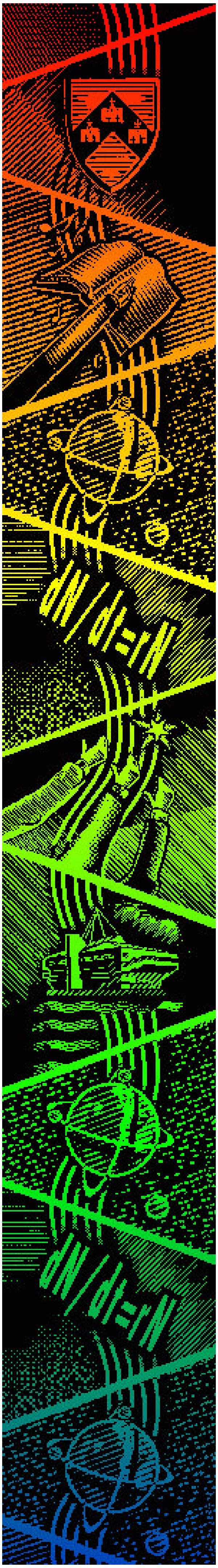

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Disinflation Dynamics in an Open Economy General Equilibrium Model

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Abstract

This paper studies money based and exchange rate based disinflation in an open economy model with explicit microfoundations. For benchmark parameter values, it is found that a money slowdown leads to a recession in the short run whereas exchange rate based disinflation leads to very rapid adjustment with minimal real effects. This corresponds to the results of directly postulated models. Overshooting of the exchange rate in response to a money slowdown, however, only occurs when there is pricing-to-market behavior. It is found that by varying certain key parameter values such as the intertemporal rate of discount and the degree of price inertia, exchange rate based stabilization can produce substantial real effects. This contrasts with the results of directly postulated models and is related to issues highlighted by the introduction of microfoundations.

1 Introduction

Disinflations are often regarded as being an important cause of recessions and other economic dislocations. The main aim of this paper is to investigate the

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real effects of disinflation in an open economy. This paper extends previous literature which has emphasized the importance of microfoundations in analyzing the real effects of disinflation in a closed economy setting. In the context of an open economy, policy makers have a choice between basing an inflation stabilization programme on a reduction in money growth or on an exchange rate peg. The comparison between these two options will be a central theme of this paper.

The view that disinflation is always costly is often based on the assumption of nominal rigidities. The staggered-contracts approach of Fischer (1977) and Taylor (1979, 1980), where wage contracts are preset for a number of periods, has been especially important in these explanations. However while some authors argue that staggered price-setting alone makes disinflation costly, others disagree.

The real effects of disinflation potentially arise from two different sources. One is the reduction in the nominal interest rate that accompanies the disinflation. This leads to an increase in demand for real balances which can only be realized with a fall in the price level. The other potential source of real effects is the presence of staggered wage/price setting. A key issue in the literature is the extent to which the second channel contributes to the real effects of disinflation. Some authors like Blanchard and Summers (1988) argue that staggering makes output losses inevitable during disinflation. Others like Taylor (1983) and Fischer (1986) argue that a fully credible disinflation policy, taking into account the structure of labour contracts, could reduce inflation with no output cost.[1] Therefore these authors argue that staggered adjustment itself does not lead to real effects of disinflation.

A recent restatement of the view that disinflation has no output costs is made by Ball (1994). He analyses the real effects of a credible disinflation using Taylor contracts and questions whether staggered preset pricing is an important barrier to costless disinflation. He concludes that with full credibility costless disinflation is indeed possible (though not instantaneous as claimed for instance by Buiter and Miller (1985)). In fact Ball goes as far as to argue that a credible permanent reduction in the rate of growth of money supply within a staggered wage model could lead to a boom. Thus Ball finds that the staggered nature of price adjustments is not enough on its own to explain why actual disinflations are costly. Accordingly, Ball and

[1] In this context inflation may only be reduced *gradually* and it must be almost constant for a few years after disinflation is announced

others like Miller and Sutherland (1993) have concluded that the main reason why disinflations lead to prolonged recessions is lack of credibility.

A common feature of all the above mentioned literature is that it uses models which are directly postulated and lacking in explicit microfoundations. Recent work by Ascari and Rankin (1997) emphasizes the importance of microfoundations and shows that the result that disinflation in staggered pricing models causes a boom is significantly altered once microfoundations are taken into account. They ask whether introducing microfoundations replicates Ball and others' conclusion and whether it explains Ball's (1994) disinflation puzzle (i.e. that disinflations cause booms) without needing to resort to additional factors like the lack of credibility. Ascari and Rankin look at the output costs of a reduction in monetary growth in a dynamic general equilibrium model with staggered wages in a closed economy with microfoundations. Their analysis suggests that directly postulated models, which lack internal consistency and dynamic optimizing behavior in all sectors, have dismissed important features of disinflation dynamics by resorting to simplifying assumptions. Directly postulated models also seem to run into certain parameter restrictions which become apparent when microfoundations are introduced. More importantly, Ascari and Rankin's findings show that disinflations, unanticipated or announced, unambiguously cause a slump and that preannounced inflation is unable to cause a boom. Ball's and other authors' results are found to depend on an important simplifying assumption which is that agents do not discount the future when setting contract prices. Once this simplifying assumption is dropped Ascari and Rankin show that staggering in itself can imply that disinflation has substantial real effects. Ascari and Rankin also show that microfoundations have important implications for the way that disinflation affects money demand and thus aggregate demand.

The shared feature of the above debate is that it has evolved in the context of a closed economy analysis. Parallel questions obviously arise in the context of open economies. The early literature on the real effects of disinflation in open economies was based on modified versions of the simple Dornbusch model. Buiter and Miller (1982) used a framework of this type and found that disinflation programmes based on monetary targeting led to the strong appreciation of the domestic currency and recession in the domestic economy in the short run. Further developments in the literature, for example Miller and Sutherland (1993), who again used a modified version of the simple Dornbusch model, found that stabilization programmes based on using the exchange rate as a nominal anchor produced very rapid adjustment of inflation and virtually no output costs. This contrast between the real effects of money and exchange rate based disinflation has been a central issue in the international macroeconomics literature on disinflation.[2] Hence it is an important theme of this paper.

The key mechanism which produces the difference between the output effects of money based stabilization and exchange rate based stabilization is the link between the nominal interest rate and the demand for real balances. A reduction in the rate of inflation implies a fall in the nominal interest rate which in turn implies an increase in the demand for real balances. In a money based stabilization, where the nominal money supply is fixed, the required increase in real balances can only come about through a reduction in the price level. A recession is required to generate this fall in the price level. In an exchange rate based stabilization, the nominal money supply is endogenous and automatically accommodates the increase in the demand for real balances that follows a fall in the nominal interest rate.

In effect the open economy debate on disinflation is drawing attention again to the issue at the centre of the closed economy debate, namely the importance of staggered price setting *per se* as a cause of real effects. It is clear that exchange rate based stabilization will only have real effects to the extent that staggered price setting is a cause of such effects. It follows from Ascari and Rankin (1997) that microfoundations will be particularly important in this context.

The above discussion of the present state of the literature shows that a study of the effects of money based and exchange rate based disinflation in an open economy model with explicit microfoundations is very relevant. This is the main objective of this paper.

Recent developments in macroeconomics have emphasized the importance of imperfect competition and nominal rigidities within a framework of intertemporal optimizing consumers. One of the main examples of this paradigm within the context of open economy analysis has been a seminal paper by Obstfeld and Rogoff (1995). The model used in this paper is a modified version of Obstfeld and Rogoff (1995) and is essentially a general

[2] The contrasting real effects of money based and exchange rate based disinflation has been central to the literature inspired by the stabilization programmes implemented by Latin American countries facing high and persistent inflation in the late 1970s and 80s. This literature has indeed shown that there are major differences between the real effects of money based and exchange rate based disinflation. See Calvo and Végh (1998) for a comprehensive survey of this literature.

equilibrium model combining nominal rigidities and imperfect competition into an intertemporal optimizing framework. The specific form of price stickiness is the overlapping price contracts structure described by Calvo (1983).[3]

An initial comparison between money and exchange rate based disinflation using benchmark parameter values shows that the model reproduces some of the standard results of previous studies. For instance a money slowdown produces a recession in the short run whereas exchange rate based disinflation leads to very rapid adjustment with minimal real effects. The model however does not produce any overshooting of the exchange rate of the type found in Buiter and Miller(1983).

One of the special features of the benchmark model is the assumption of purchasing power parity(PPP). Extensive empirical evidence has shown that real exchange rates display large and persistent deviations from PPP. [4] In this vein Betts and Devereux (1996) present a dynamic general equilibrium model combining the concept of pricing-to-market (PTM) with imperfectly competitive firms and sticky prices. They show that PTM coupled with sticky nominal prices magnifies the effects of monetary shocks on the exchange rate and dampens the expenditure switching role of exchange rate changes. This suggests that PTM could have important implications in the analysis of inflation stabilization in an open economy model. These implications could be especially important for the effects of money based stabilization where the exchange rate acts as one of the main transmission mechanisms of the monetary slowdown. Therefore the second step taken in this paper is to look at the implications of PTM for disinflation dynamics. It is found that the presence of PTM produces overshooting of the exchange rate following a monetary slowdown.

The paper then turns to consider the contribution of staggered contracts to the real effects of disinflation in this open economy model. Ascari and Rankin (1997) have shown that staggered contracts in a microfounded model

[3]The above mentioned literature on the stabilization experiences of Latin American countries has focused on developing theoretical models which generate the key stylized facts observed in these countries. Some of the contributions in this strand of literature have included developing microfoundations, for instance by including intertemporal optimizing consumers. Nevertheless there has been no systematic attempt to examine disinflation in an open economy model with fully worked out microfoundations such as represented by Obstfeld and Rogoff(1995).

[4]Froot and Rogoff (1995) and Rogoff's (1996) survey papers on PPP present extensive empirical evidence on the failure of the law of one price.

can generate substantial real effects from disinflation. The benchmark simulations based on the model presented in this paper show minimal real effects. However, when key parameters (in particular the degree of price inertia and the rate of time preference) are varied it is found that substantial real effects can indeed be generated within this model.

The paper proceeds as follows, section two outlines the model, section three discusses the derivation of the steady state, section four presents the simulation results and section five concludes the paper.

2 The Model

There are two countries of equal size, home and foreign. Foreign country variables are denoted with an asterisk. The two countries are inhabited by a continuum of infinitely lived individual consumers and producers. Households consume a group of differentiated, perishable goods of total measure unity. These goods, produced by firms, are indexed by z on the unit interval. Home country firms produce fraction n goods and foreign firms produce $1-n$ goods.

Firms are assumed to engage in price discrimination according to market destination, i.e. there is PTM. The model assumes that each PTM good is sold exclusively by an individual firm in an imperfectly competitive setting where all firms are price setters. This rules out the possibility of individuals engaging in trade in PTM goods and arbitraging away price differentials between the two countries. Fraction s of firms price discriminate across countries and set prices independently for the home and foreign country, these are called PTM firms. The remaining $1-s$ of firms produce non-PTM goods which are traded freely by consumers in both countries. Price differences in non-PTM goods may be arbitraged away so firms set a single international price. The share of PTM and non-PTM firms is identical in both countries. Complete PTM ($s=1$) implies goods markets are totally segregated. When $s=0$ (there are no PTM goods) there is no market segmentation according to destination, goods markets are completely integrated and PPP holds.

2.1 Households

2.1.1 Preferences and Pricing Structure

Consumers in both countries have the same preferences, defined over a consumption index, real money balances and labour supply. A representative home resident maximizes a utility function that depends on consumption C, real money balances M/P and labour supplied N:

$$U_t = \sum_{s=t}^{\infty} \beta^{s-t} \left[\frac{\sigma}{\sigma - 1} C_s^{\frac{(\sigma-1)}{\sigma}} + \frac{\chi}{1-\epsilon} \left(\frac{M_s}{P_s} \right)^{1-\epsilon} - \frac{\kappa}{\mu} N_s^{\mu} \right] \tag{1}$$

with $0 < \beta < 1$, $\sigma > 0$, $\epsilon > 0$ and $\mu > 1$. Letting $c(z)$ be a home individual's consumption of good z and θ be the elasticity of demand for consumption goods, the consumption index C is:

$$C = \left[\int_0^1 c(z)^{\frac{(\theta-1)}{\theta}} dz \right]^{\frac{\theta}{(\theta-1)}} \tag{2}$$

Domestic consumers face a consumer price index defined as:

$$P_t = \left\{ \int_0^n p_t(z)^{1-\theta} dz + \int_n^{n+(1-n)s} p_t^*(z)^{1-\theta} dz + \int_{n+(1-n)s}^1 \left[E_t q_t^*(z) \right]^{1-\theta} dz \right\}^{\frac{1}{(1-\theta)}} \tag{3}$$

The home country's CPI is made up of a combination of $p_t(z)$ representing the home currency price of the domestically produced good, $p_t^*(z)$ the domestic currency price of a foreign PTM good, and $q_t^*(z)$ the foreign currency price of a foreign non-PTM good. So, p represents home currency prices and q represents foreign currency prices. Prices without asterisks are for home goods and those with asterisks are for foreign goods. E_t is the exchange rate in terms of the domestic unit cost of foreign currency.

World capital markets are assumed to be perfectly integrated, so there is a single world bond market. This implies uncovered interest parity as follows:

$$(1 + i_t) = \frac{E_{t+1}}{E_t} (1 + i_t^*) \tag{4}$$

where i_t denotes the domestic nominal interest rate.

Individuals divide their wealth holdings between holdings of domestic currency and bonds. The government in each country prints money and makes lump sum transfers, T_t. The domestic government budget constraint is $P_t T_t = M_{t-1} - M_t$. Given the above setting for their interactions with financial markets and that consumers receive income from wages $w_t N_t$ and profits Π_t on their ownership of domestic firms, holdings of bonds are governed by the flow budget constraint:

$$D_t = (1 + i_{t-1}) D_{t-1} + M_{t-1} - M_t + w_t N_t - P_t C_t + \Pi_t - P_t T_t \tag{5}$$

2.1.2 Households' Maximization Problem

Domestic households maximize lifetime utility (1) subject to their holdings of wealth in forms of domestic currency and bonds. The first order conditions are:

$$C_{t+1} = C_t \left[\beta (1 + i_t) \frac{P_t}{P_{t+1}} \right]^{\sigma} \tag{6}$$

$$\frac{M_t}{P_t} = \left[\frac{\chi}{C_t^{-\frac{1}{\sigma}}} \left(\frac{1 + i_t}{i_t} \right) \right]^{\frac{1}{\epsilon}} \tag{7}$$

$$N_t = \left(\frac{C_t^{-\frac{1}{\sigma}}}{P_t} \frac{w_t}{\kappa} \right)^{\frac{1}{(\mu - 1)}} \tag{8}$$

Equation (6) is the standard consumption Euler equation. The household's demand for each differentiated good is:

$$c_t(z) = \left[\frac{a_t(z)}{P_t} \right]^{-\theta} C_t \tag{9}$$

where $a_t(z)$ can be $p_t(z)$, $p_t^*(z)$ or $[E_t q_t^*(z)]$ depending on the type of good.

The household's optimal money demand schedule is given by (7) which equates the marginal rate of substitution of composite consumption for real money balances to the opportunity cost of holding real balances. The household's optimal labour supply decision is shown by (8), this equates the marginal disutility of labour effort to the marginal utility of the real wage. Labour markets are assumed to be completely segregated with real wages determined by market clearing in each labour market.

2.2 Firms

2.2.1 Firms and Price Determination

Two types of firms exist, PTM firms which price discriminate according to market destination and non-PTM firms which set a single international price. Both types produce differentiated goods by using domestic labour as the only input. All firms have an identical linear production technology, $Y_t(z) = N_t(z)$ where $Y_t(z)$ is total output of the firm and $N_t(z)$ is total employment.

Total output of a domestic PTM firm is made up of output sold domestically, y_t^D and output for sales to the foreign country y_t^F. The total domestic demand for good z is

$$y_t^D(z) = \left[\frac{p_t(z)}{P_t}\right]^{-\theta} C_t \tag{10}$$

and there is a similar expression for $y_t^F(z)$. Total output of the non-PTM firm is made up of output sold domestically, y_t^D as in (10) and output for sales to the foreign country y_t^N. Total foreign demand for a domestically produced non-PTM good is given by

$$y_t^N(z) = \left[\frac{p_t(z)}{P_t^* E_t}\right]^{-\theta} C_t^* \tag{11}$$

In a monopolistically competitive goods market each firm, having some degree of monopoly power, sets prices of its good separately to maximize its profits. PTM firms separately choose $p_t(z)$, the nominal price of their good for the home market and $q_t(z)$, the nominal price of their good in the foreign market. Non-PTM goods producers set a single international price since these goods can be traded by individuals and price differentials can thus be arbitraged away.

The presence of nominal rigidities which involve sluggish price adjustment makes the present dynamic optimizing open economy model more realistic both theoretically and empirically. Prices are sticky in that some firms cannot immediately respond to economic disturbances by changing prices within the period under consideration. Instead these firms respond to disturbances by meeting market demand at preset prices. (This is profitable for firms since prices are above marginal cost)

The specific form of sluggish price adjustment considered here is that described by Calvo (1983), which assumes that firms change their prices after time intervals of random length. In other words, the specific time period between price changes is a random variable.[5] Though Calvo's model is one of continuous time, following Rotemberg (1987), Sutherland (1996) and Kollmann (1996) a discrete time version of this model is presented. The probability that a given firm changes its price at any particular period is taken to be a constant, $(1-\gamma)$. Accordingly the probability that a given firm will leave its price at the previous predetermined level is γ. Given the law of large numbers the proportion of firms leaving their price levels unchanged is therefore γ, and the proportion $(1-\gamma)$ reset their prices at a new optimal level.

Prices of PTM goods are preset in the buyer's currency, so the foreign currency price of the seller's good will not automatically change with movements in exchange rates. Foreign currency prices of non-PTM goods, set in seller's own currency, change with movements in the exchange rate.

2.2.2 Firms' Maximization Problem

The specific nature of nominal rigidities assumed above coupled with imperfect goods market integration represented by the presence of PTM, makes the profit maximizing problem of the firm more complicated. In the absence of nominal rigidities, PTM firm z would maximize:

$$\Pi_t^P(z) = \left[\frac{p_t(z)}{P_t}\right]^{-\theta} C_t\left[p_t(z) - w_t\right] + \left[\frac{q_t(z)}{P_t^*}\right]^{-\theta} C_t^*\left[E_t q_t(z) - w_t\right] \qquad (12)$$

The first part of the above equation represents profits from domestic sales of good z, $\Pi_t^D(z)$, and the second profits from sales of the good to the foreign country, $\Pi_t^F(z)$. Total profits of firm z can thus be expressed as $\Pi_t^P(z) = \Pi_t^D(z) + \Pi_t^F(z)$.

However, the presence of nominal rigidities, in the form of Calvo price inertia introduces a dynamic dimension to the firm's optimization problem in the sense that prices chosen by the firm in one period may still be in force in further periods and thus have influences on the profits of the firm in the

[5] Although the underlying source of price stickiness is not explicitly modelled here, the rationalization for it could be that firms are bound by contracts which can only be renegotiated intermittently. Another rationalization for price stickiness is the presence of "menu costs" which may deter producers from changing prices in the face of small demand shocks. The Calvo model is consistent with both interpretations of price stickiness.

future. In this case the firm must maximize the discounted value of all its current and future profits taking into account the probability of the current price being in force. This is done by weighting each future period by the probability the firm will leave its price unchanged, namely γ. In this case an individual domestic firm z maximizes:

$$V_t^P(z) = \sum_{s=t}^{\infty} \gamma^{s-t} R_{t,s} \Pi_s^D(z) + \sum_{s=t}^{\infty} \gamma^{s-t} R_{t,s} \Pi_s^F(z) \tag{13}$$

where $R_{t,s}$ is the discount factor defined as $R_{t,s}$=(1/(1+r$_t$))(1/(1+r$_{t+1}$))... (1/(1+r$_s$)). The first order conditions of the domestic PTM firm z are

$$p_t(z)(\theta-1)\sum_{s=t}^{\infty} \gamma^{s-t} R_{t,s} \frac{C_t}{P_s^{-\theta}} = \theta \sum_{s=t}^{\infty} \gamma^{s-t} R_{t,s} \frac{C_t}{P_s^{-\theta}} w_s \tag{14}$$

and

$$q_t(z)(\theta-1)\sum_{s=t}^{\infty} \gamma^{s-t} R_{t,s} \frac{C_t^*}{P_s^{*-\theta}} E_t = \theta \sum_{s=t}^{\infty} \gamma^{s-t} R_{t,s} \frac{C_t^*}{P_s^{*-\theta}} w_s \tag{15}$$

The structure of pricing behavior by firms implies that firms who do change their price in period t, will all change it to the same levels p_t and q_t in domestic and foreign currency respectively. The number of firms who last set their prices in period $t-1$, given by $(1-\gamma)\gamma$, again will have set it at the same levels p_{t-1} and q_{t-1}. Redefining the general price index (3) for the domestic economy thus yields

$$\begin{aligned} P_t = (n(b_t^D)^{1-\theta} + [(1-n)\,s]\,(b_t^{*D})^{1-\theta} + \\ \{1-[n+(1-n)\,s]\} E_t^{1-\theta} (b_t^{*F})^{1-\theta})^{\frac{1}{(1-\theta)}} \end{aligned} \tag{16}$$

where to simplify notation the following price indices are defined as:

$$b_t^D = \left[(1-\gamma)\sum_{s=0}^{\infty} \gamma^s p_{t-s}^{1-\theta}\right]^{1/(1-\theta)} \tag{17}$$

$$b_t^{*D} = \left[(1-\gamma)\sum_{s=0}^{\infty} \gamma^s p_{t-s}^{*1-\theta}\right]^{1/(1-\theta)} \tag{18}$$

$$b_t^{*F} = \left[(1-\gamma)\sum_{s=0}^{\infty} \gamma^s q_{t-s}^{*1-\theta}\right]^{1/(1-\theta)} \tag{19}$$

Equation (17) is a price index for domestic currency price of domestically produced goods, (18) is a price index for domestic currency prices of foreign produced PTM goods sold in the domestic market and (19) an index of foreign produced non-PTM goods for sale in the domestic country priced in foreign currency.

A non-PTM firm's maximization problem is very similar to the PTM firm's. Non-PTM firms determine a single price for their good to be charged both in the domestic and foreign country. In the absence of nominal rigidities, non-PTM firm z maximizes:

$$\Pi_t^{NP}(z) = \left[\frac{p_t(z)}{P_t}\right]^{-\theta} C_t\left[p_t(z) - w_t\right] + \left[\frac{p_t(z)}{P_t^* E_t}\right]^{-\theta} C_t^*[p_t(z) - w_t] \qquad (20)$$

The first part of (20) represents profits from domestic sales of good z, $\Pi_t^D(z)$, and the second profits from sales of the good in the foreign country, $\Pi_t^N(z)$. Total profits of non-PTM firm z is $\Pi_t^{NP}(z) = \Pi_t^D(z) + \Pi_t^N(z)$. Introducing nominal rigidities in the form of Calvo price inertia leads to the following profit equation, i.e. the non-PTM counterpart of equation (13):

$$V_t^{NP}(z) = \sum_{s=t}^{\infty} \gamma^{s-t} R_{t,s} \Pi_s^D(z) + \sum_{s=t}^{\infty} \gamma^{s-t} R_{t,s} \Pi_s^N(z) \qquad (21)$$

Since non-PTM firms set a single international price for their good, the first order condition of non-PTM firm z leads to a price setting condition for $p_t(z)$ which is identical to (14).

2.3 Equilibrium Conditions

Equilibrium in the world economy is a set of consumption, output, exchange rate, prices and wages enabling market clearing in goods, labour, money and bond markets i.e. set of variables that:

i. satisfy the optimal evolution of intertemporal consumption given by the Euler equation in each country.

ii. clear the money market in both countries at each period.

iii. clear labour markets at each period.

iv. satisfy conditions for optimal price setting by domestic and foreign firms at each time period for both PTM and non-PTM goods.

v. satisfy the intertemporal budget constraint for each country, with present discounted values of total consumption in each country being equal to the present discounted values of total labour and profit income.

3 Steady State Analysis

At the initial steady state the domestic economy faces positive inflation and policymakers aim to bring inflation down through an immediate and unanticipated stabilization programme. The above described open economy model of staggered prices is used to analyze disinflation firstly through a reduction in the rate of growth of the money supply where the money supply is exogenous and the exchange rate floats and accommodates the monetary slowdown. The model will then be used to analyze the real effects of disinflation through a reduction in the rate of depreciation of the domestic currency where the exchange rate is fixed and the money supply accommodates any changes in the exchange rate .

Since no closed-form solution to the model may be obtained, the effects of disinflation through a reduction in the rate of growth of the money supply and rate of depreciation of the domestic currency are separately analyzed through numerical simulations of the above model in its calibrated and log-linearized form.

In order to linearize the system, a well defined steady state around which to approximate is required. The most convenient one corresponds to the case where all exogenous variables are constant and the rate of growth of all nominal variables is zero. It is also convenient to assume that asset stocks are zero. The steady state values around which the system is linearized are the following:

$$\bar{r} = \frac{1-\beta}{\beta} \tag{22}$$

$$\frac{\bar{w}}{\bar{P}} = \frac{\theta-1}{\theta} \tag{23}$$

$$\bar{y} = \bar{C} = \bar{N} = \left(\frac{\theta-1}{\theta\kappa}\right)^{\frac{\sigma}{\sigma(\mu-1)+1}} \tag{24}$$

$$\frac{\bar{M}}{\bar{P}} = \left(\frac{\chi \bar{C}^{\frac{1}{\sigma}}}{1-\beta}\right)^{\frac{1}{\epsilon}} \tag{25}$$

The dynamics of the calibrated and log-linearized model are analyzed in terms of deterministic solution paths in the next section.

In order to see the effect of a monetary slowdown in the domestic country, we assume that at the initial steady state with positive domestic inflation, the money supply is growing at rate α, i.e. $M_{t+1} = (1+\alpha)M_t$. A sudden, discontinuous slowdown in money growth to zero results in transitional dynamics and finally a new zero inflation long run equilibrium. Alternatively, disinflation via the use of an exchange rate peg implies an immediate, unanticipated reduction from a positive rate of depreciation of the domestic currency to one where the nominal exchange rate is fixed at its final steady state value. Again there are transitional dynamics which lead to a new zero inflation long run equilibrium.

In order to simulate this process it is necessary to derive starting values for variables based on an initial inflationary steady state. This requires an analysis of the effects of α (the initial rate of inflation) on steady state values. This is most conveniently achieved by considering a linearized version of the model's steady state relationships where the linearization is based around the above defined zero-inflation steady state values, equations (22), (23), (24) and (25).

At the initial steady state, domestic money and consequently all other domestic nominal variables including the exchange rate grow at a constant rate α, such that $M_{t+1} = (1+\alpha)M_t$. Given that consumption and output are constant in the steady state, the steady state values of the nominal interest rate is tied down by the consumption Euler equation (6) and is given by

$$\hat{\imath}_0 = \frac{\alpha}{1-\beta} \tag{26}$$

After linearizing and rearranging the price setting equations ((14) and (15)) for the domestic firms, the following steady state relationships are derived:

$$\hat{p}_0\left(z\right) = \hat{w}_0 + \frac{\beta\gamma\alpha}{1-\beta\gamma} \tag{27}$$

$$\hat{q}_0(z) = \hat{w}_0 - \hat{E}_0 \tag{28}$$

Equation (27) shows that the steady state value of the price of domestically produced goods (PTM and non-PTM) in domestic currency, it is effectively a mark up over the domestic wage rate. The mark-up is determined by the discount factor (β), the degree of price inertia (γ) and the rate of growth of money supply (α). Equation (28) shows that the steady state value of the price of domestically produced PTM goods is unaffected by the rate of growth of domestic money supply since it is produced for sale in foreign markets only and priced in terms of the buyers' currency.

The foreign counterparts of the above steady state relationships are the following:

$$\hat{p}_0^*(z) = \hat{w}_0^* + \hat{E}_0 + \frac{\beta\gamma\alpha}{1-\beta\gamma} \tag{29}$$

$$\hat{q}_0^*(z) = \hat{w}_0^* \tag{30}$$

As above, equation (29), the price of foreign goods denoted in domestic currency, is mark up over costs where the mark up depends on the rate of growth of money supply in the domestic country since it is set in domestic currency. Equation (30) is the price of foreign produced goods denoted in the foreign currency and is unaffected by domestic monetary growth.

After linearizing and rearranging the equations defining the price indices (equations (17), (18) and (19)) yield the following steady state relationships:

$$\hat{b}_0^D = \hat{p}_0(z) - \frac{\gamma\alpha}{1-\gamma} \tag{31}$$

$$\hat{b}_0^{*D} = \hat{p}_0^*(z) - \frac{\gamma\alpha}{1-\gamma} \tag{32}$$

$$\hat{b}_0^{*F} = \hat{q}_0^*(z) \tag{33}$$

The log-linearized version of the general price index (16) for the domestic economy is:

$$\hat{P}_0 = \left(n\hat{b}_0^D + [(1-n)\,s]\hat{b}_0^{*D} + \{1-[n+(1-n)\,s]\}(\hat{E}_0 + \hat{b}_0^{*F})\right) \tag{34}$$

A similar expression exists for the general price index of the foreign economy.

Log-linearizing the domestic intertemporal budget constraint, equation (5) yields:

$$\frac{1}{2}[s\hat{y}_0^F + \hat{y}_0^D + (1-s)\hat{y}_0^N] = \hat{C}_0 + \hat{P}_0 - \frac{1}{2}[s\hat{b}_0^F + s\hat{E}_0 + (2-s)\hat{b}_0^D] \tag{35}$$

Log-linearizing the money market equilibrium conditions for the domestic country leads to:

$$\epsilon\hat{M}_0 - \epsilon\hat{P}_0 = \frac{1}{\sigma}\hat{C}_0 - \beta\hat{\imath}_0 \tag{36}$$

Log-linearizing the labour market equilibrium conditions for the domestic country gives:

$$\frac{1}{2}[s\hat{y}_0^F + \hat{y}_0^D + (1-s)\hat{y}_0^N] = \frac{1}{\mu - 1}[\hat{w}_0 - \hat{P}_0 - \frac{1}{\sigma}\hat{C}_0] \tag{37}$$

The log-linearized counterparts of the output demand equations(10), (11) and for total foreign demand $y_t^F(z)$, take the form of:

$$\hat{y}_0^D(z) = \hat{C}_0 - \theta\hat{b}_0^D + \theta\hat{P}_0 \tag{38}$$

$$\hat{y}_0^F(z) = \hat{C}_0^* - \theta\hat{b}_0^F + \theta\hat{P}_0^* \tag{39}$$

$$\hat{y}_0^N(z) = \hat{C}_0^* - \theta\hat{b}_0^D + \theta\hat{E}_0 + \theta\hat{P}_0^* \tag{40}$$

The above equations augmented where necessary with foreign counterparts gives a system of equations which can be solved to yield steady state values for all the variables as a function of α.

The process of deriving initial conditions differs slightly between money based and exchange rate based stabilization. In the case of a money based stabilization, the money supply is fixed at its long-run equilibrium level immediately after the unanticipated reduction in money growth. Since $\hat{M}_0$ measures the deviation form the long-run equilibrium level a money based stabilization implies $\hat{M}_0 = 0$. A money based stabilization also implies that the exchange rate is endogenous and is one of the variables determined by the above system of equations. In the case of an exchange rate based stabilization, however, it is the exchange rate that is fixed at its long-run equilibrium level. Hence, $\hat{E}_0 = 0$ and the money supply is endogenous and is one of the variables determined by the above outlined system.

It is important to note that even though money based and exchange rate based stabilization start with identical initial conditions in terms of the absolute level values of nominal variables, they produce different long-run equilibria in terms of these variables. Since log-linearization in each case is based around an approximation of the final steady state, it follows that the log-linearized variables will show differences in initial conditions in nominal variables. The initial conditions of the real variables, however, are identical in each case for both the levels and log-linearized measures.

4 Simulation Results

Since no closed form solution of the above model is found, numerical solutions of the model in its calibrated and log-linearized form are presented. The model is analyzed in terms of deterministic solution paths. Numerical simulations of disinflationary policy experiments using a reduction in the rate of growth of money supply and a reduction in the rate of depreciation of the domestic currency are carried out. In addition simulations of the model are used to find the impact of changes in key parameters on the real effects of disinflation.

In the case of money based disinflation an asymmetric domestic country policy experiment taking the form of an immediate and discontinuous cut of 1 per cent in the rate of growth of money supply is carried out. The foreign money supply is assumed to be growing at a zero rate. As for exchange rate based disinflation, the domestic government reduces the rate of depreciation of the domestic currency by 1 per cent in its attempt to disinflate.

The results of these simulations are presented in four subsections. The aim of the first subsection is to provide a comparison of disinflation using a money based disinflation and an exchange rate disinflation. The second subsection analyzes the effects of PTM on disinflation dynamics. The third and fourth subsections analyze disinflation dynamics separately under different key parameter variations. Two key parameters, namely the intertemporal rate of discount and the degree of price inertia are varied. These parameters have important implications for the real effects of money based and exchange rate based disinflation, in terms of the short run transitional dynamics and the long run real effects.

4.1 Money Based Disinflation vs Exchange Rate Based Disinflation

In this section we consider two alternative methods of disinflation, one is through a reduction in money growth and the second is by a reduction in the rate of depreciation of the domestic currency, in each case the rate of growth of the targeted variable is reduced by 1 per cent in the domestic country, and is left unchanged in the foreign country.

The relative effects of money based versus exchange rate based disinflation are presented. We are seeking to answer the following question: Does an intertemporal general equilibrium model with staggered prices and imperfect competition produce the conventional directly postulated models' results of disinflation policies through monetary slowdown and through reduction in the depreciation rate of the domestic currency?

Simulation results of a monetary slowdown and a reduction in the depreciation rate of the domestic currency under the benchmark parameter configurations are presented. The parameter values used in the benchmark simulations in this section are taken from Hairault and Portier(1993), Sutherland(1996) and Senay(1998) and are

$$\beta = \frac{1}{1.05} \ \epsilon = 9.0 \ \chi = 1.0 \ \mu = 1.4 \ \sigma = 0.75 \ \theta = 6.0 \ \gamma = 0.5 \ s = 0.0$$

Dynamic adjustment paths of domestic and foreign macroeconomic variables are presented in Figure 1. In each panel of each figure there are two plots illustrating the money based disinflation and the exchange rate based disinflation. Money based stabilization is represented by the plot marked with triangles and exchange rate based stabilization is represented by the plot marked with dots.

In the case of the monetary slowdown, domestic policymakers carry out an immediate and unanticipated cut in monetary growth by 1 per cent. The most obvious effect of a monetary slowdown with no PTM ($s = 0$) in our microfounded open economy model, is that a domestic recession immediately follows the monetary slowdown. More specifically, domestic output falls by 2.25 per cent in the short run. This significant output cost, nearly twice the fall in money growth, indicates a large recession. An exchange rate based disinflation, however, leads to instantaneous equilibrium in all real and nominal variables and does not bring any output costs. Therefore it has no significant long-run real or nominal effects and produces minimal adjustment in price levels.

One of the key factors leading to the output costs of the money based stabilization is the increase in real interest rates, and the appreciation of the exchange rate. The fall in output in a money based stabilization is accompanied by a fall in domestic consumption. Due to consumption smoothing, however, the fall in consumption is smaller than the fall in output. So the domestic economy runs down its stock of assets, and this leads to some long-run effects. These take the form of lower long-run consumption and higher long-run output levels in the domestic economy in order to finance the loss of domestic assets.

The earlier literature on the real effects of disinflation in open economies, as explained above, concluded that money based disinflations led to recessions in the domestic economy in the short run with an overshooting of the exchange rate. Exchange rate based disinflations were found to bring a rapid adjustment of inflation with no output costs. It appears that these fundamental results of earlier directly postulated models also hold true under a microfounded dynamic general equilibrium model such as the one used in this paper. With monetary slowdown, there are substantial short run output costs and disinflation does take time with high real interest rates in the short run and exchange rate appreciation. With a reduction in the rate of depreciation of the domestic currency, adjustment to a new equilibrium is instantaneous and new steady state levels are reached almost immediately. Output costs are minimal with all real variables showing no real changes in the long run.

The link between the nominal interest rate and the money demand plays an important role in explaining the difference in output effects of money based and exchange rate based stabilization in directly postulated models. The fall in nominal interest rates following disinflation causes an increase in the demand for real balances. Money market equilibrium necessitates a subsequent rise in real balances. With money based disinflation, the money supply is fixed and this rise is made possible by a fall in the price level. This fall comes about through a recession. With exchange rate based disinflation, the nominal money supply is free to adjust to meet the changes in demand for real balances. So no recession or price falls are necessary. As simulation results for the money based disinflation has shown, the domestic nominal interest rate and the price level fall with a corresponding reduction in domestic output. Similarly, simulation results for the exchange rate based disinflation show minimal adjustment in prices and no output costs. Therefore, the link between the nominal interest rate and demand for real balances is also important in explaining the difference in output effects related to money and exchange rate based stabilization under the microfounded model as well as directly postulated models.

In order to highlight the importance of the link between nominal interest rates and the demand for real balances in this model, simulations varying ϵ, the inverse of the consumption elasticity of money demand, are reported in Figure 2. Simulations on money based disinflation show that the extent of the fall in domestic prices and output is reduced at higher values of ϵ. That is as the consumption elasticity of money demand decreases, so do the price and output adjustments required for money market equilibrium. In exchange rate based stabilization, different values of ϵ have negligibly small effects on the movements in all real and nominal variables. This is as expected since the nominal money supply is adjusted in response to changes in the demand for real balances under exchange rate based disinflation.

Although, the output effects under the two disinflation processes are common to both the directly postulated and microfounded models, there remain important differences between the results of the two models. One is the presence of long-run real effects arising from the run down in domestic assets under money based stabilization in the microfounded model. The second is that although the microfounded model leads to some appreciation in the exchange rate under money based disinflation, there is no overshooting, which is a key result of directly postulated models' analysis of monetary slowdown. The absence of overshooting in the exchange rate (and empirical evidence showing systematic deviations from PPP) warrants an analysis of disinflation with our open economy microfounded model with PTM, which is dealt with in the next section.

The significance of microfoundations for analyzing the importance of staggered price contracts for the real effects of disinflation was explained in the introduction. While the presence of microfoundations seems to be important for understanding the effects of staggered prices in money based disinflations, this is not immediately obvious under exchange rate based stabilization. The simulation of exchange rate based stabilization with the benchmark parameter values used here does not result in any significant real effects. However, given Ascari and Rankin's (1997) discussion regarding the importance of key parameters such as the intertemporal rate of discount r and degree of price inertia γ, further simulations varying these parameters are carried out. These are presented and discussed in sections 4.3 and 4.4.

4.2 The Effects of Pricing-to-Market on Disinflation Dynamics

This section looks at the effects of PTM on disinflation policies. We seek to answer the following questions: Does the presence of PTM alter the real effects of disinflation policies? Given that market segmentation manifested by PTM exacerbates the response of the exchange rate, the analysis of the implications of PTM on the exchange rate response for monetary slowdown seems relevant. If higher degrees of PTM do indeed lead to exchange rate overshooting how is this transmitted to real variables?

In analyzing the effects of PTM on money based disinflation, it is apparent that PTM makes an important difference to the responses of the exchange rate and real variables. The magnitudes of the impact effects and the transitional values of all real and nominal variables to a new long run equilibrium are significantly changed with higher degrees of PTM. One of the main implications of PTM is that the nominal exchange rate overshoots its long run equilibrium value in response to the monetary slowdown. And the amount of overshooting increases with higher degrees of PTM, as seen in the exchange rate panel of Figure 3. This is expected since the presence of PTM (coupled with sticky prices) magnifies the exchange rate response to changes in monetary policy.[6]

Higher degrees of PTM leads to exchange rate overshooting but what are the implications of this on the movements of real variables? The extent to which exchange rate movements induced by a monetary slowdown leads to a decrease in demand for domestic goods depends on the degree to which exchange rate changes are passed onto the relative price of domestic goods. If producers engage in PTM and prices are fixed by contracts, the expenditure switching effect of the monetary slowdown will be diminished. Therefore, as the degree of PTM in the economy increases, the contractionary effect of the disinflation on domestic output will be mitigated. This can be seen in the exchange rate and domestic output panels of Figure 3. Moving from lower to higher degrees of PTM, it is seen that the overshooting of the exchange rate is higher, and the fall in domestic output is smaller.

For exchange rate based disinflation, the presence of PTM makes little difference to any of the real or nominal variable responses. Although individ-

[6] See Betts and Devereux(1996) for a detailed discussion of how PTM alters the exchange rate response to monetary shocks.

ual variable responses under different degrees of PTM do change, they only do so by a negligibly small amount. This is as expected, exchange rate based disinflation implies keeping the exchange rate fixed following a reduction in the rate of depreciation. The main implications of PTM are related to its effects on the transmission of nominal exchange rate movements to the rest of the economy. If there are no movements in the nominal exchange rate then PTM becomes irrelevant.

4.3 Varying the Intertemporal Rate of Discount

This section presents the effects of varying the intertemporal rate of discount on disinflation dynamics under money and exchange rate based disinflation. In the case of money based disinflation, changes in the intertemporal rate of discount alter the short run transitional dynamics of real variables by changing the price level responses to the disinflation. In the cases of both money and exchange rate disinflation changes in the intertemporal rate of discount also alter the long run effects of disinflation.

Ascari and Rankin (1997), using a microfounded model, conclude that a permanent reduction in the rate of monetary growth reduces output and that superneutrality does not hold. One of the main factors behind this is the presence of a strictly positive time preference rate. They state the following proposition:

"In the microfounded model with a strictly positive time preference rate (i.e. $\beta < 1$*), an unanticipated disinflation always produces a slump in the short, medium and long run. As the time preference rate tends to zero (i.e.* $\beta \to 1$*), the size of the long-run slump tends to zero and the size of the short-run slump tends to infinity."* [7]

We test the relevance of this proposition for the above open economy model and carry out simulations varying the intertemporal rate of discount. The results of these are presented in Figure 4. Equation (22) defines the relationship between r, the intertemporal rate of discount, and β, the discount factor, namely $r = \frac{1-\beta}{\beta}$. Given that $0 < \beta < 1$, smaller values of β imply greater values of r. We consider the following values in the simulations: $r = 0.05$, $r = 0.1$ and $r = 0.2$.

As explained in a previous subsection, money based stabilization produces a short run recession because the initial price level is too high. This is due to

[7] Ascari and Rankin(1997), Proposition 1, p.22.

the effect of inflation on the demand for real balances. In order to understand the effects of the intertemporal rate of discount on the short run recession, consider the log-linearized money market equilibrium condition evaluated at the steady state, equation (36). After substituting the steady state value of $i_0 = \frac{\alpha}{1-\beta}$, i.e. equation(26), this becomes :

$$\epsilon \hat{M}_0 - \epsilon \hat{P}_0 = \frac{1}{\sigma} \hat{C}_0 - \frac{\alpha}{r} \tag{41}$$

This equation makes clear the link between steady state price level and steady state inflation (α). It is apparent from equation (41) that the response of real balances, and hence the steady state price level, to a change in inflation (α) depends on r, the intertemporal rate of discount. Higher values of r will imply smaller responses in real balances. This will require the steady state price level to fall by less when there is a change in α. The price level panel of Figure 4 shows that under high values of r, prices fall by less. The initial value of the price level under $r = 0.05$ is approximately 2.25 per cent, whereas under $r = 0.2$ this is 0.5 per cent. With the initial price level being so high under $r = 0.05$, a greater recession is needed to bring the price level down to the new long run equilibrium. Hence output at $r = 0.05$ falls by more than it does at $r = 0.2$. At $r = 0.05$ output falls by nearly 2.3 per cent whereas at $r = 0.2$ output falls by only 0.5 per cent. In short, at lower rates of intertemporal discount r (higher rates of β) the initial price level is greater and this necessitates domestic output to fall by more. These results are all in accordance with Ascari and Rankin's (1997) *Proposition 1.*

The long run real effects of the money based stabilization is understood by making use of the steady state expressions of the log-linearized price setting equations, namely equations (27) to (34). Since parameters such as the discount factor β, the degree of price inertia γ and the growth rate of money supply α appear in these equations, their effects on the steady state values of nominal variables will illustrate how real variables will be altered when these parameters are varied.

As a benchmark case consider a stripped down closed economy and no-PTM version of the above model, the log-linearized version of the general price index (34) for the domestic economy is then reduced to:

$$\hat{P}_0 = \hat{b}_0^D \tag{42}$$

substituting $\hat{p}_0(z) = \hat{w}_0 + \frac{\beta\gamma\alpha}{1-\beta\gamma}$ (the steady state expression for $\hat{p}_0(z)$, equation (27)) into the log-linearized price index expression

$$\hat{b}_0^D = \hat{p}_0(z) - \frac{\gamma\alpha}{1-\gamma} \tag{43}$$

and further substituting this into the general price index yields,

$$\hat{P}_0 = \left[\hat{w}_0 + \frac{\beta\gamma\alpha}{1-\beta\gamma} - \frac{\gamma\alpha}{1-\gamma}\right] \tag{44}$$

The log-linearized real wage rate can be expressed as:

$$\hat{w}_0 - \hat{P}_0 = \frac{\gamma\alpha}{1-\gamma} - \frac{\beta\gamma\alpha}{1-\beta\gamma} \tag{45}$$

Equation (45) shows that the steady state value of the real wage rate is effectively determined by the discount factor (β), the degree of price inertia (γ) and the rate of growth of money supply (α).

Keeping γ constant and with a positive α (i.e. an inflationary steady state), it is seen that higher rates of intertemporal discount r, implying lower discount factor β, will mean that the second term on the right hand side of equation (45) is smaller and thus the real wage is higher. Higher real wages will induce agents to work more and supply more labour and thus output will be higher. It follows from this that a reduction in α will have a bigger negative effect on steady state output with higher values of r. In short, a greater r means that a money based disinflation leads to a bigger recession in the long run. This is entirely in accordance with Ascari and Rankin's proposition.

The economic intuition for the result just described is the following. Lower values of β imply that agents discount the future more and that present variables have greater importance. Hence in an inflationary steady state agents setting current prices give relatively low weight to future inflation when setting these prices. This tends to raise real wages in an inflationary steady state relative to a zero inflation steady state. This effect becomes stronger with higher discounting.

The effects of varying the intertemporal rate of discount under exchange rate based disinflation are presented in Figure 5. Under a disinflation based on the reduction of the rate of depreciation, monetary aggregates become endogenous and the money market equilibrium condition disappears. The link between the rate of time preference and real balances no longer holds.

In other words, an exchange rate based disinflation eliminates the short run transitional dynamics, i.e. the short run recession is removed. This is seen in the output and price level panels of Figure 5. However the long run recessionary effect of the disinflation remains. This is evident in the output panel of Figure 5. These effects can again be understood by making use of the above linearized steady state expressions for the real wage.

4.4 Varying the Degree of Price Inertia

This section investigates the implications of the degree of price stickiness for the results of money based and exchange rate based disinflation. Given that γ is the probability that an individual firm will not adjust its price in the current period, a higher value of γ implies more inertia in prices and a lower γ implies more price flexibility. The above benchmark simulations of disinflation experiments were carried out using the value $\gamma = 0.5$, implying an average delay of 2 periods between price adjustments. Figure 6 presents the solution paths of the monetary slowdown with no PTM under different degrees of price inertia, ranging from $\gamma = 0.75$, indicating an average delay of 4 periods, to $\gamma = 0.9$, an average delay of 10 periods.

Consider first the transitional dynamics of a money based disinflation under different degrees of price inertia. Figure 6 shows that the impact of monetary slowdown on real variables increases as the degree of price inertia increases. This is as expected since in the absence of price inertia, a monetary slowdown produces an equal percentage change in all nominal variables and leaves real variables unchanged. As explained above monetary slowdown coupled with staggered price contracts has important dynamic implications in this intertemporal model. This slows down the output response to disinflation. Thus, as price inertia increases so does the persistence of output effects. Transitional paths of variables to their new long run equilibrium values also show slower adjustment.

The output panel in Figure 6 shows that a 1 per cent domestic monetary slowdown leads to more than 2 per cent decline in output when $\gamma = 0.5$. The extent of the recession deepens at higher values of γ, for instance output declines by 5.5 per cent when $\gamma = 0.9$.

Now consider the long run real effects of a money based disinflation under different degrees of price inertia. These are again best illustrated using the above closed economy price setting equations, namely the real wage equation (45). Since the degree of price inertia γ appears in both the terms on the right hand side with different signs the precise relationship is more complicated to disentangle. Given $0 < \beta < 1$, higher degrees of price inertia γ will mean the positive impact of the first term will override the negative impact of the second term on the right hand side of equation (45). This means that higher values of γ,will imply higher steady state real wage rates (and hence higher steady state output) for any given value of α. Therefore the long run effects of disinflation on output will be more negative at higher levels of γ.

The basic economic intuition behind this result is again related to the effect of discounting on pricing decisions. As γ increases the intertemporal nature of price setting becomes more significant and hence discounting has a bigger impact on pricing decisions.

The effects of varying price inertia on exchange rate based disinflation can be seen in the simulation results presented in Figure 7. Again exchange rate based stabilization removes the short run recessionary impact associated with money based stabilization. But the long run effect of disinflation remains. Figure 7 shows that an exchange rate based disinflation has significant real effects when there is a very high degree of price inertia. A 1 per cent cut in the rate of depreciation leads to a 1.6 per cent decrease in the long run level of domestic output when $\gamma = 0.9$. In addition when γ is large there are significant transitional dynamics in moving towards the new long run level of output.

5 Conclusions

This paper has analyzed the effects of money based and exchange rate based disinflations on macroeconomic variables in the framework of an open economy dynamic general equilibrium model. The model is based on explicit microfoundations where firms engage in Calvo(1983) type staggered price setting. It is found that a money slowdown leads to a recession in the short run whereas an exchange rate based disinflation leads to very rapid adjustment with minimal real effects. This corresponds to the results of directly postulated models typical of the existing literature. Overshooting of the exchange rate in response to a money slowdown, however, only occurs when there is pricing-to-market behavior. It is found that by varying certain key parameter values such as the intertemporal rate of discount and the degree of price inertia exchange rate based stabilization can produce substantial real effects. This contrasts with the results of directly postulated models and is directly related to issues highlighted by the introduction of microfoundations.

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Figure 1 Money Based vs Exchange Rate Based Stabilization

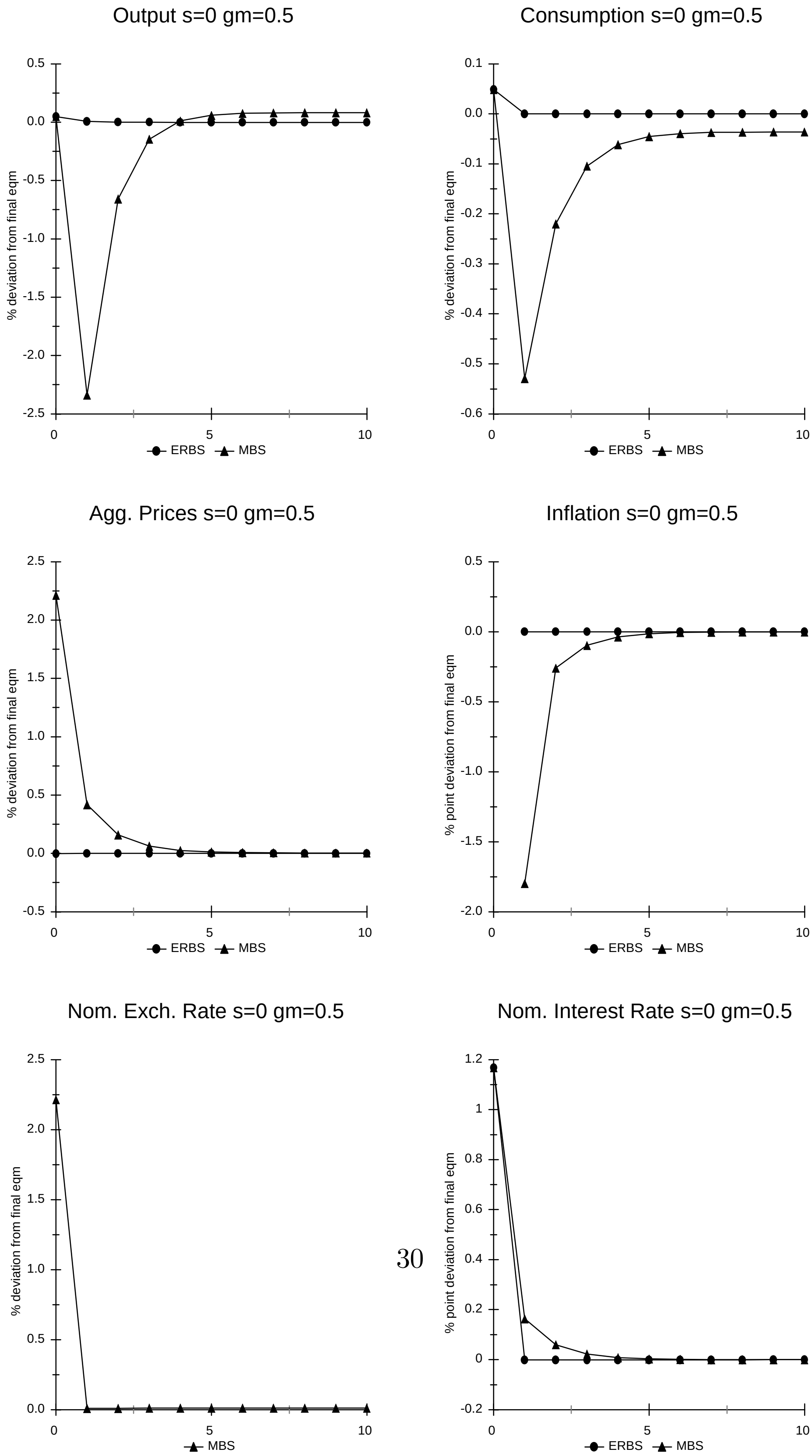


Figure 2 Money Based Stabilization Varying Epsilon

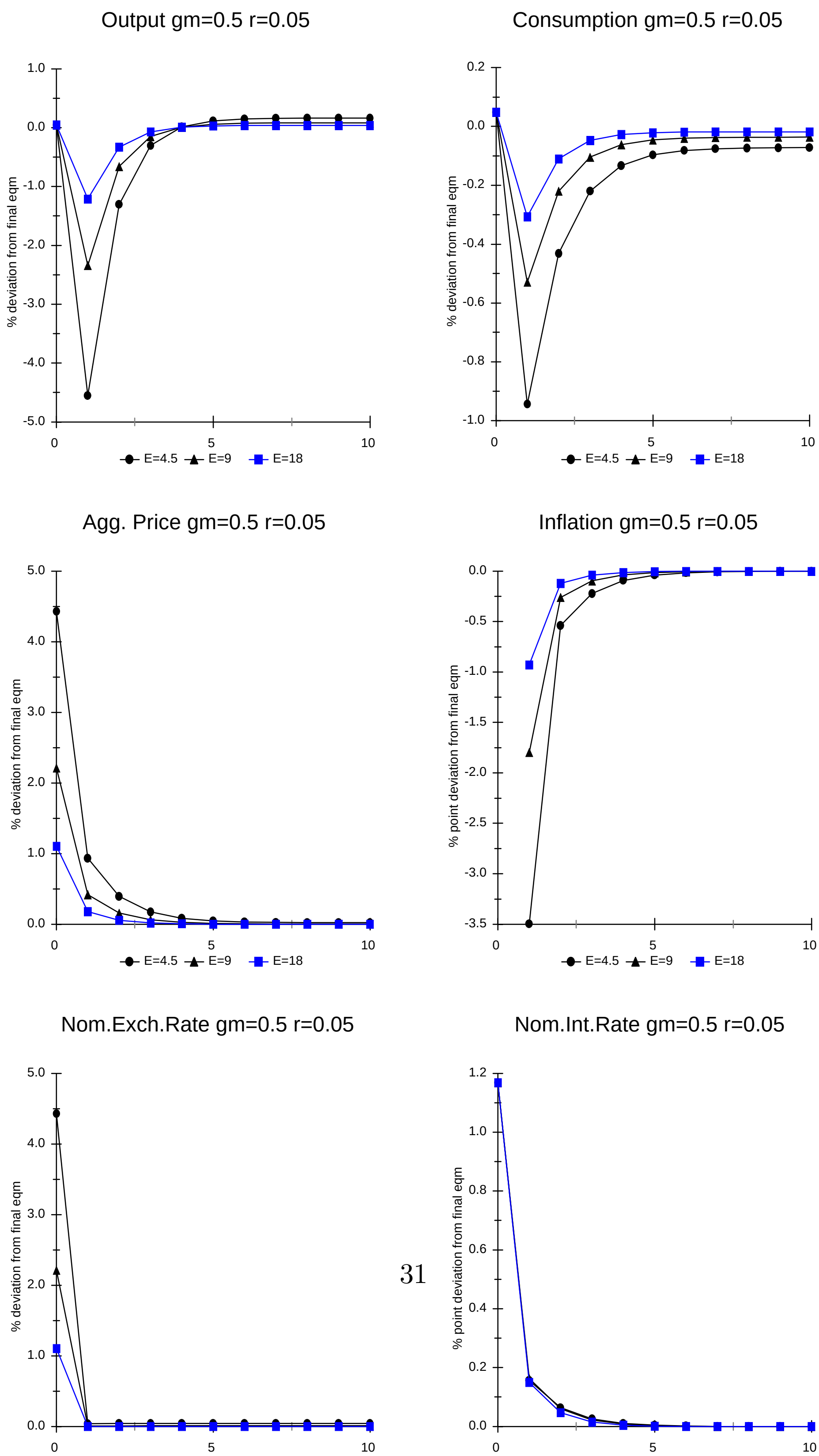


Figure 3 Money Based Stabilization PTM Effects

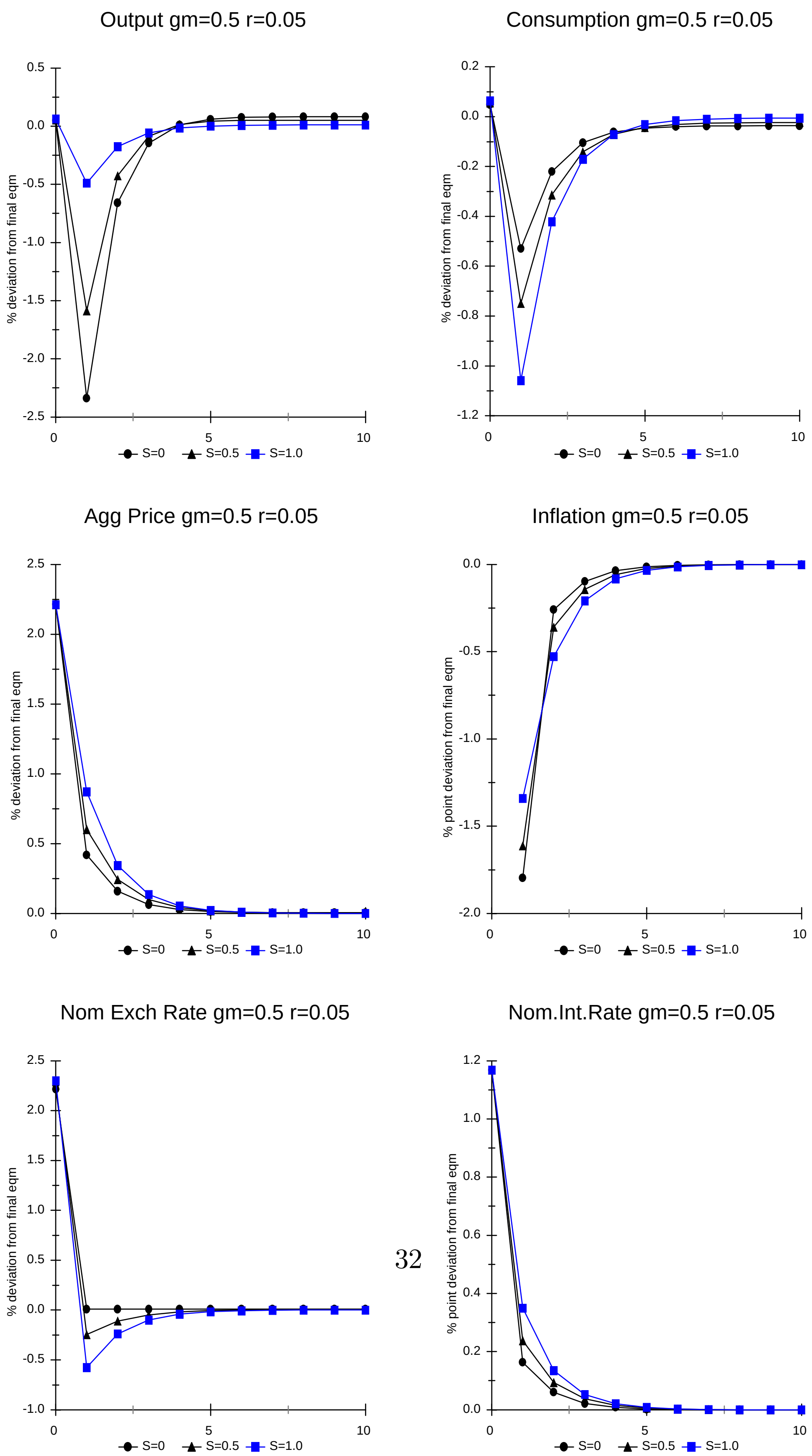


Figure 4 Money Based Stabilization Varying Intertemporal Rate of Discount

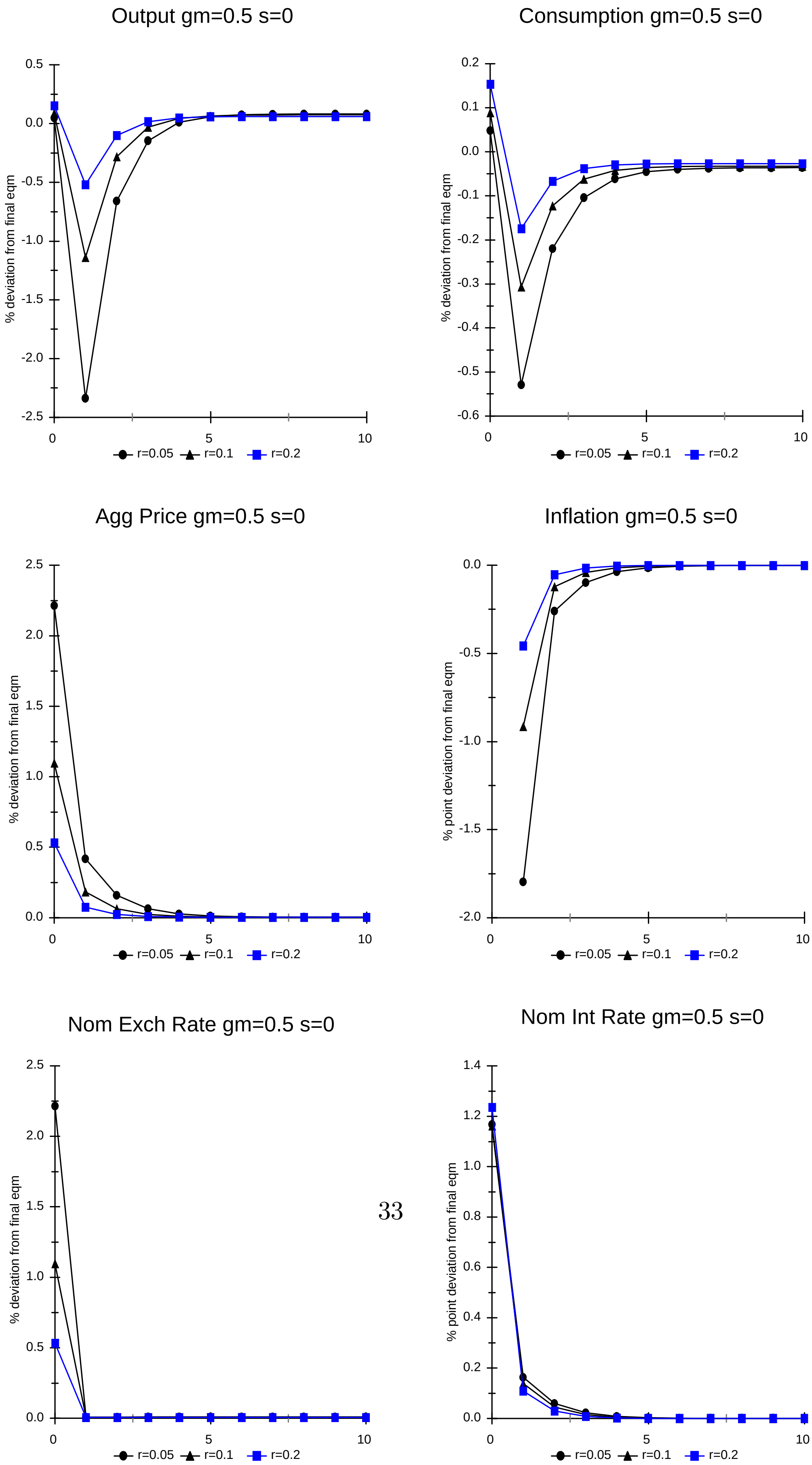
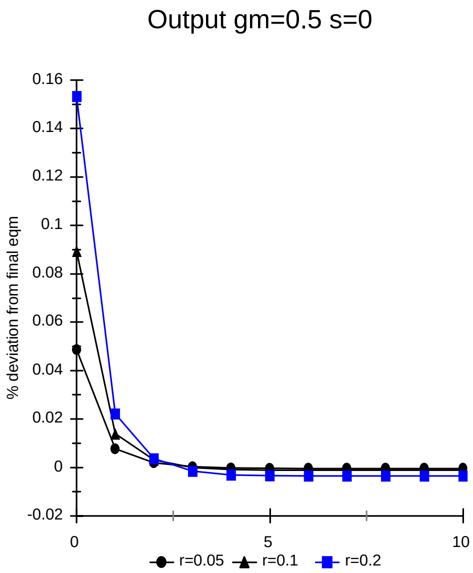
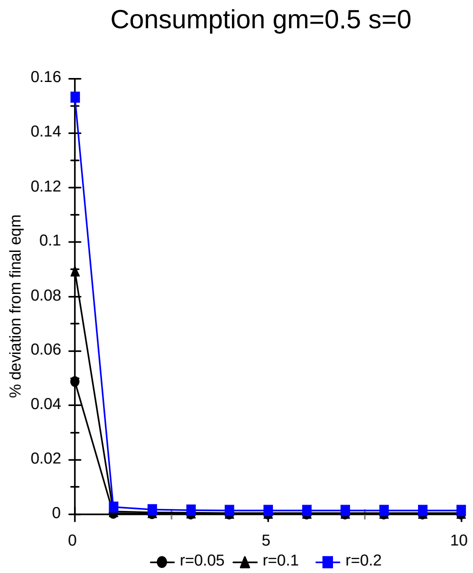
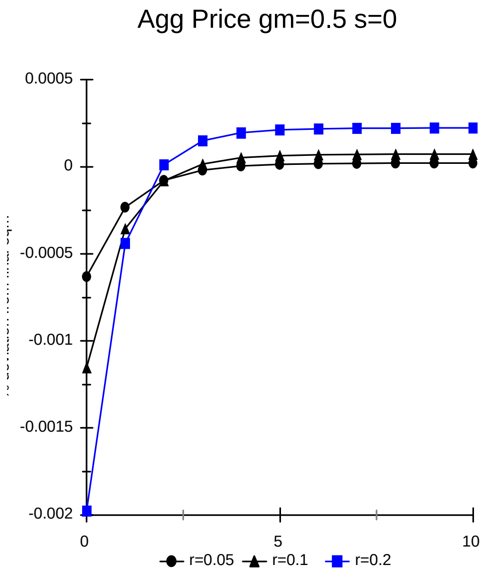
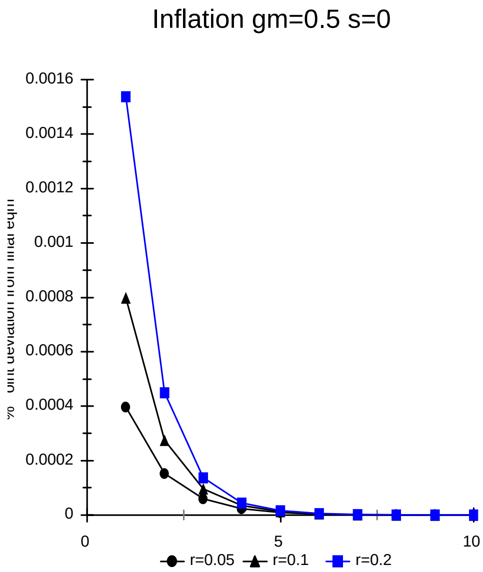


Figure 5 Exchange Rate Based Stabilization Varying Intertemporal Rate of Discount









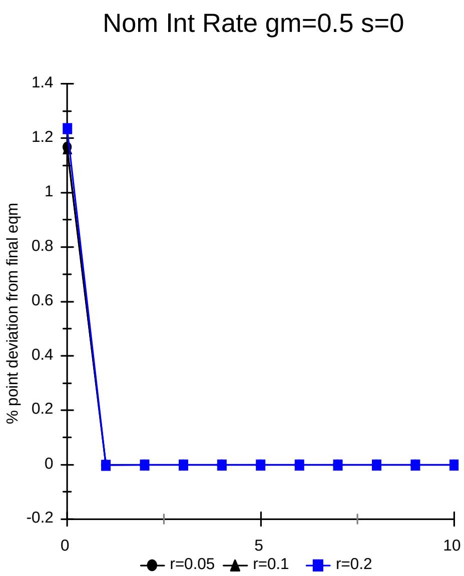


Figure 6 Money Based Stabilization Varying Price Inertia

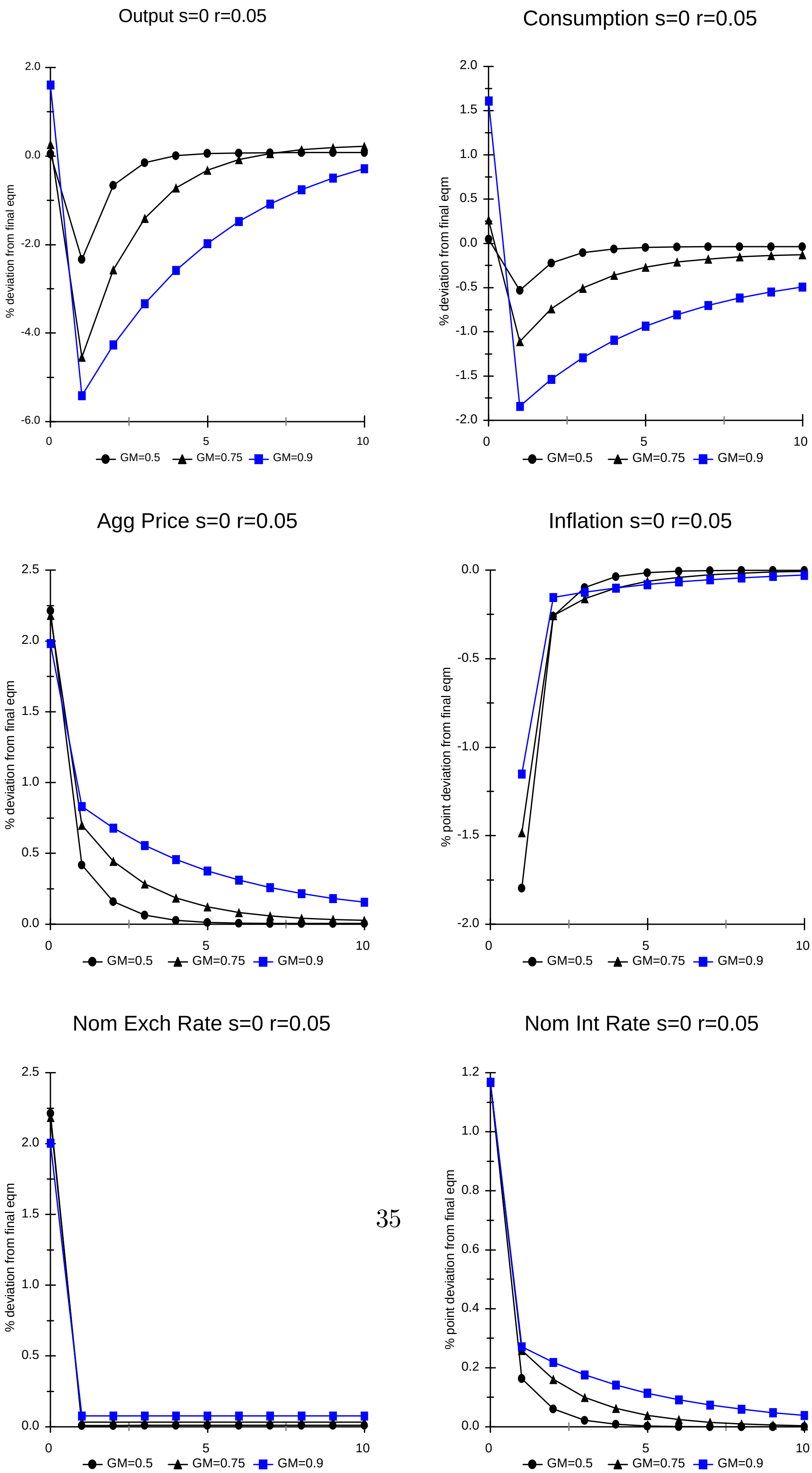


Figure 7 Exchange Rate Based Stabilization Varying Price Inertia