho,$$

which ensures the existence of an equilibrium with a constant rate of inflation. In this case equation (5) implies the functional relationship between x_t and x_{t+2} as described in Figure 1. The curve is rising, going to infinity as x approaches $\bar{x}$ from below, and going to minus infinity as x approaches $\bar{x}$ from above. It intersects the 45° line at the steady state point A, with a slope larger than one. It is clear from Figure 1 that perfect foresight and expected positive prices require expected and actual values of x to be in the interval $(\underline{x},\bar{x})$ in all time periods. This, however, is satisfied if and only if the expected rate of inflation is equal to the constant level represented by point A. Hence, in this case perfect foresight leads to a constant rate of inflation as long as the underlying parameters are constant; i.e., inflation does not depend on predetermined factors.

In this model unexpected permanent shocks to fundamentals bring about permanent changes in the rate of inflation, and there is no inflationary inertia. The model suggests that in order to permanently disinflate an economy with these characteristics it is necessary to generate some combination of decreases in the real wage rate, the markup, and marginal labor requirement, and an increase in the real interest rate. As discussed in Helpman and Leiderman (1988), models of this class are useful for analyzing recent anti-inflation plans such as those implemented in Israel and Argentina in mid-1985, where the initial impact of the policy measures featured decreases in the real wage and markup and an increase in the real interest rate.

While the foregoing discussion was confined to unexpected permanent shocks, it turns out that anticipated changes in key parameters may generate a gradual rise in inflation which can mistakenly be interpreted as inflationary inertia. Consider a gradual increase in the real wage rate ω_t, with a_t being constant. It is easy to see from (4) that this brings about a riwhtward shift of the curve that passes through A in Figure 1. If $\omega_1 = \omega'$ and it rises over time until it reaches a constant level ω from time $t=T$ on, then on a perfect foresight path the rate of inflation at time T has to be the constant rate of inflation that corresponds to the wage rate ω (i.e., the solution to (6)). Solving (4) backwards produces the unique perfect foresight path. In terms of our diagram, Figure 2 describes the adjustment path for a two-period increase in real wages. If the real wage was constant at the level ω_1 the rate of inflation would have been constant at point A. However, since $\omega_3 > \omega_1$, the relevant curve is more to the right, such as curve 2.

Hence, in period 2 the system has to be on curve 2. Similarly, in period 4 it has to be on curve 4 and in period 6 on curve 6. Moreover, in period 6 it has to be at point B. Therefore, moving backwards we identify the arrow path as the equilibrium trajectory. It is clear that on this trajectory the rate of inflation is rising, and so is positively autocorrelated, thus possibly giving the impression that there is inflationary inertia. Yet the latter interpretation is not valid in the current context.

4. General Equilibrium Considerations

So far we have discussed price-wage dynamics under the assumption that monetary policy accommodates the resulting price developments. We have also assumed a given time pattern of real spending per-firm, a_t. We now develop an explicit model of intertemporal choice that provides general equilibrium underpinnings for this analysis. It is assumed for this purpose that the number of firms is n in every time period. Hence, n is also the number of available varieties. In addition, there exist indexed bonds that are freely traded in the capital market. These bonds can be issued by the government or the private sector.

Consider a representative individual that maximizes the discounted flow of utility:

$$\sum_{t=0}^{\infty} \rho^t [u(c_t) + v(M_t/p_t)]$$

subject to the budget constraint:

$$(7) \qquad \sum_{t=0}^{\infty} \delta_t[c_t + (M_{t+1} - M_t)/p_t] \le \sum_{t=0}^{\infty} \delta_t(y_t - \tau_t) + (1 + r_{-1})b_{-1}.$$

Here the utility level depends on real consumption and real balance holdings, where the dependence on real consumption is derived from a Spence-Dixit-Stiglitz utility function with a fixed number n of equally priced varieties.[8] The period t real discount factor is denoted by δ_t (discounted from time t to time 0), M_t stands for nominal money balances, y_t for real income, τ_t for lump-sum taxes, r_{-1} for the real interest rate in the period prior to zero, and b_{-1} for bonds acquired in the period prior to zero. If $b_{-1}>0$, these bonds have been issued by the government, and if $b_{-1}<0$, the bonds have been issued by the private sector. The evolution of private bond holdings is described by:

$$b_{t+1} = (1 + r_t)b_t + y_t - \tau_t - c_t - (M_{t+1} - M_t)/p_t.$$

Let θ be the multiplier of constraint (7). Then the first order conditions for the consumer's maximization problem are:

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[8] Let $u^o(U)$ be the original utility function from which $u(\cdot)$ has been derived, with $U=[\int_{i\epsilon I} c_i^{\gamma}]^{1/\gamma}$, where c_i is consumption of variety i and $0<\gamma<1$ (see Appendix). Then if p is the price of every variety, it is optimal to choose equal quantities $c_i=a$. Given real consumption spending c this yields $a=c/n$, where n is the number of available varieties. Hence, we can define $u(c)=u^o(n^{1/\gamma-1}c)$, which is used in the text.

(8) $\rho^t u'(c_t) = \delta_t \theta$, $t = 0,1,2...$

(9) $\rho^{t+1} v'(m_{t+1})/P_{t+1} = \theta(\delta_t/P_t - \delta_{t+1}/P_{t+1})$, $t = 0,1,2...$

where m_t is real balance holdings.

In what follows we deal with the case in which real income y_t is constant; i.e., $y_t = y$. It will be shown that this is indeed an equilibrium (albait not the only one). Assume also that government spending is the same in all time periods at the level g, and that its allocation across varieties is the same as in the private sector. In this case

$$c_t = c = y - g,$$

which implies with the aid of (8) that $\delta_t = \rho^t u'(c)/\theta$. However, since by definition $\delta_0 = 1$, this yields $\theta = u'(y-g)$ and $\delta_t = \rho^t$ for all t. Applying these results to (9) yields

(10) $$\frac{v'(m_{t+1})}{u'(y-g)} = \frac{P_{t+1}}{\rho P_t} - 1 \qquad \text{for all } t.$$

This equation provides a link between inflation and real money holdings, given real income y, real government spending g, and the real interest factor ρ. In order for this equation to be satisfied at each point in time while price movements are determined by the process described in the previous section, the government has to accommodate the demand for money. It is, therefore, necessary to see whether and how this can be done.[9]

Taking b_{-1}^G to be the government's outstanding debt, and using $\delta_t = \rho^t$, the government's consolidated intertemporal budget constraint is:

$$(11) \qquad \sum_{t=0}^{\infty} \rho^t [\tau_t + (M_{t+1} - M_t)/p_t - g] = (1 + r_{-1}) b_{-1}^G .$$

The left hand side represents the present value of its income minus spending, where income is derived from lump-sum taxes and monetary injections. The right hand side represents its liabilities at time zero. This implies the evolution of government debt according to

$$b_{t+1}^G = \rho^{-1} b_t^G + g - \tau_t - (M_{t+1} - M_t)/p_t .$$

Naturally, in equilibrium $b_t = b_t^G$.

The government is solvent as long as (11) is satisfied. This intertemporal budget constraint can also be written as:

$$(11') \qquad \sum_{t=0}^{\infty} \rho^t \tau_t = (1 + r_{-1}) b_{-1}^G + \sum_{t=0}^{\infty} \rho^t (g + m_t - m_{t+1} p_{t+1}/p_t),$$

which implies that given a) the inflation path that is determined by means of

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[9]Observe that the analysis in the previous section implied that $p_{t+1} = p_t$ for t even. Therefore, in this case (10) implies that real balance holdings are the same in all even periods. Hence, if there is inflation, real balance holdings are higher in even periods than in odd periods. The amplitude of these fluctuations in real balance holdings is smaller the lower is the rate of inflation.

the mechanism described in the previous section; b) the implied real balance holdings that are described in (10); c) the real spending level g; and d) accommodation of the demand for money; the right hand side of (11') is given. Therefore, this determines the present value of lump-sum taxes. Naturally, there is more than one time pattern of taxes that ensures solvency, and with each feasible pattern there is an associated pattern of government debt. However, the substitution of debt for taxes has no real effects (there is Ricardian neutrality). Hence, as long as taxes can be chosen so as to ensure intertemporal balancing of the government budget, the government can indeed pursue an accommodating monetary policy. Given some natural restrictions on the level of taxes at each point in time (such as the requirement that taxes cannot exceed income), this leaves a wide range of cases in which this policy is feasible.

It remains to discuss the consistency of a constant real income level y with the predetermined price-wage dynamics. Recall that we assumed that government spending g is allocated across varieties in the same way as in the private sector. Hence, aggregate spending per-firm is

$$a = (c + g)/n = y/n.$$

On the other hand, employment is given by

$$\ell = n\phi^{-1}(a) = n\phi^{-1}(y/n),$$

where $\phi^{-1}(\cdot)$ may include fixed costs. Hence, as long as y is low enough so that ℓ is below the full employment level (assuming an inelastic labor supply), we have an equilibrium configuration. Namely, if individuals expect such y to be their real income in every period (from wages and profits), and firms expect y to be the level of aggregate spending in every time period, then indeed these will be equilibrium values. The pattern of inflation, on the other hand, is determined according to the mechanism described in the pevious section. Since every level of real income y that leads to less than full employment of labor is an equilibrium value, there is a continuum of equilibria with constant income and consumption. In fact, there also exist many others in which private consumption, and therefore also aggregate spending, change over time (while government spending is constant). In the latter case the real interest rate is not the same in all time periods.

Observe that given constant values of (a,ω), and the constant real interest rate, the rate of inflation is constant. In this case government debt may be growing over time if higher taxes are expected in the future. Hence, there may be constant inflation despite the fact that the economy is not in a steady state. In addition, rising marginal costs imply higher inflation for a higher real spending level per-firm, while higher real spending implies higher employment. Therefore, in this type of an economy one may observe a long-run Phillips curve, although it may be argued that this model is not suitable for long-run analysis because in the long-run the rules for determining prices and wages may change.

Can the government affect employment? The answer is yes if private sector expectations are such that an increase in public spending makes people believe that income will be higher. If expectations satisfy this condition, then an increase in public spending brings about expectations of higher income, which induces in turn higher aggregate spending and higher employment. Given rising marginal costs the result will be higher inflation. Consequently, the correspondingly lower demand for real balances has to be accommodated, implying the need to adjust the present value of tax revenue in order to satisfy (11').

5. Concluding Remarks

We have analyzed the dynamics of inflation in an economy characterized by a forward-looking, staggered, price and wage determination process, and by monetary accommodation. In our model, inflation reconciles the conflicting claims of workers and firms. The model is capable of generating a positive association between real wages and inflation, of the type that has been observed in some high-inflation countries. It generates a price-wage spiral but does not result in inflationary inertia. We have identified changes in key underlying parameters that are required in order to disinflate an economy with these characteristics.

Our results can be used to question the meaning of recent research that has used autoregressive representations in order to empirically assess inflationary inertia. Consider for example the analysis by Bruno and Fischer (1986). They show that in quarterly inflation autoregressions for Israel the size and sum of coefficients on the first and second lags have increased over time along with the inflation rate. For 1965:I-1971:I this sum is 0.56, for 1975:III-1978:IV it is 0.87, and for 1979:I-1982:IV it is 1.04. Their conclusion is that the evidence supports the notion that there is considerable inertia in the inflationary process in Israel and that this inertia has been growing over time.

In the light of our model, an important limitation of using univariate inflation autoregressions to assess inertia is that the latter do not explicitly allow for changes in fundamentals. Equation (4) describes the inflation rate as an implicit function of the markup, the evolution of the target real wage, the real interest rate, the evolution of aggregate demand, and expected future inflation. Thus, from this model's standpoint inflation autoregressions that do not allow for changes in these factors are misspecified. Another problem with the above-mentioned autoregressions, discussed in Helpman and Leiderman (1988), arises from the fact that no detrending was applied despite the fact that inflation appears to be nonstationary. The upshot is that there seems to be no meaningful model-free test of inflationary inertia. In order to test this hypothesis, it is necessary to formulate an explicit model that embodies it, allowing for changes in the forcing variables, and then test it directly.

In order to sharply focus on the new features of our wage-price spiral we have intentionally disregarded backward looking wage indexation that prevails in many high inflation economies. In principle, our forward looking mechanism is complementary to conventional backward looking wage indexation and stabilization programs have to address both. Indeed, reductions in the degree of indexation have been used in early stages of disinflation programs in an attempt to deal with the latter. Our model underlines the need for additional steps that have been used in recent programs, such as the lowering of target real wages.

Our analysis can be extended in several directions in an attempt to relax some of the restrictive assumptions that were used. First, the rules of wage and price determination can be modified so as to include the effects of backward-looking wage indexation. Second, the assumption of perfect foresight could be relaxed. When discussing the effects of government policies on inflation, credibility characteristics of these policies can aso be considered. Third, wage-setting rules could be derived from first principles by explicitly taking into account workers' and trade unions' objectives. Fourth, the extent of staggering could be expanded, by allowing some firms or sectors and some workers to change their prices and wages every period. Naturally, the ways in which these extensions and modifications alter our results remains to be determined in future work.

Appendix

Let the utility function of the representative individual be of the Spence-Dixit-Stiglitz type with a constant elasticity of substitution and a continuum of varieties. Then it can be represented as:

$$\text{(A.1)} \qquad U = \left[\int_{i \in I} c_i^{\gamma} di\right]^{1/\gamma},$$

where i is and index of varieties, I is the set of available varieties, c_i is consumption of variety i, and $0<\gamma<1$ is a parameter. The elasticity of substitution is given by $\sigma=1/(1-\gamma)$. This utility function implies the demand function for variety i:

$$\text{(A.2)} \qquad c_i = \left[\frac{p_i}{P}\right]^{-\sigma} a,$$

where P is a price index and $a=A/(Pn)$ iş real spending per-variety (or per-firm). Here, A stands for nominal spending and n for the number of firms. The number of firms is defined as:

$$n = \int_{i \in I} di$$

and the price index P is defined as:

$$P = \left[\frac{1}{n}\int_{i \in I} p_i^{1-\sigma}\right]^{1/(1-\sigma)}.$$

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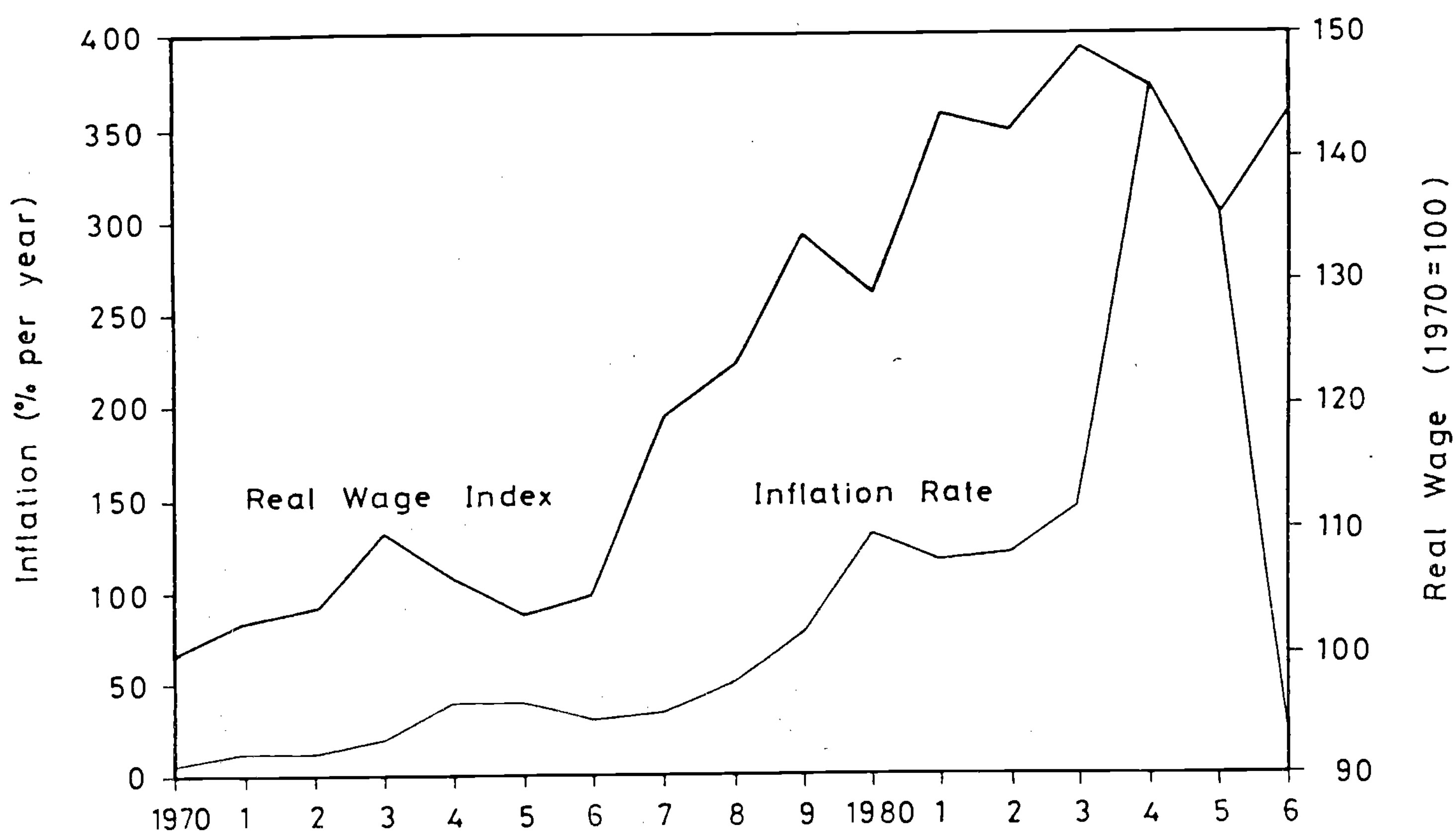
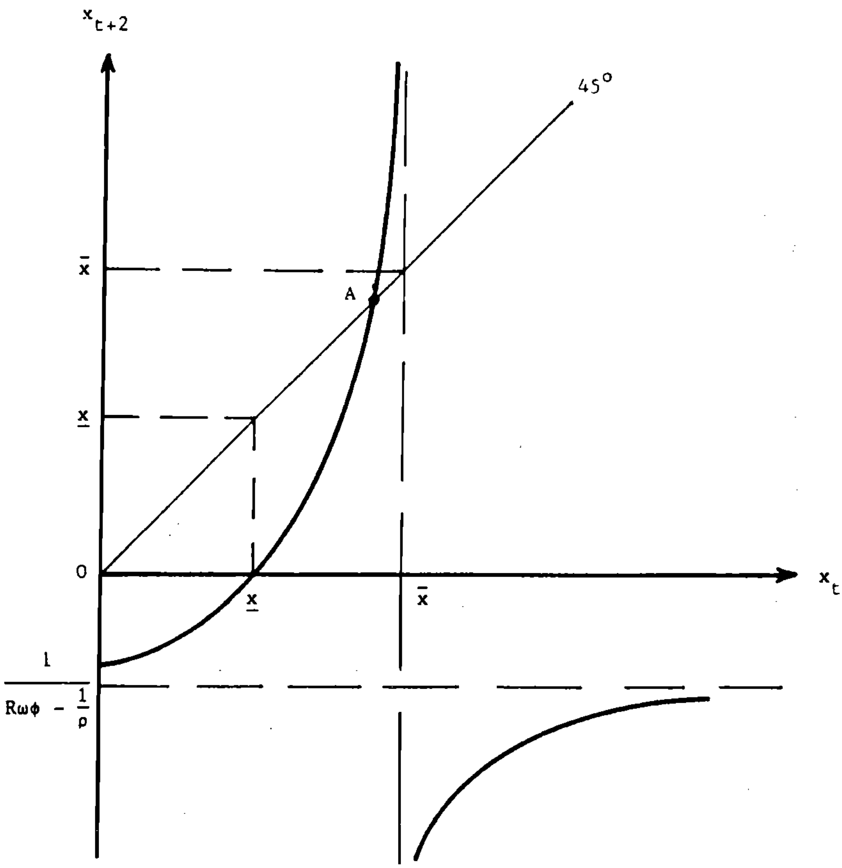


Chart 1: Inflation and Real Wages in Israel (1970–1986).



$$\bar{x} = \frac{1}{\frac{1}{R\omega\phi} - \rho} - \rho \quad , \qquad \rho < R\omega\phi < \frac{1}{\rho}$$

FIGURE 1

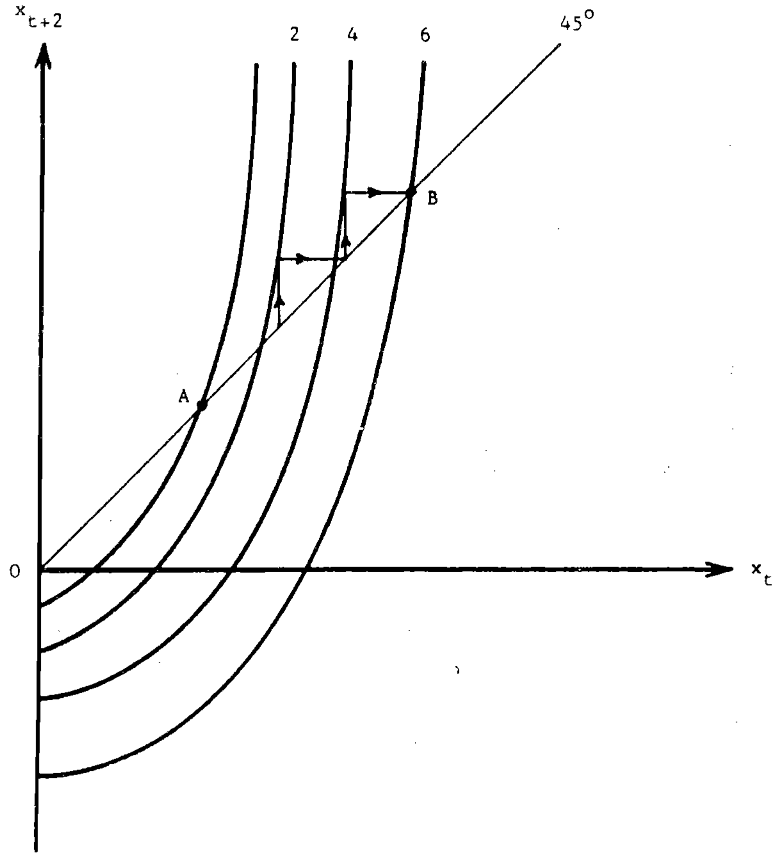


FIGURE 2