The GSBGM Working Paper Series

WORKING PAPER 15/95

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ISSN 1173-4523
ISBN 0-475-11496-5

The GSBGM Working Paper Series 15/95 September 1995.
Jan Whitwell 'Monetary disinflation with inflation inertia: Central bank autonomy in an open economy'

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Printed by The Victoria University of Wellington Printers.

MONETARY DISINFLATION WITH INFLATION INERTIA: CENTRAL BANK AUTONOMY IN AN OPEN ECONOMY†

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Abstract

This paper draws on the strategic policy literature to model the optimal disinflation trajectory for an economy subject to external shocks and where the inflation process is characterised by a degree of expectational and externally-sourced inertia. In particular, it shows that the optimal inflation rate will converge on an interval bounded by the targetted rate and by the rate of externally-sourced inflation. Moreover, the point of convergence will vary with the openness of the economy, with the degree of wage flexibility, and with the relative weight given to the inflation objective.

The policy implications of these results are examined with some reference to the New Zealand institutional environment and the disinflation of the post-1984 period. New Zealand did not adopt a disinflationary policy stance until late 1984, at a time when most other OECD countries were already well down their disinflation paths. As if to compensate for the late start, and in anticipation of the ratifying legislation, the Reserve Bank of New Zealand narrowed its macro-policy focus to a single objective – inflation. The *Reserve Bank of New Zealand Act 1989* subsequently set "stability in the general level of prices" (currently defined in terms of maintaining an absolute target for consumer price inflation of 0 to 2 percent) as the primary macro-objective for monetary policy and freed the Bank from day-to-day political directives on the implementation of policy. The legislation has generated a vigorous Antipodean debate about optimal monetary policy in a small, open economy. This paper provides a theoretical underpinning for the contention that, in general, monetary disinflation under the Reserve Bank Act is a sub-optimal strategy.

† This paper reflects research incomplete at the time of Jan's death in October 1993. It was labelled "Preliminary Draft" by Jan, but her colleagues and an independent reviewer consider the ideas developed in the paper to have reached the stage where it should be circulated for wider discussion purposes. No significant alterations have been made to Jan's latest known electronic copy, dated 19 October 1993.

Introduction

This paper draws on the strategic policy literature (for example, Barro and Gordon, 1983) to model the optimal disinflation trajectory for an economy subject to external shocks and where the inflation process is characterised by a degree of expectational and externally-sourced inertia. In particular, it shows that the optimal inflation rate will converge on an interval bounded by the targetted rate and by the rate of externally-sourced inflation. Moreover, the point of convergence will vary with the openness of the economy, with the degree of wage flexibility, and with the relative weight given to the inflation objective.

The policy implications of these results are examined with reference to the New Zealand institutional environment and the disinflation of the post-1984 period. New Zealand did not adopt a disinflationary policy stance until late 1984, at a time when most other OECD countries were already well down their disinflation paths. As if to compensate for the late start, and in anticipation of the ratifying legislation, the Reserve Bank of New Zealand narrowed its macro-policy focus to a single objective – inflation. The *Reserve Bank of New Zealand Act 1989* subsequently set "stability in the general level of prices" (currently defined in terms of maintaining an absolute target for consumer price inflation of 0 to 2 percent) as the primary macro-objective for monetary policy and freed the Bank from day-to-day political directives on the implementation of policy. The legislation effectively absolves the monetary authorities from any responsibility for unemployment by requiring them to operate a strategy that gives no significant weight to real-sector outcomes.

This paper provides a theoretical underpinning for the contention that, in general, monetary disinflation under the Reserve Bank Act is a sub-optimal strategy. The first part of the paper models formally equivalent, but competing, visions of the supply side of a small, open economy. The second section then demonstrates why a zero-inflation target may not be superior, and can be inferior, to a relative inflation target under the assumption that the policy-maker reflects society's preferences. Finally, given that some sectors of New Zealand society appear not to share the preferences of the monetary authorities that are enshrined in the 1989 legislation, the last part of the paper explores the policy implications of allowing the policy-maker's preferences to deviate from those of society as the key characteristics of the economy vary.

The Model

The derivation of the model is familiar. The expectations-augmented Phillips curve for a small, open economy can be derived either from an administered-price equation and a wage equation which exhibits both administered and competitive characteristics or, equivalently, from a

Friedman-Phelps vision of continuous labour-market clearing. The formal equivalence of the two approaches is first established in order to counter any impression that the results obtained rest on price or institutional rigidities. The conclusions turn out to be essentially independent of the nature of the price and wage-setting processes which operate domestically.

A small economy is usually characterised as a price-taker in the world markets for its imports but a price-maker in the markets for its exports. But when exports are predominantly commodity-based, as in the case of New Zealand, the economy can also be characterised as a price-taker in the markets for its exports. The domestic prices of tradeables are, therefore, taken to be the foreign-currency prices set in world markets multiplied by the exchange rate (the price of foreign currency). Exportables which are used as inputs into domestic production processes are assumed to be priced at world prices.

A Fix-Price Vision

In a fix-price economy, where non-tradeable product prices are set as a mark-up on unit labour and tradeable-input costs, the domestic-price level can be approximated as a weighted geometric mean of the nominal wage rate, the export-price level and the import-price level, ie.

$$P = W^{\phi}\left(Q^{x}\right)^{\psi}\left(Q^{z}\right)^{1-\phi-\psi} \qquad 0 \le \phi < 1,\ 0 \le \psi < 1,\ 0 \le \phi + \psi < 1$$

where Q^x $(= SP^x)$ = the export-price level (domestic currency units)
Q^z $(= SP^z)$ = the import-price level (domestic currency units)
P^x = the export-price level (foreign currency units)
P^z = the import-price level (foreign currency units)
S = the nominal exchange rate (price of foreign currency)
W = the nominal wage rate

Using the corresponding lower-case letter to denote the logarithmic derivative of an upper-case price variable, logarithmic differentiation with respect to time gives the domestic inflation rate as a weighted average of the rates of nominal wage, export-price and import-price inflation, ie.

$$p = \phi w + \psi q^{x} + (1 - \phi - \psi) q^{z}$$

or

$$p = \phi w + (1 - \phi) q^{w} \qquad (1)$$

where $q^w = s + p^w$ = the externally-sourced component of the domestic inflation rate and $$p^w = \frac{\psi}{1-\phi}p^x + \left(1 - \frac{\psi}{1-\phi}\right)p^z$$

is the rate of world inflation measured as a weighted average of the country's export-price and import-price inflation. The significance of externally-sourced inflationary pressures for domestic inflation increases as the parameter ϕ decreases, that is, as the openness of the economy increases. Hence, the imported-inflation or real-exchange-rate measures relevant to this small, open economy are based on the world-price index for tradeables:

$$P^w = \left(P^x\right)^{\frac{\psi}{1-\phi}}\left(P^z\right)^{1-\frac{\psi}{1-\phi}}$$

Wages are envisaged to respond to both administered and competitive pressures with the rate of wage inflation modelled as:

$$w = p^e + \beta(n - n_0) \qquad \beta > 0$$

where p^e = the expected domestic inflation rate
n = labour units employed
n_0 = the natural level of employment

In this context, the natural level of employment is defined as the level of employment consistent with a wage settlement that reflects exactly workers' expectation of inflation. The parameter β is an indicator of the degree of labour-market flexibility with an increase in β representing an increase in the competitiveness of the labour market.

Output is produced according to a simple constant-returns stochastic production function:

$$y = n + u \qquad \mathrm{E}(u) = 0$$

which admits both pro-cyclical ($u < 0$) and counter-cyclical ($u > 0$) labour productivity shocks. Given that the natural level of output is:

$$y_0 = n_0$$

the rate of wage inflation may be expressed as:

$$w = p^e + \beta(y - y_0 - u) \qquad \beta > 0 \qquad (2)$$

The wage-price system captured by equations (1) and (2) combine to give a short-run, expectations-augmented Phillips curve for an open economy of the form:

$$p = \phi p^e + (1-\phi)q^w + \phi\beta(y - y_0 - u) \tag{3}$$

The slope parameter $\phi\beta$ of the Phillips curve in *y-p* space depends, not only on the degree of flexibility in the labour market, but also on the openness of the economy. In particular, the more open the economy, or the less flexible the labour market, the smaller is the slope of the Phillips curve and, therefore, the greater is the potential short-run trade-off between inflation and unemployment. The openness of the economy also influences the position of the Phillips curve in *y-p* space. In contrast to the case of a closed ($\phi = 1$) economy, where any revision of inflation expectations is reflected in a vertical shift of the Phillips curve by the full amount of the change, only a proportion ϕ of any expectations change is embodied in the shift of an open-economy Phillips curve. Instead, in a relatively open (small ϕ) economy, a change in the rate of externally-sourced inflation, generated by a change in world inflation p^w or in the rate of depreciation of the exchange rate s, can be a far more potent influence on the position of the Phillips curve than any expectations revision. Moreover, the above specification of the Phillips curve highlights the fact that the common practice of abstracting from externally-generated shifts in the short-run Phillips curve in open-economy monetary analysis is predicated on (relative) purchasing-power parity, since substituting $q^w = p$ in (3) gives the familiar closed-economy specification of the short-run Phillips curve:

$$p = p^e + \beta(y - y_0 - u)$$

A Flex-Price Vision

In a flex-price economy, output of non-tradeables is produced according to a decreasing-returns production function $y = f(n)$ where $f' > 0$, $f'' < 0$. The representative firm operating under decreasing returns will hire labour up to the point where its value-added marginal-revenue product is equal to the nominal wage rate. Hence, its demand for labour can be characterised as:

$$n^d = n^d\left(\frac{W}{P - \zeta Q^w}\right) \qquad n_1^d < 0$$

where Q^w $(= SP^w)$ is the domestic-currency price of tradeable intermediates which are assumed to be used in a fixed proportion ζ to the level of output y. Note that, if all imports are treated as intermediates, then the economy's GDP exceeds this measure of output by the foreign trade surplus. For analytical simplicity, this distinction is neglected; the trade surplus is taken to be sufficiently small for y to be a good proxy for GDP.

Using Friedman's representation, that workers base their labour-supply decision on the expected real wage rate, the labour-supply function can be specified as:

$$n^s = n^s\left(\frac{W}{P^e}\right) \qquad n_1^s > 0$$

Short-run employment outcomes are given by the labour-market equilibrium condition $n^d = n^s \ (= n)$ as:

$$n = n\left(\frac{P}{P^e}, \frac{Q^w}{P}\right) \qquad n_1 > 0,\ n_2 < 0$$

For, if there were, say, an unexpected fall in the inflation rate (a fall in the ratio P/P^e) then workers would reduce their labour supply at the existing real wage rate because of their perception that the real wage rate will be lower than it actually is. Workers' incorrect belief that the inflation rate will be higher results in the labour market clearing at a higher real wage rate and lower level of employment. Similarly, if input-price inflation were to exceed output-price inflation (a rise in the real exchange rate Q^w/P) firms would reduce their demand for labour at the existing real wage rate and, as a consequence, both the real wage rate and employment would fall.

Consider the following log-linear specification of this employment function:

$$\phi \ln\frac{P}{P^e} = (1-\phi)\ln\frac{Q^w}{P} + \phi\gamma n \qquad 0 \le \phi < 1,\ \gamma > 0$$

where, as in the fix-price vision, ϕ decreases with the openness of the economy. The natural level of employment is defined as the level of employment consistent with an invariant real exchange rate given $P^e = P$, that is, n_0 must satisfy:

$$0 = (1-\phi)\ln\frac{Q_{-1}^w}{P_{-1}} + \phi\gamma n_0$$

Subtracting these two equations gives the open-economy Phillips curve in *n-p* space as:

$$p = \phi p^e + (1-\phi)q^w + \phi\gamma(n - n_0)$$

where $p \approx \ln P - \ln P_{-1}$, $p^e \approx \ln P^e - \ln P_{-1}$ and $q^w \approx \ln Q^w - \ln Q_{-1}^w$.

The corresponding linearised curve in *y-p* space is obtained by substituting from a first-order Taylor's series expansion of the production function $y = f(n)$ about the natural level of employment:

$$y = y_0 + f'(n_0)(n - n_0) + u$$

where u measures the error of the approximation, ie.

$$p = \phi p^e + (1-\phi)q^w + \phi\beta(y - y_0 - u) \tag{3a}$$

where $\beta = \dfrac{\gamma}{f'(n_0)} > 0$

In any given time period, this representation is identical to the fix-price one in (3). Here the error term embodies the productivity shifts implied by the decreasing-returns production function as output fluctuates around the natural level.

The Long-Run Phillips Curve

By setting $p^e = p$ in (3), the long-run Phillips curve for an open economy is obtained as:

$$p = q^w + \frac{\phi\beta}{1-\phi}(y - y_0 - u) \tag{4}$$

which, in general, has a finite positive slope in *y-p* space, thereby preserving part of the trade-off exhibited by the short-run curve. This residual trade-off decreases as the openness of the economy diminishes and in two limiting cases:

- a closed economy with less-than-perfect wage flexibility ($\phi \to 1,\ \beta < \infty$)
- perfect wage flexibility in an open economy ($\beta \to \infty,\ \phi < 1$)

ultimately vanishes. Again, the common presumption that the long-run Phillips curve is vertical in an open ($\phi < 1$) economy with less-than-perfect wage flexibility rests on the purchasing-power-parity assumption.

In the absence of any productivity shocks ($u = 0$), a pivotal long-run property of the open-economy Phillips curve (4) is:

$$p \gtrless q^w \quad \Leftrightarrow \quad y \gtrless y_0$$

which means that declining international competitiveness ($p > q^w$) will be associated with an output level in excess of its natural level. Similarly, increasing international competitiveness ($p < q^w$) will be associated with output below the natural level. On the premise that the market-determined natural level of output will generally lie below the level y^* desired by society, ie.

$$y^* = y_0 + v \qquad\qquad v \geq 0 \qquad\qquad (5)$$

it is this property which gives rise to the potential for a conflict of objectives when the economy's inflation target

$$p^* \leq q^w$$

is set so as to maintain the existing degree of, or to deliver a pre-determined gain in, international competitiveness.

The Optimal Disinflation Strategy

The policy-maker is presumed to share society's objective of minimising the costs z associated with deviations of output y and the inflation rate p from their desired values y^* and p^* respectively, ie. the policy-maker's solves society's decision problem:

$$\text{minimise} \qquad z^s = \mu(y - y^*)^2 + (1 - \mu)(p - p^*)^2 \qquad\qquad 0 \leq \mu \leq 1 \qquad\qquad (6)$$

$$\text{subject to} \qquad p = \phi p^e + (1 - \phi)q^w + \phi\beta(y - y^* + v - u) \qquad\qquad (7)$$

taking expectations and the track of world inflation as given. Further, the rate of depreciation of the exchange rate s is also taken as pre-determined on the presumption that the monetary authorities operationalise policy via an exchange-rate target zone. Indeed, in spite of vigorous official claims to the contrary, there is now little doubt that the floating exchange rate regimes in small, open economies, such as those of Australia and New Zealand, are managed, albeit indirectly managed, within a "zone of comfort". The first term in the objective function captures the costs associated with increased unemployment as output falls while the second term reflects the costs associated with a loss of international competitiveness as a consequence of a rise in the domestic inflation rate. The constraint (7) is obtained by using (5) to eliminate y_0 in (3).

The first-order conditions for a minimum, which require that:

$$y - y^* = -\phi\beta\lambda(p - p^*) \tag{8}$$

on the Phillips curve (7) give the optimal inflation rate as:

$$p = \frac{\phi p^e + (1-\phi)q^w + \phi^2\beta^2\lambda p^* + \phi\beta v - \phi\beta u}{1+\phi^2\beta^2\lambda} \tag{9}$$

where $\lambda = (1-\mu)\mu^{-1}$.

If expectations are fully rational then

$$p^e = \mathrm{E}_{-1}(p)$$

where E_{-1} is the mathematical expectations operator conditional on the information available at the end of the previous period, then, from the mathematical expectation of (9), it follows that the expected rate of inflation is:

$$p^e = p + \frac{\phi\beta u}{1+\phi^2\beta^2\lambda}$$

and, hence, the time-consistent optimal inflation rate for society is:

$$p^s = \frac{(1-\phi)q^w + \phi^2\beta^2\lambda p^* + \phi\beta v}{1-\phi+\phi^2\beta^2\lambda} - \frac{\phi\beta u}{1+\phi^2\beta^2\lambda} \tag{10}$$

Figure 1 depicts this optimal inflation rate for a zero-inflation target $p^* = 0$ given $u = 0$ and $v > 0$. The time-inconsistent status of a zero-inflation target in a closed economy, depicted in Figure 2, is replicated in an open economy. There is an incentive for the monetary authorities to renege on a commitment to zero inflation and to pursue a path along the short-run Phillips curve, since points along this trajectory are superior to a zero-inflation rate at output y_2. If they were to renege, then higher inflation rates would trigger a revision of inflation expectations upwards and the economy would subsequently come to rest at the time-consistent rate p^s at output y_1 ($> y_2$). However, in contrast to the case of a closed economy, the finite slope of the long-run Phillips curve may mean that zero inflation is inferior to the time-consistent optimal rate, as is the case in Figure 1. It is in this sense that a zero-inflation target may be not only infeasible but also sub-optimal.

Abstracting from productivity shocks ($u = 0$) and the likelihood that the desired level of output may exceed the market-determined level ($v = 0$), it follows that the optimal rate of inflation for an open economy is a weighted average of the targetted and external inflation rates, ie.

$$p^s = \frac{(1-\phi)q^w + \phi^2\beta^2\lambda p^*}{1-\phi+\phi^2\beta^2\lambda} \quad \in \quad \left(p^*, q^w\right]$$

In contrast to the case of a closed ($\phi = 1$) economy, where the optimal inflation rate coincides with the targetted rate for $u = v = 0$, the optimal inflation rate for an open economy will generally exceed the target rate by a margin which increases as the openness of the economy increases (as ϕ decreases), as the labour-market flexibility decreases (as β falls), or as society places a higher weight on the output objective (as λ falls). The closed-economy result can be replicated by setting the inflation target to the rate of externally-sourced inflation ($p^* = q^w$) so that the above interval collapses to a point as illustrated in Figure 3. This strategy would leave the traded-goods sector fully exposed to terms-of-trade shocks since movements in real export and import prices are given respectively by

$$q^x - p^* = \left(1 - \frac{\psi}{1-\phi}\right)t \quad \text{and} \quad q^z - p^* = -\frac{\psi}{1-\phi}t$$

where $t = p^x - p^z$ = the logarithmic derivative of the country's terms of trade:

$$T = \frac{P^x}{P^z} = \frac{Q^x}{Q^z}$$

But, even in this special case, an adverse productivity shock ($u < 0$) or an output target in excess of the market-determined level ($v > 0$) will raise the optimal inflation rate above its targetted rate except for two limiting cases:

- $p^s \to p^*$ as $\beta \to \infty$

that is, perfect wage flexibility in an open economy replicates the vertical long-run Phillips curve of a closed economy and thus the optimality of the target rate of inflation;

- $p^s \to p^*$ as $\lambda \to \infty$ ($\mu \to 0$)

that is, as society places a zero weight on the output target, thereby opting for a horizontal indifference map, implying that a zero-inflation target, as depicted in Figure 4, is not only optimal but also time-consistent.

These two observations provide a theoretical underpinning for the *Employment Contracts Act 1991* and the *Reserve Bank of New Zealand Act 1989*. The 1989 legislation narrowed the focus of New Zealand monetary policy to the primary objective of price stability. For, as noted above, a zero-inflation target (defined as 0 to 2 percent annual increase in the Consumer Price Index) is optimal when output does not enter the policy-makers' loss function.

However, when output is an argument in the loss function, optimality of a zero-inflation target requires, not only that $u = v = 0$, but also that the monetary authorities set the track of the nominal exchange rate to insulate the domestic inflation rate from movements in world inflation, that is:

$$p^s = p^* = 0 \quad \text{for} \quad s : q^w = s + p^w = 0$$

This operating strategy would shift the long-run Phillips curve down to intersect the natural level of output at a zero inflation rate, as illustrated in Figure 5. But, as with a relative inflation target, the policy framework exposes the traded-goods sector to the full force of terms-of-trade shocks since

$$q^w = 0 \quad \Rightarrow \quad q^x = \left(1 - \frac{\psi}{1-\phi}\right)t \quad \text{and} \quad q^z = -\frac{\psi}{1-\phi}t$$

For example, a deterioration in the terms of trade ($t < 0$) causes domestically-denominated export prices to fall as import prices rise. A zero-inflation target is not superior to a relative inflation target. Both strategies deliver identical terms-of-trade shocks to the traded-goods sector; the fortunes of the traded-goods sector are determined entirely by the rest of the world.

When expectations are not strictly rational the inflation process will exhibit some inertia. Following Walsh (1991), and in accordance with the empirical record (RBNZ Survey of Expectations, 1987-93), a degree of inertia, which increases with the parameter α, is embedded in the general expectations mechanism:

$$p^e = \alpha p_{-1} + (1-\alpha)\mathrm{E}_{-1}(p) \qquad 0 \le \alpha \le 1$$

Rational expectations ($\alpha = 0$) and adaptive expectations ($\alpha = 1$) emerge as special cases of the above mechanism. A reworking of the expectations calculus under this hypothesis gives the expected inflation rate as:

$$p^e = \alpha p_{-1} + (1-\alpha)p + \frac{(1-\alpha)\phi\beta u}{1+\phi^2\beta^2\lambda} \tag{11}$$

and the time-consistent optimal inflation rate as:

$$p^s = \frac{\alpha\phi p_{-1} + (1-\phi)q^w + \phi^2\beta^2\lambda p^* + \phi\beta v}{1-(1-\alpha)\phi + \phi^2\beta^2\lambda} - \frac{\phi\beta u}{1+\phi^2\beta^2\lambda} \tag{12}$$

which, for $u = 0$ and a constant value of q^w ($= q^*$ say), converges to the inertia-free rate (10). In particular, for $u = v = 0$, the optimal inflation rate converges on the interval bounded by the target rate and the constant rate of externally-sourced inflation, ie.

$$p^s \rightarrow \frac{(1-\phi)q^* + \phi^2\beta^2\lambda p^*}{1-\phi+\phi^2\beta^2\lambda} \in \left(p^*, q^*\right]$$

with a speed which increases as the parameter $\alpha\phi[1-(1-\alpha)\phi+\phi^2\beta^2\lambda]^{-1}$ decreases. Hence, not only will the point of convergence shift towards the targetted inflation rate, but also the speed of convergence to that rate will accelerate as labour-market flexibility increases (an increase in β) or as society reduces the weight attached to the output target (an increase in λ). Further, although the point of convergence is independent of the degree of inertia embodied in the parameter α, the speed of convergence is not. Increased inertia slows the speed at which the optimal inflation rate converges to the inertia-free rate.

However, if the degree of wage flexibility is small (β is sufficiently small for second-order terms to be neglected) inflation is, essentially, inertial. When society places a non-trivial weight on the output target the optimal inflation rate will approximate the externally-sourced rate q^*. In other words, the optimal rate will tend towards the rate of externally-sourced inflation irrespective of the targetted rate. Hence, simple logic dictates that, if the degree of labour-market flexibility is small, the targetted rate should be in the neighbourhood of the externally-sourced inflation rate. Again, for a zero-inflation target to be optimal the monetary authorities must set the track of the nominal exchange rate to appreciate at the same rate as world inflation. This strategy would ultimately insulate domestic inflation from world inflation leaving the fortunes of the traded-goods sector to be dictated by the terms of trade. But, if this strategy were adopted in the face of an output target in excess of the market-determined level ($v > 0$), then a zero-inflation target would again be sub-optimal. For, (12) implies that, given $u = 0$, the optimal inflation rate converges to a positive value:

$$p^s \to \frac{\phi\beta\nu}{1-\phi+\phi^2\beta^2\lambda} > 0 \quad \text{for} \quad p^* = q^* \, (= s + p^w) = 0$$

Unless society places a zero weight on the output target, a zero inflation rate will be sub-optimal when inflation is essentially inertial.

The Optimal Preferences of the Monetary Authorities

The above analysis was conducted on the presumption that the policy-maker and society have identical loss functions. But, under legislation such as the *Reserve Bank of New Zealand Act 1989* which sets price stability as the primary objective of monetary policy, the policy-maker may place a zero weight on the output objective even though society attaches a non-trivial weight to that objective. Following Rogoff (1985) and Walsh (1991), this section considers the conditions under which it is optimal for the preferences of the monetary authorities to deviate from those of society.

Suppose monetary policy in an open economy with a degree of inflation inertia α is conducted on the basis of the policy-maker's loss function:

$$z^m = \tilde{\mu}(y - y^*)^2 + (1-\tilde{\mu})(p - p^*)^2 \qquad\qquad 0 \le \tilde{\mu} \le 1$$

where $\tilde{\mu}$ is the weight the policy-maker attaches to the output objective. Reworking the above analysis gives the time-consistent optimal inflation rate as:

$$p^m = \frac{\alpha\phi p_{-1} + (1-\phi)q^w + \phi^2\beta^2\tilde{\lambda}p^* + \phi\beta\nu}{1-(1-\alpha)\phi+\phi^2\beta^2\tilde{\lambda}} - \frac{\phi\beta u}{1+\phi^2\beta^2\tilde{\lambda}} \tag{12a}$$

where $\tilde{\lambda} = (1-\tilde{\mu})\tilde{\mu}^{-1}$.

The superscript m replaces the superscript s in order to denote that this optimal rate of inflation is based on the monetary authorities' preferences, not society's as in (12). The loss society can expect if monetary policy is operated according to the policy-makers preferences is obtained by substituting (5), (8) and (12a) into (6) , ie.

$$\frac{z^s}{\mu} = \left(\phi^2\beta^2\tilde{\lambda}^2 + \lambda\right)\left[\frac{\pi_{-1}}{1-\phi(1-\alpha)+\phi^2\beta^2\tilde{\lambda}} - \frac{\phi\beta u}{1+\phi^2\beta^2\tilde{\lambda}}\right]^2$$

and then taking the mathematical expectation:

$$E_{-1}\left(\frac{z^s}{\mu}\right) = \left(\phi^2\beta^2\tilde{\lambda}^2 + \lambda\right)\left[\frac{\pi_{-1}^2}{\left[1-\phi(1-\alpha)+\phi^2\beta^2\tilde{\lambda}\right]^2} + \frac{\phi^2\beta^2\sigma_u^2}{\left[1+\phi^2\beta^2\tilde{\lambda}\right]^2}\right]$$

where $\pi_{-1} = (1-\phi)(q^w - p^*) + \phi\alpha(p_{-1} - p^*) + \phi\beta v$

and σ_u^2 = the variance of the supply shock u.

The first-order condition for a minimum, obtained by differentiating with respect to $\tilde{\lambda}$, is:

$$\frac{[1-\phi(1-\alpha)]\tilde{\lambda} - \lambda}{\left[1-\phi(1-\alpha)+\phi^2\beta^2\tilde{\lambda}\right]^3}\pi_{-1}^2 + \frac{\phi^2\beta^2(\tilde{\lambda}-\lambda)}{\left[1+\phi^2\beta^2\tilde{\lambda}\right]^3}\sigma_u^2 = 0$$

In the presence of supply shocks ($\sigma_u^2 > 0$), since the denominators are both positive, the first-order condition requires that the first term be negative and the second term positive, ie.

$$\tilde{\lambda} \in \left(\lambda, \frac{\lambda}{1-\phi(1-\alpha)}\right)$$

Since $\phi(1-\alpha) < 1$, it follows that it is optimal for the monetary authorities to place a higher weight on inflation than society, ie.

$$\tilde{\lambda} > \lambda$$

Several interesting conclusions emerge from the observation that optimality requires that $\tilde{\lambda}$ lie on this open interval. The first relates to the role of inertia in the inflation process. As the degree of inertia rises the interval contracts until, in the limiting case when inflation is entirely inertial ($\alpha = 1$), it collapses to the point λ. Walsh's closed-economy result, that it is optimal for the monetary authorities to mirror society's preferences ($\tilde{\lambda} = \lambda$) when inflation is entirely inertial, carries over to an open economy.

The second issue relates to the openness of the economy. As an economy becomes more open (as ϕ falls) again the interval contracts until, in the limit as $\phi \to 0$, it collapses to the point λ. Moreover, the closed-economy results, derived by Rogoff (1985) and Walsh (1991):

$$\tilde{\lambda} = \frac{\lambda}{\alpha} \geq \lambda$$

are obtained as a limiting case of the open-economy result by setting $\phi = 1$. In particular, in the absence of any inflation inertia ($\alpha = 0$) in a closed economy, it is optimal for the monetary authorities to place a zero weight on the output objective ($\tilde{\lambda} \to \infty$).

In the absence of supply shocks

$$\sigma_u^2 = 0 \quad \Rightarrow \quad \tilde{\lambda} = \frac{\lambda}{1 - \phi(1 - \alpha)} > \lambda$$

But note how the optimal weight declines as the degree of inertia α increases and, as a limiting case when inflation is entirely inertial ($\alpha = 1$), it is optimal for the monetary authorities to mirror society's preferences ($\tilde{\lambda} = \lambda$).

Finally, the above analysis highlights the conditions that must obtain ($\phi \to 1,\ \alpha = 0$) for it to be optimal for the monetary authorities to place a zero weight on the output and employment objective ($\tilde{\lambda} \to \infty$) when society attaches a non-trivial weight to the objective ($\lambda < \infty$); the economy must be closed and inertia free.

Conclusion

This paper demonstrates that, in general, an absolute inflation target, such as the 0 to 2 percent target adopted by the New Zealand monetary authorities, is sub-optimal. Moreover, zero inflation is not even unambiguously superior to the time-consistent inflation rate as is the case in a closed economy. The time-consistent optimal inflation rate in an open economy is shown to be positive even when output is targetted at the market-determined natural level and, in the absence of productivity shocks, to lie on an interval bounded by the (zero) target rate and the rate of externally-sourced inflation. The optimal inflation rate decreases as the degree of labour-market flexibility increases or when a greater weight is given to inflation in the policy-maker's (and society's) objective function. In particular, a zero inflation rate satisfies the optimality conditions only if output does not enter the policy-maker's objective function. This observation provides a theoretical rationale for the Policy Targets Agreement of 0 to 2 percent under the

Reserve Bank of New Zealand Act 1989. When inertia characterises the inflation process, the optimal properties of the inertia-free system are shown to hold asymptotically.

The second part of the paper demonstrates that, when the policy-maker's preferences differ from those of society, the optimal choice of weights depends on three key characteristics of the economy: the degree of expectational inertia, the openness of the economy and the degree of labour-market flexibility. Any notion of optimality under the *Reserve Bank of New Zealand Act 1989* must be predicated on a closed economy without any inertia in the inflation process. In effect, by abstracting from the reality that New Zealand is a relatively open economy[1] with a significant degree of expectational inertia[2], the legislation requires the New Zealand monetary authorities to deliver a sub-optimal policy regime.

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1 In 1990 exports were 27% of GDP while imports were 28% of GDP.

2 See Reserve Bank of New Zealand Survey of Expectations 1987-93.

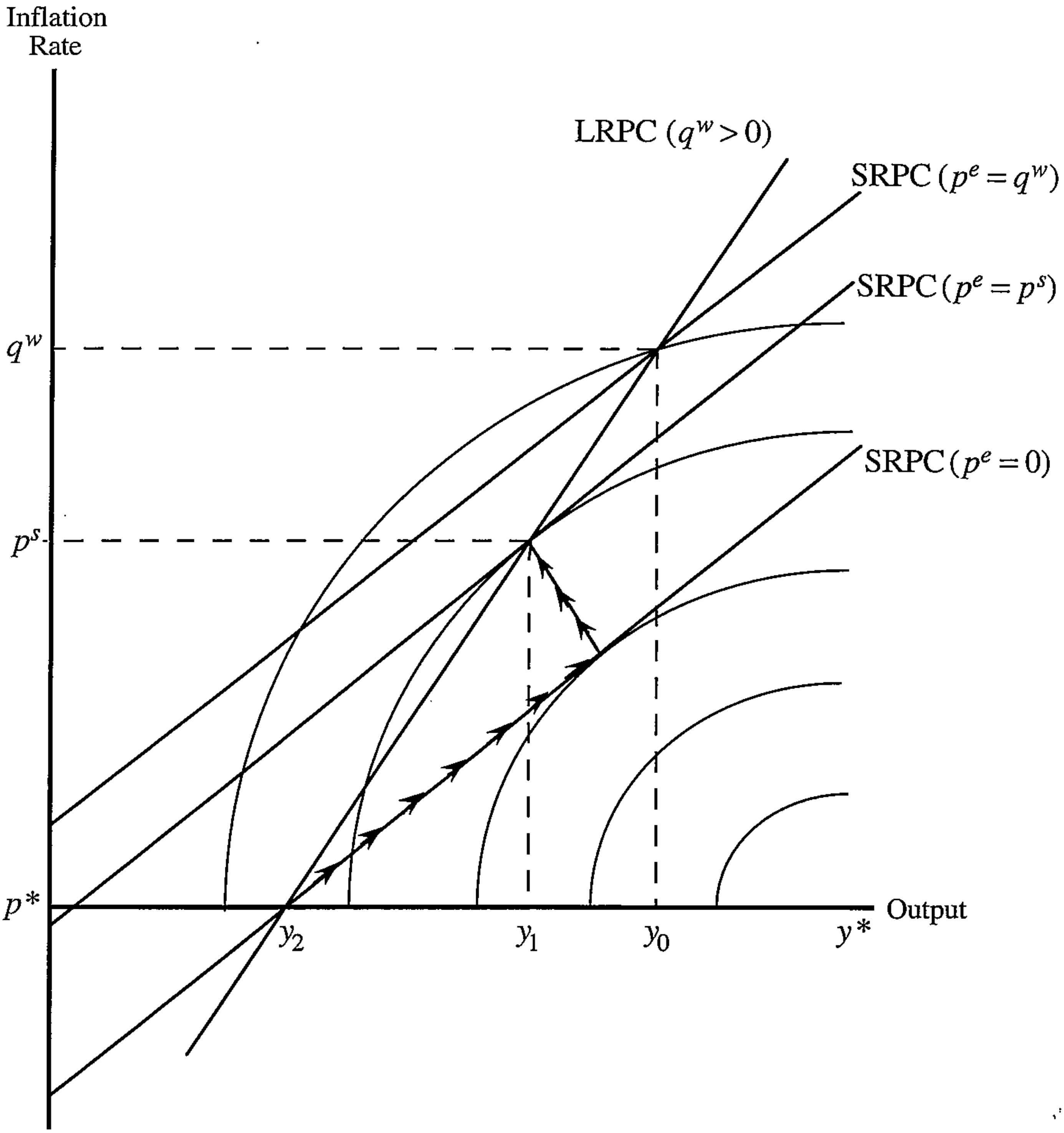
Inflation Rate
LRPC ($q^w > 0$)
SRPC ($p^e = q^w$)
SRPC ($p^e = p^s$)
SRPC ($p^e = 0$)
q^w
p^s
p^*
Output
y_2
y_1
y_0
y^*

Figure 1

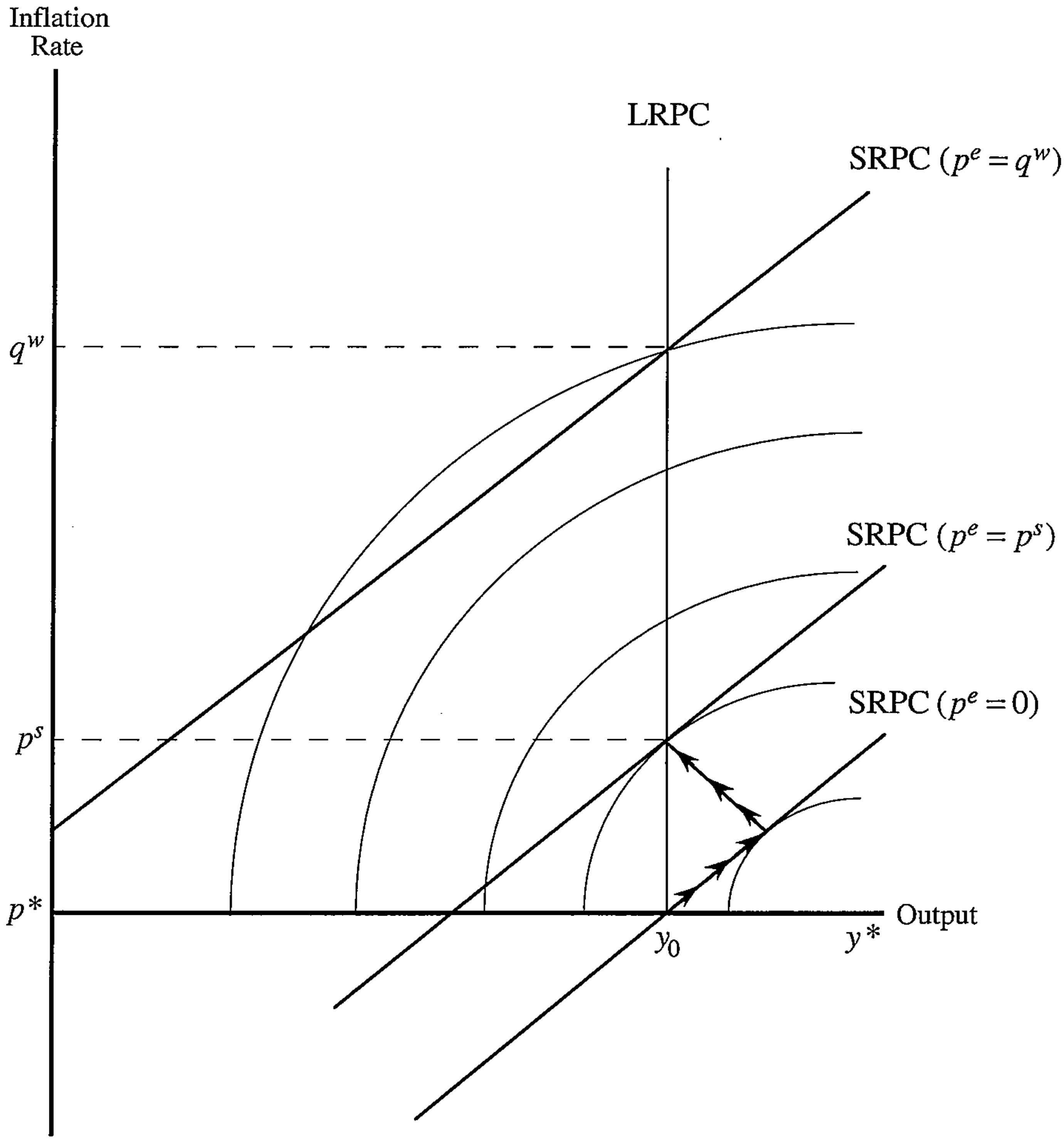
Inflation Rate
LRPC
SRPC ($p^e = q^w$)
SRPC ($p^e = p^s$)
SRPC ($p^e = 0$)
q^w
p^s
$p*$
Output
y_0
$y*$

Figure 2

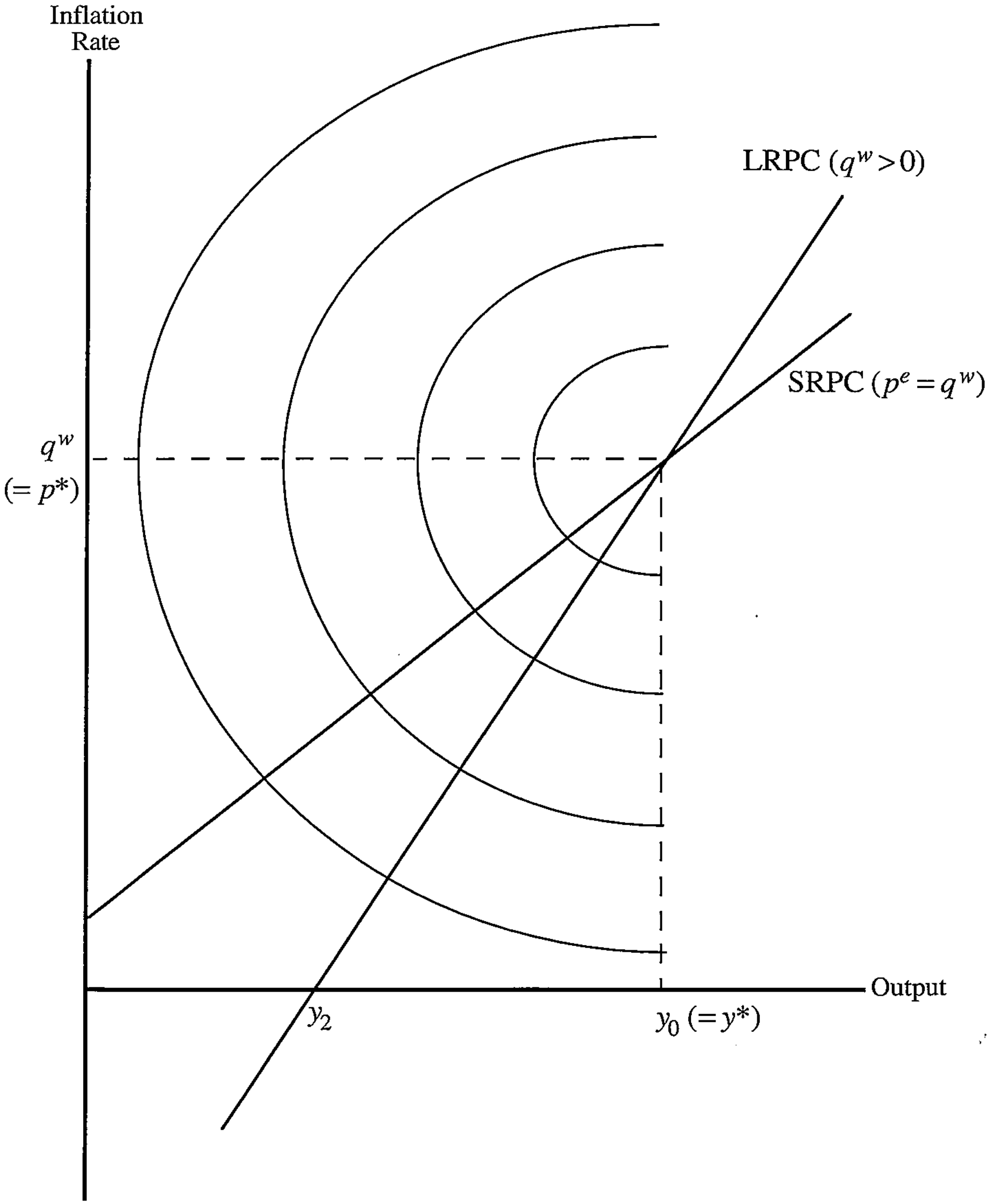

Figure 3

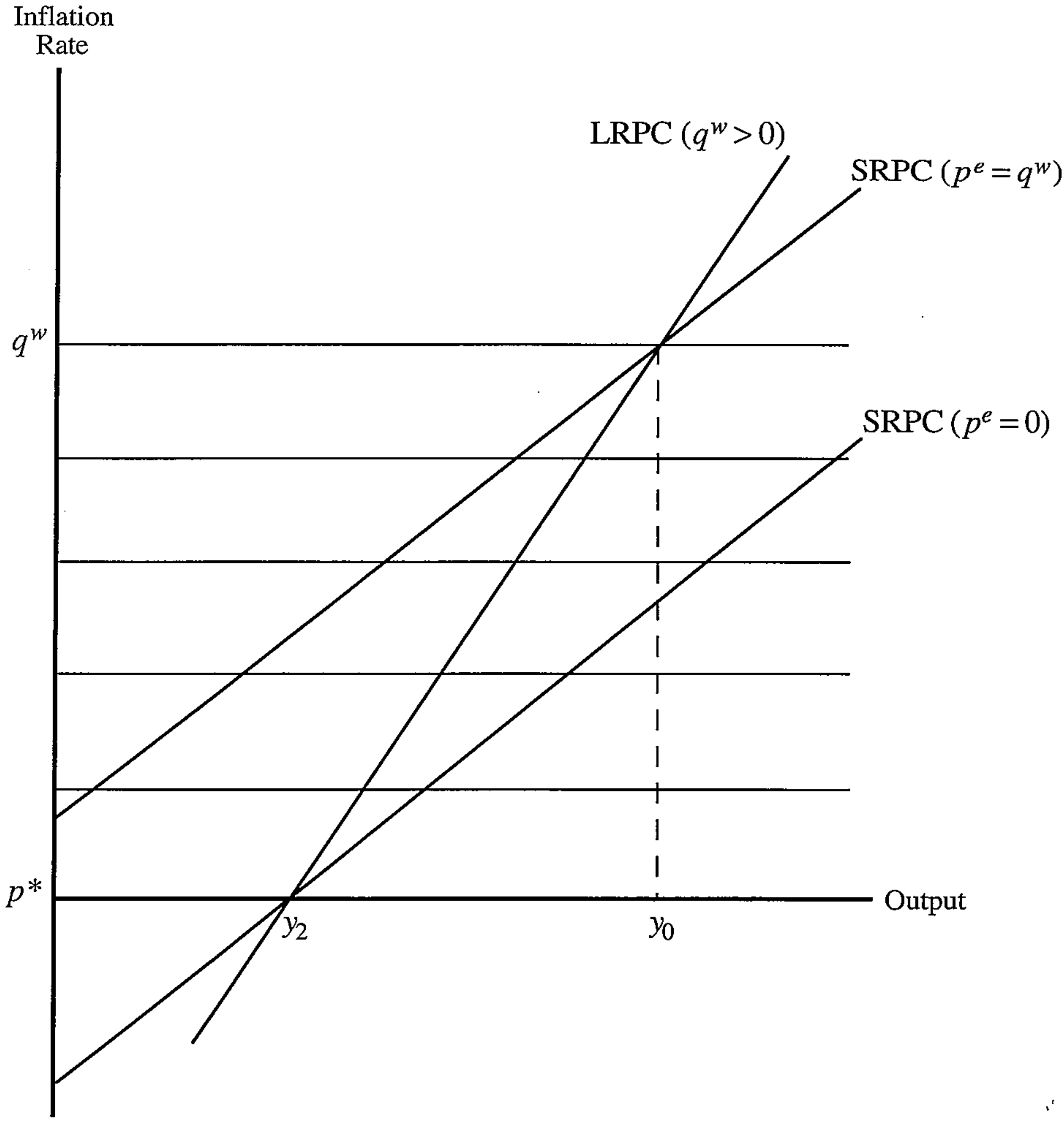

Figure 4

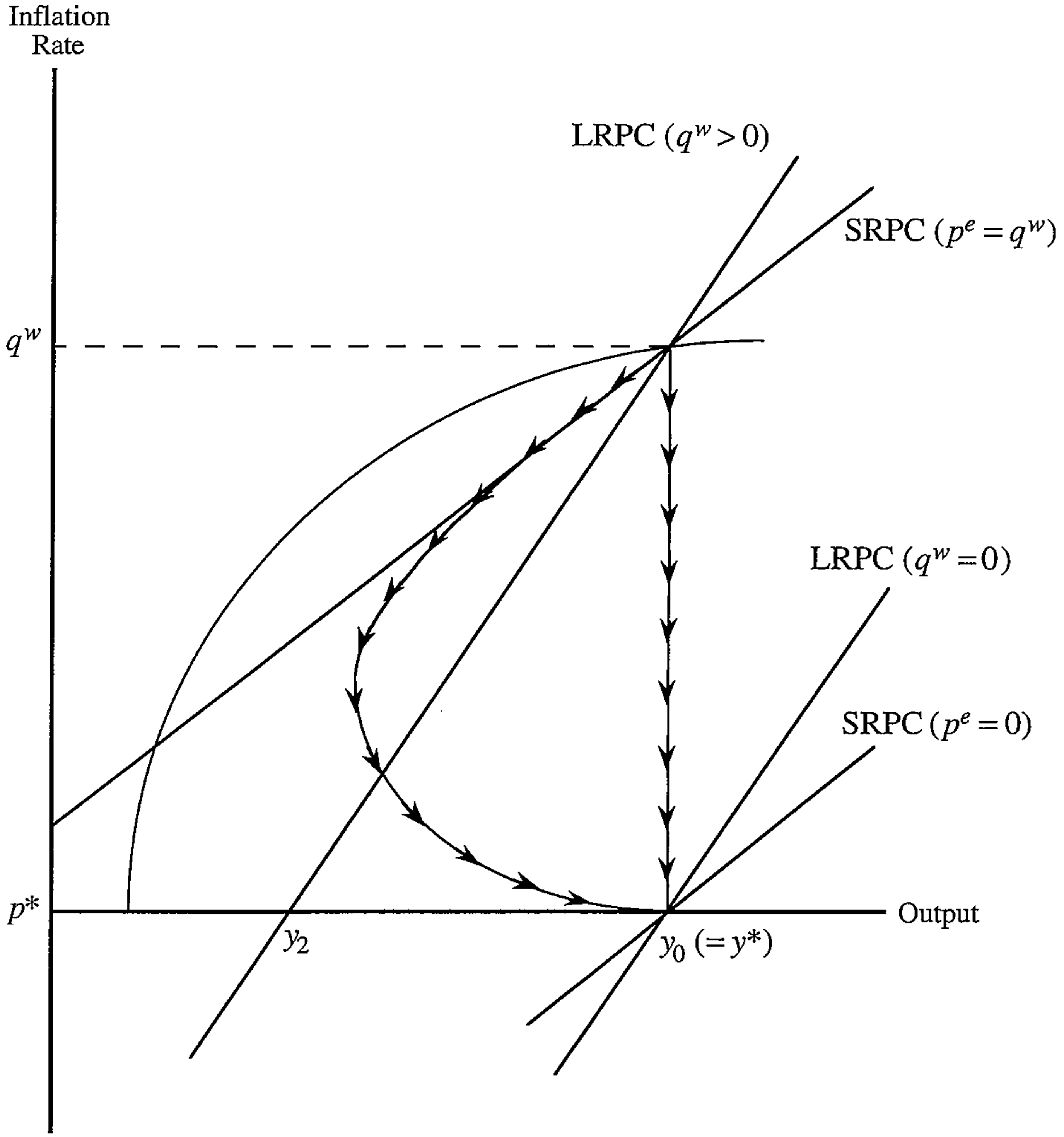
Inflation
Rate
LRPC ($q^w > 0$)
SRPC ($p^e = q^w$)
q^w
LRPC ($q^w = 0$)
SRPC ($p^e = 0$)
p^*
Output
y_2
y_0 ($= y^*$)

Figure 5

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