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A Bubble without Inflation*

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We show that pro-cyclical financing of non-produced assets can introduce a disinflationary tendency in the rest of the economy, if capital gains from the assets produce relatively small income effect. Hence when growth is in upswing, it can sustain a boom in land and real property with disinflation in other sectors. We argue that peculiarities of the Japanese banking and financial system resulted in an environment close to this model creating the eighties' puzzle of a bubble accompanied by a low inflation rate.

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1. INTRODUCTION

Low CPI inflation rate of Japan from 1976 to 1987 when the real economy was growing robustly was a source of surprise and often praised in the literature of the time. It appeared particularly impressive given that the Bank of Japan was not legally autonomous of the government.[1)] Later on when it became clear that Japan had been passing through a bubble since early eighties, the surprise grew further. At the same time however many observers wondered if the Bank had been really that wise (e.g. Bernanke and Gertler, 1999). They pointed out that the Bank might have inadvertently fostered the bubble by maintaining an easy money policy almost till its end. Later on of course the Bank took a hard position. But when finally the official discount rate (ODI) was increased in May 1989 and then in a quick sequence raised to a peak in August 1990, critics thought it was too late.

In search of explanations, part of the literature has focused on the inadequacies of the Japanese financial sector. We agree with the spirit of that literature — namely that the financial and banking sectors were ill-equipped to deal with the crisis when it broke out and also partly responsible for its development. However the focus of our paper is theoretical. We have used the features of the Japanese financial system, the way loans were financed during the bubble and some other stylized facts of the time to develop a macroeconomic model that gives some insight into the macroeconomics of the episode.

As the demand for land, real property and stocks grew at the end of seventies and early eighties, it created a surge for loans. Handling of these loans by Japanese banking and financial system has been generally found inadequate. Institutional arrangements and underlying political economy have been discussed in a large literature, e.g. Wood (1992), Amyx (2004). A common theme of this literature is that there was no economic (as opposed to, say, political) rationing mechanism for the loans. As a result loans were

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[1)] For example, Cargill, Hutchison, and Ito (1997) suggested that the Bank of Japan might have had *de facto* independence and had been using it astutely.

accommodated without significant increase of real interest cost. This is true not only for the period before the deregulation of interest rates in 1985 but also after it. When banks were allowed to pay interest on deposits after deregulation, they used interest rate to compete for deposits but did not necessarily shift parts of it to their borrowers. To offset the cost of deposits they would often sell the shares of stock they owned and counted the realized capital gains as profits.[2] All in all, the demand for loans driven by the bubble was not disciplined by any market mechanism. We have used this feature of the bond market in our model together with two other stylized facts explained in the next paragraph.

The bubble was a speculative price increase confined to land and real property (apart from stocks), which did not embody much recent value-added. Secondly the purchase of these assets was financed by borrowing without much regard for the cost of borrowing or other financial variables as explained earlier. These assets can therefore be thought of as a group separate from assets like plant, equipment and inventory which are currently produced and whose purchase is influenced by financial variables. While such clear-cut distinctions are never one hundred per cent true in reality, we think the distinction was sufficiently pronounced to provide the basis of a stylised model of the episode. In what follows, we will assume that the bubble assets like land and real property are not currently produced and no current value-added is embodied in them. Purchase of these assets is financed by borrowing driven by expectation of capital gains and is not influenced by real interest rate. The other group of assets, like plant, equipment and inventory, embody current value-added and their production figures in current GDP. Their purchase will be referred to as gross domestic capital formation or investment, and the decision to invest in them depends on standard variables like the real cost of borrowing.

[2] This created a peculiar situation for Japanese banks. They bought back the shares at the new higher price given the obligation of cross-holding of stock among the members of a *keiretsu*. This must have led to a net loss of cash flow on these operations because capital gains were accounted as profit and tax was to be paid on them. For an interesting discussion, see Wood (1992).

The result of this distinction is that purchase of bubble assets affects the rest of the economy only through a portfolio effect. Assuming that the majority of lenders are risk-averse, the demand for money increases with bonds as lenders would like to maintain a desired inflation-adjusted bond-to-money ratio. Thus portfolio demand for money increases as the bubble goes on, to that extent reducing the money for transaction. This introduces a disinflationary tendency — a lower rate of inflation for any given growth of money. To this tendency we may add the negative effect on consumption and investment of any increase of interest rate.[3] Thus as the asset bubble develops it introduces, rather improbably, a contractionary and disinflationary tendency in the real economy. Our model suggests that in this condition inflation in general and its steady state rate are expected to be lower than what is warranted by the growth rate of money and the real economy.[4]

This paper does not model the growth of an asset bubble — it shows a macroeconomic system where a bubble already exists and is fed through borrowing in expectation of capital gain. The model focuses on the long run effects alone abstracting from the cyclical aspects.[5] It also abstracts from open economy features, which in our view, added complications for the Japanese economy, but were not basic to either the disinflation problem or the bubble.[6]

The fact that during a growth phase, loan financing of non-produced assets sends their prices soaring but introduces a disinflation in the rest of the economy might explain both the surprisingly low inflation rate during the bubble and the dilemma of the monetary authorities. If the authorities viewed the growing bubble with concern, the traditional prescription would be a drastic cut in the growth rate of money supply. But that did not look a

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[3] As discussed earlier, increase of interest rate was negligible until fairly late in the episode.

[4] However, we find that these features do not introduce any additional instability or convergence problem. An economy which is stable in terms of the usual Cagan (1956) conditions, remains stable with procyclical financing of non-produced assets.

[5] There is a large literature on the cyclical effects of business debt on the macroeconomic system. See for example Jarsulic (1990), Asada (2006) and Ninomiya (2007a).

[6] For an open economy model with somewhat similar structure as the model of this paper, see Ninomiya (2007b).

convincing option given the very low inflation rate. Our paper also looks at other standard options. As we have pointed out, the debt stock grows faster as the real economy grows faster, creating a larger demand for portfolio money. To arrest the disinflationary tendency, then, money supply growth faster than that of the real economy may be considered. We however show that such a policy could be effective in controlling disinflation but would worsen the bubble. Curiously, a money supply rule that goes opposite to the growth rate, might succeed. But this requires the authorities to choose an unlikely and unorthodox combination of a very high long run rate of growth of money with a severe anticyclical component. Obviously such combinations are unlikely and difficult to implement. Anticyclical inflation targeting is also not very promising. It can curb disinflation if a high long run growth rate of money and a high inflation target are chosen, but most likely it would worsen the bubble. In short, speculative borrowing created both the bubble and a disinflationary tendency creating a monetary policy problem whose solution is not well charted out.[7)]

Though our paper presents a macroeconomic model, implications of the paper for policy would be to call for appropriate change in the banking and financial system. Banking and financial rules constrain macroeconomic behaviour with far-reaching results for the overall macro system. We believe our paper is an example of this general truth and it applies to other economies as well. For example, it has been argued in the literature that South Korea's banking system seriously impeded her ability to fight the 1997-1998 crisis (e.g. Krugman, 1998; Adelman and Nak, 2002).

Korean banks were privatised in the early eighties making the financial system more market-based (Jo, 2002). But lack of full liberalization has hindered the growth of sound banking and financial practices. So-called policy loans of earlier era persisted, resulting in balance sheets with unacceptable proportion of inherently risky policy-mandated loans. The government's use of interest rate subsidy as a tool of development policy

7) For a close analysis of the policy difficulties of the Japanese monetary authorities during the period, see Ito and Mishkin (2004).

rendered rational evaluation of borrowers impossible. All these prevented banks from developing the norms and skills for assessing borrowers.[8)] Main-bank system, like in Japan, continued to stall competition and banks did not feel the need to adapt requisite norms for business risk and foreign exchange risk. It appeared that both local and foreign banks operating in Korea were working with implicit government guarantee against insolvency-leading them to take more risk than commercially warranted (Adelman and Nak, 2002).[9)] A macroeconomic system with a banking sector constrained like this will behave quite differently. In particular the banking sector may fail to make appropriate adjustments even when adverse factors develop over several years, as happened in the run up to the 1997-1998 crisis (Lee, 2001).

The rest of the paper is organised as follows. In section 2 we present some observations about the Japanese economy of the period to cull out a set of stylized facts that we use in our models later on. Section 3 sets up a short run model of the economy. In section 4, a reduced form equation for the short run equilibrium output is used to develop a long run model that connects the short periods. Section 5 shows the disinflation bias of the model and that a bubble and disinflation can co-exist. We also show that an increase in the growth rate of money supply tends to reduce its effectiveness in inducing higher inflation. Section 6 analyses the available policy options. Here we show that a money supply rule that follows growth pro-cyclically can remove the disinflation bias, but would worsen the bubble. Secondly, if money supply targets a high inflation rate, most likely the bubble will worsen. Finally, money supply policy countercyclical to growth rate might cure both tendencies of the economy but it has to combine two contradictory features: high long run growth of money with a severely anticyclical component. Obviously a combination like that is far-fetched and unlikely. Section 7 concludes the paper with a discussion of the intuition of the model.

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8) See Cho Soon (1994) and Choi (2003).

9) Some economists, notably Paul Krugman (1998) attributes the entire crisis to this unwarranted level of risk taking forced by the political system.

2. STYLIZED FACTS

The model of the next two sections differs from an orthodox model of a closed economy because of our treatment of assets. We assume that bubble assets did not incorporate any current value added. Secondly, capital gain on bubble assets did not create significant contribution to consumption and investment. Together they mean that trading of these assets did not create any income effect. They did not create income directly through the process of value addition. Nor did capital gains realized on trading contribute indirectly through demand creation. Of course these features can not be literally true. But we think they are pronounced enough to justify treating the goods market as if it was virtually insulated from the income effects of asset trading.

The bubble raised the stock market index to spectacular levels before it burst. At the same time it created similar upward spirals in some domestic markets. From all available accounts the domestic effect was contained in real estate, housing and land-related property markets. This is borne out by a comparison of price movement of goods in general and of real estate and housing group. Table 1 shows the annual increase of land prices in Tokyo, Osaka and Nagoya metropolitan areas during 1979 to 1989. This spectacular increase in land price also led to parallel increase of house prices. Monthly rent for the average dwelling unit in Japan increased from 17,908 Yen in 1978 to 33,214 Yen in 1988— an 85% increase. For Tokyo the corresponding figures are 25,160 Yen and 49,501 Yen- an increase of 97%.[10) By contrast between 1979 and 1989, CPI rose from 69.73 to 89.35 (2000 = 100, World Development Indicators Database) — which is an increase of approximately 2.56% a year. No individual group in the CPI, the WPI or the Domestic Corporate Goods Price Index shows an annual rate of increase even remotely close to that of the real estate and housing group. The contrast clearly demonstrates that the price bubble was contained in land and

[10) Unless otherwise stated, source of all statistical data in this section is Statistics Bureau and the Director-General for Policy Planning (Statistical Standards), Japan.

Table 1 Percentage Increase of Land Price in Metropolitan Areas (All Categories of Land and Commercial Land)

	All Land			Commercial Land		
	Tokyo	Osaka	Nagoya	Tokyo	Osaka	Nagoya
1979	12.0	8.4	8.6	8.0	6.3	4.9
1980	15.4	11.6	12.0	11.2	9.2	7.5
1981	8.8	9.3	8.7	6.7	8.0	6.0
1982	5.2	6.4	5.8	4.7	5.8	4.8
1983	3.2	4.0	3.0	4.3	3.7	2.6
1984	2.6	3.4	1.9	5.4	4.2	2.3
1985	3.2	3.1	1.7	8.6	5.0	3.0
1986	10.4	3.8	1.8	23.6	9.7	4.4
1987	57.5	7.9	3.0	76.1	19.9	7.0
1988	22.6	27.0	12.8	15.8	36.4	20.1
1989	3.5	35.6	14.7	1.9	36.1	16.8

Source: Statistics Bureau and the Director-General for Policy Planning (Statistical Standards), Japan.

land-based properties alone.

The moot question is how much did the increased activity in real estate and housing markets contribute to i) value addition and ii) demand for goods and services. We will first examine the issue of value addition.

Value addition: In spite of the hectic activity in the housing market, the number of new housing unit construction did not show any significant increase during the years 1979 to 1989. For example, during 1979-1989, the average number of new houses started in Tokyo prefecture was 171,584 per year which was actually fewer than the average of the previous decade, 178,966; and was not significantly larger than the average of the next decade after the bubble had burst, namely, 167,924. Data for all other prefectures show the same pattern. Thus the increase of house prices was not accompanied by any significant new construction above the long run trend.

Between 1979 and 1989 private investment in dwellings increased from

15,575.4 billion Yen to 23,522.4 billion Yen. Considering that the construction deflator increased from 77.7 to 93.3 during the period, this represents an annual growth rate of 2.8%. This annual rate is not significantly different from the long run trend. Therefore we do not find any indication of increase in value addition beyond the long run trend coming from private housing.

The bubble comprised not just private dwellings but also commercial and entertainment properties — like office and shopping areas, entertainment parks, natural springs, golf greens and so on — and so we should check the profile of real investment in those areas. Total investment in private construction in commerce and service sector properties in 1979 was 6,979.7 billion Yen increasing to 13,626.7 billion Yen in 1989. This represents an annual real growth rate of 6.8% and compares very poorly against 20.5% annual real growth rate in the previous decade.[11)]

Demand for goods and services: We would expect the bubble to contribute to demand for goods and services through two probable routes: from investment spending in construction and housing, and consumption spending from the wealth effect of the bubble.

We have noted above that the bubble did not lift investment in either housing or commercial construction above trend rates. Hence we will examine the other probable avenue — the possible extent of wealth effect on consumption. Japan's consumption is thought to be significantly influenced by wealth (see, for example, Hayashi, 1986)[12)] and hence a small variation in wealth may create significant impact on consumption. However MPC out of different forms of wealth is expected to be different. An OECD estimate finds that while Japan's MPC from financial wealth at 7% is one of the

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11) Our estimate of private construction investment during 1979-1989 is biased upwards because Nippon Telegraph and Telephone Corporation and Japan National Railway Company were privatized in April 1985 and April 1987 respectively, thereby shifting from government construction to private construction.

12) Hayashi's study of Japan's high postwar saving rate suggests that it can be largely explained by the destruction of the war. The Japanese needed to save at a high rate for decades to replace the lost wealth. Saving rate fell when wealth was restored.

highest among the OECD countries, its MPC from housing property is between 1% and 2% and is one of the lowest (Catte *et al*., 2004). Effect of housing wealth is expected to be greater in countries with more sophisticated mortgage and financial markets that consumers can use to leverage housing wealth to get liquidity or directly transform it into liquidity. 'Equity extraction' is relatively rare in Japan. This perhaps explains why Japan appears to have the largest difference between the marginal propensity to consume from financial wealth and the marginal propensity to consume from housing wealth of all the major industrial counties.

The reason we do not expect any significant wealth effect on consumption during the bubble is that during the period the household sector's financial wealth fell as its housing assets increased. Housing assets increased from 10% in 1970 to 14 in 1980 and then fell to about 8% in 1990. However during the rise in housing assets households increasingly got into debt. Growth rate of household debt was much higher than the growth rate of nominal GDP in the late 1980s.[13)] Given that MPC out of financial wealth is significantly larger than that from housing wealth, we expect no positive wealth effect in this period.

3. THE SHORT RUN MODEL

Goods and money market open with a stock of bonds and money, an inflation expectation and a real interest rate, denoted respectively by B, M, π and r. These markets close in an equilibrium that determines real output Y and nominal interest rate i. Net supply of new bonds during the period changes the existing stock and determines B and r for the next period. Inflation expectation also is revised according to the equilibrium outcome of the period. A new period then begins with the new values of B, π, r and exogenously determined M. The labour market is represented by a Phillips curve which is instrumental in determining the actual inflation rate.

[13)] Economic Planning Agency (1994).

3.1. The Bond Market

We will begin the account with the events of the bond market. Assets whose prices are the subject of the bubble are financed by borrowing i.e. by the supply of new bonds. This supply is driven by expectation of capital gains. We will use the growth rate of the economy as a proxy for asset price expectation. Writing respectively *b* and *y* for the natural logs of *B* and *Y*, the growth rate of stock of bonds is written as

$$\dot{b} = \mu_0 + \mu\left(\dot{y} - g\right); \quad \mu,\ \mu_0 > 0. \tag{1}$$

In equation (1) *g* denotes the natural rate of growth. We will also use $\bar{Y}(t)$ to denote the natural rate of output in period *t*, and $\bar{y}$ for the natural log of $\bar{Y}$.[14] Thus $g = \frac{1}{\bar{y}}\frac{d\bar{y}}{dt} = \dot{\bar{y}}$.

Net supply of new bonds is absorbed by the market through the adjustment of real interest rate *r*. Lenders' portfolios contain both money and bonds, so that the demand for each is affected by the stock of the other. We can write lenders' optimal bond to money ratio as $R = R(\pi,\ r),\ R_\pi > 0,\ R_r > 0,$ and assume that in any general equilibrium the optimal ratio is attained. This would imply three properties of lending behaviour.

i) Given π and *r*, a larger holding of bonds must accompany a larger equilibrium holding of money. Hence $L_B > 0$, where *L*(.) denotes the real demand for money.
ii) Second, given *M* and π, *r* has to increase if the stock of bonds increases, $r_B > 0$.
iii) Finally, the desired portfolio ratio may change across periods as *r* and π change. We can write $\dot{R}/R = \phi\left(\dot{r},\dot{\pi}\right),\ \phi_1 > 0,\ \phi_2 > 0.$ Further if the

[14] Equation (1) and the investment function introduced below together imply that retained profits and the repayments of debt adjust residually. The fluctuation of retained profits and debt repayment can be analysed as a source of short term cycles. We ignore these cyclical effects as stated in the introduction.

economy attains a steady state wherein $\dot{\pi}=0$, then along that steady state $\dot{R}/R=\varphi(\dot{r}),\ \varphi'>0.$

Recalling that R is the optimal ratio of bond to money holding and that it is always attained in equilibrium, the ratio $\dot{R}/R$ along any equilibrium path is simply the difference between the growth rates of bond stock and money supply, i.e. $\dot{b}-\dot{m}.$ Further, if the economy attains a steady state where $\dot{b}\neq\dot{m},$ then r will continue to change after the attainment of the steady state.

3.2. Markets for Goods and Money

Goods market clears when real output equals real expenditure. We are assuming a closed economy and no demand by the government. As explained earlier, open economy and public expenditure aspects are not germane to the problem examined in this paper. Accordingly the goods market equilibrium condition is

$$Y=C(Y,\ r)+I(Y,\ r,\ B),\ C_Y>0,\ C_r<0,\ I_Y>0,\ I_r<0,\ I_B<0. \qquad (2)$$

In equation (2) $C(.)$ and $I(.)$ denote the aggregate consumption and investment functions. B is an argument in the investment function and we assume $I_B<0.$ By this assumption we recognise that a larger stock of debts implies a larger repayment obligation (for any given r) and hence a strain on net cash flow and investment. However the qualitative results of the paper do not change if $I_B = 0$. We have not used B as an argument in the consumption function because the wealth effect of bonds on aggregate consumption has been found to be small or negligible- perhaps because among the consumers bonds are wealth to lenders but liability for borrowers.

Money market equilibrium condition is

$$\frac{M}{P}=L(Y,\ i,\ B),\ L_Y>0,\ L_i<0,\ L_B>0. \qquad (3)$$

P is the price level and *M/P* the real quantity of money. In the short run *P* is taken as given. Assuming that equations (2) and (3) are solvable, they would yield the unknowns *Y* and *i* as functions of the given variables

$$i = i\left(\frac{M}{P},\ B,\ \pi\right), \tag{4}$$

and

$$Y = Y\left(\frac{M}{P},\ B,\ \pi\right). \tag{5}$$

The short run system (2) and (3) is assumed stable, i.e. a shift of any of the given variable would lead to a dynamics that converges to a short run equilibrium. The stability conditions are $C_Y + I_Y < 1$ and $\Delta \equiv L_i(C_Y + I_Y - 1) - (C_r + I_r)L_Y > 0.$ Using these conditions we get the signs of the effects of (*m/P*), π and *B* on *Y*

$$Y_{(M/P)} = \frac{-(C_r + I_r)}{\Delta} > 0,$$

$$Y_{\pi} = \frac{(C_r + I_r)L_i}{\Delta} > 0,$$

$$Y_B = \frac{-I_B L_i + (C_r + I_r)L_B}{\Delta} < 0.$$

4. THE LONG RUN SYSTEM AND STABILITY

For analysing the long run dynamics we will use a reduced log-linear form of (5)

$$y = \alpha(m - p) + \beta b + \gamma\pi, \tag{6}$$

where m and p respectively denote log M and log P. The signs of coefficients in (6) are based on the partials of Y established above, so that $\alpha > 0,\ \beta < 0,\ \gamma > 0.$

Define

$$x = y - \bar{y} = \alpha(m - p) + \beta b + \gamma\pi - \bar{y}. \tag{7}$$

Differentiating (7) gives

$$\dot{x} = \alpha\dot{m} - \alpha\dot{p} + \beta\dot{b} + \gamma\dot{\pi} - g. \tag{8}$$

Substituting (1) in (8)

$$\begin{aligned} &\dot{x}(1 - \beta\mu) = \alpha\dot{m} - \alpha\dot{p} + \beta\mu_0 + \gamma\dot{\pi} - g, \text{ or} \\ &\dot{x} = \frac{1}{(1 - \beta\mu)}\left(\alpha\dot{m} - \alpha\dot{p} + \beta\mu_0 + \gamma\dot{\pi} - g\right). \end{aligned} \tag{9}$$

Since $\beta < 0$ and $\mu > 0$ we have $1/(1 - \beta\mu) < 1$. Equation (9) shows that the effects of increase in real money on the growth of real output is reduced by a drag factor. The same is true of the effect of inflation expectation. If real money or inflation expectation increase, there is a resulting growth in real output. But a unit growth of output generates an increase in borrowing for the speculative assets by μ, which raises real interest rate and reduces output by $\beta\mu$. Equation (9) describes the net effect on growth.

We use a Phillips' curve relation to determine the inflation rate $\dot{p}$

$$\dot{p} = \varepsilon x + \pi,\ \varepsilon > 0. \tag{10}$$

Expected inflation is assumed to follow the adjustment rule

$$\dot{\pi} = \theta(\dot{p} - \pi), \ \ \theta > 0. \tag{11}$$

From (10) and (11) we get

$$\dot{\pi} = \theta\varepsilon x. \tag{12}$$

Substituting (10) and (12) in (9) we have

$$\dot{x} = \frac{1}{(1-\beta\mu)}\left\{\alpha\dot{m} - \alpha(\varepsilon x + \pi) + \beta\mu_0 + \gamma\theta\varepsilon x - g\right\}. \tag{13}$$

Equations (12) and (13) define the long run dynamics of (π , x).

The steady state of the model is characterised by $\dot{x} = \dot{\pi} = 0$, which implies $x = 0$, $\dot{y} = g$, and $\dot{b} = \mu_0$. Steady state value of π is

$$\pi^* = \dot{m} - \frac{g - \beta\mu_0}{\alpha}. \tag{14}$$

Let the Jacobian for the system (13) and (12), arranged in that order be

$$J = \begin{vmatrix} f_{11} & f_{12} \\ f_{21} & f_{22} \end{vmatrix}$$

Then $f_{11} = \dfrac{1}{(1-\beta\mu)}\left(-\alpha\varepsilon + \gamma\theta\varepsilon\right)$, $f_{12} = \dfrac{-\alpha}{(1-\beta\mu)}$, $f_{21} = \theta\varepsilon$, $f_{22} = 0$.

The characteristic equation is

$$\lambda^2 + \frac{(\alpha\varepsilon - \gamma\theta\varepsilon)}{(1-\beta\mu)}\lambda + \frac{\alpha\theta\varepsilon}{(1-\beta\mu)} = 0.$$

Since $\alpha\theta\varepsilon > 0$, both roots of the equation are negative if and only if

$(\alpha\varepsilon - \gamma\theta\varepsilon) > 0.$ We rewrite this condition as

$$\varepsilon(\gamma\theta - \alpha) < 0. \tag{15}$$

The stability condition (15) is the same as Cagan's condition for stability in standard models without explicit bond markets.[15] In our model a unit output shock raises inflation by $\varepsilon,$ inflation expectation by $\varepsilon\theta$ and then output by $\varepsilon\theta\gamma.$ At the same time the inflation reduces real money supply by $\varepsilon,$ and hence output by $\varepsilon\alpha.$ Cagan's condition for stability requires the net result of these two opposing effects to be negative as in (15). Thus bond financing of non-produced assets envisaged in (1) does not make the stability condition any different than in standard models.

5. DISINFLATION BIAS

The model developed in this paper has a significant disinflation bias compared to conventional macroeconomic models. Equation (14) predicts a smaller steady state inflation rate for a given rate of money and output growth compared to the expression $\dot{m} - g$ that arises in standard models.

In conventional models $\beta = 0.$ Secondly, *r* and *i* stabilise in the steady state, so that the growth of demand for real money comes only from the growth of output. Hence the steady state ratio $\frac{Y}{M/P}$ converges to $\frac{\partial Y}{\partial(M/P)},$ giving $\alpha \equiv \frac{\partial Y}{\partial(M/P)} \cdot \frac{(M/P)}{Y} = 1.$ Under these conditions equation (14) would reduce to the standard expression $\dot{m} - g.$

By contrast, $\beta < 0$ in our model. Secondly, *r* and hence *i* continue to change after the steady state is attained if $\dot{b} = \mu_0 \neq \dot{m}.$ Therefore in general,

[15] By applying the Hopf bifurcation theorem it can be shown that there is a closed orbit in our dynamic system.

$\frac{Y}{M/P} \neq \frac{\partial Y}{\partial (M/P)}$, and $\alpha \neq 1$. These two factors alter the steady state inflation from the standard expression $\dot{m} - g$. Compared to $\dot{m} - g$, (14) is necessarily smaller if $\alpha < 1 - (\beta\mu_0 / g)$. For all such values of α, our model has a disinflation bias.

In economic terms the bias can be traced to two separate factors. First, the negative parameter β tends to reduce the inflation rate for any given rate of money supply growth. Intuitive explanation is that the growth of output triggers additional speculative lending and increase of bond stock. The increase of bonds also increases portfolio demand for money and thus demobilises a part of money from use in transactions. Hence the inflation effect of any given $\dot{m}$ is lessened.

The second factor is that some more money is demobilised if nominal interest rate is falling — a very likely outcome of our model. To appreciate, consider the case $\dot{m} > \mu_0$. In that case, in the steady state $(\dot{R}/R) = \dot{b} - \dot{m} = \mu_0 - \dot{m} < 0$. Hence $\dot{r} < 0$ and given that $\dot{\pi} = 0$ in the steady state, $\dot{i} < 0$. This falling nominal interest rate impounds growing amount of money reducing its impact on inflation. When nominal interest rate is falling, income elasticity of demand for real money is greater than unity because of the extra demand on account of falling interest rate. Note that α is the reciprocal of income elasticity of demand for real money and hence $\alpha < 1$ in this situation. From (14) inflation rate will be less than $\dot{m} - g$ if $\alpha < 1 - (\beta\mu_0 / g)$ and a sufficient condition for this is $\alpha < 1$.

The above example uses $\dot{m} > \mu_0$ which results in $\alpha < 1$ and disinflation bias. However $\alpha < 1$ is a strongly sufficient requirement. From (14), disinflationary bias exists not only for $\alpha < 1$, but also for α in $1 - (\beta\mu_0 - g) > \alpha > 1$.

The value of α depends on $\dot{i}$. Noting that $(\dot{R}/R) = \dot{b} - \dot{m} = \mu_0 - \dot{m} < 0$ higher value of $\dot{m}$ leads to a higher rate of fall of i in the steady state. Hence the higher is $\dot{m}$, more is the additional money demand on account of interest rate fall and larger is the income elasticity of real money demand. Hence a higher growth rate of money reduces α making faster monetary expansion less rather than more effective in fighting disinflation.

We conclude this discussion with the summary observation that a tendency for lower inflation rate is introduced by pro-cyclical growth of debt for financing non-produced assets. Further an increase in the growth rate of money makes it less effective in combating the tendency.

6. MONETARY POLICY

This section looks at the standard policy options when an economy is experiencing a bubble. We find that the possibility of arresting disinflation without worsening the bubble is severely limited. A policy that can be theoretically conceived as appropriate is not practical; it needs to combine contradictory features of policy in a contrived way.

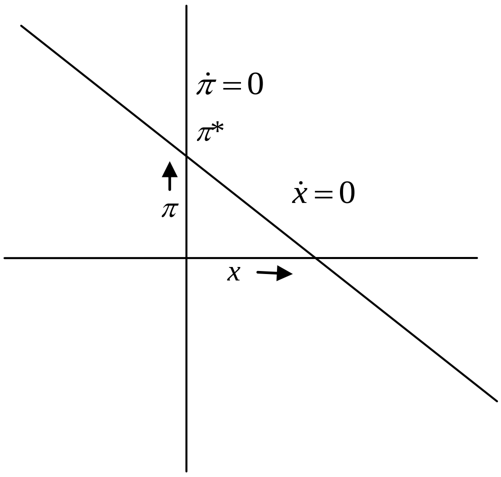
The phase diagram for the system, assuming it is stable, is presented in figure 1. The steady state equilibrium is at $(0, \pi^*)$. Depending on $\dot{m}$, π^* could be positive or negative. In the area below the line $\dot{x} = 0$, $\dot{b} > \mu_0$ and the bubble continues to grow. Assume that the economy is currently in this region and experiencing a bubble. We can then analyse the effects of monetary policy options on the inflation rate and the growth of the bubble. We consider two standard policies.

6.1. Money Supply Follows Growth Rate

The stock of debt grows with the growth of the economy (equation (1)) increasing the demand for portfolio money with growth. Hence a possible option is to allow money supply to grow faster when the growth rate is higher in order to neutralise the growth in demand. Consider such a pro-cyclical supply rule

$$\dot{m} = m_0 + \rho(\dot{y} - g) = m_0 + \rho\dot{x},\ \rho>0. \tag{16}$$

Figure 1 Dynamic System



In this rule m_0 represents the long run rate of growth of money supply while the rest stands for the cyclical part of supply. Substituting the rule in (13) we get

$$\dot{x}=\frac{1}{(1-\beta\mu-\alpha\rho)}\left\{\alpha m_0-\alpha(\varepsilon x+\pi)+\beta\mu_0+\gamma\theta\varepsilon x-g\right\}. \qquad (17)$$

The stability condition for the system given by (17) and (12) is the same as (15).

The steady state solution for inflation is $m_0-((g-\beta\mu_0)/\alpha)$. It implies that higher steady state inflation can be attained by committing to a higher long run rate of growth of money supply m_0 in rule (16).

What is the effect of the rule on the bubble? Since $\rho<0$, $\dot{x}$ along the trajectory (17) is larger than along (13). In view of (1), this should have worsening effect on the bubble.

Interestingly, a supply rule that goes against the growth rate may work if it uses an unorthodox combination of high long run rate of supply and a severely punishing anticyclical component. To see this, let $\rho<0$ in (16).

The steady state inflation rate is not altered, and is $m_0 - ((g - \beta\mu_0)/\alpha)$. By increasing m_0, a suitably high inflation rate can be supported in the steady state. Now for the effect on the bubble. Since $\rho < 0$, $\dot{x}$ along the trajectory (17) is smaller than along (13). Note that in this course of policy, part of the countercyclical effect ρ on the bubble will be lost by less than unit income elasticity of demand for money, $\alpha < 1$. The policy has a higher chance of denting the bubble, the larger the absolute value of ρ.

This monetary policy rule would thus have to combine two contradictory aspects: high long run growth of money supply with a severe anticyclical component. It is obviously impractical.

6.2. Countercyclical Inflation Targeting

Countercyclical money supply policy generally adds to stability, but as we have seen, stability is not a problem in this model.[16] To tackle the disinflationary tendency, it is not anticyclical supply *per se*, but a higher inflation target is important. However, a target of higher inflation essentially would mean committing to a high long run growth rate of money supply. We illustrate this with the supply rule:

$$\dot{m} = m_0 + \rho(\dot{p}_0 - \dot{p}), \quad \rho > 0. \tag{18}$$

To operate (18), the target inflation rate $\dot{p}_0$ has to coincide with the steady state solution of π, namely $m_0 - ((g - \beta\mu_0)/\alpha)$ or else the system will be over-determined. Suppose we follow this specification. Then substituting (18) in (13) gives

$$\dot{x} = \frac{1}{(1-\beta\mu)}[\{\alpha m_0 + \alpha\rho\dot{p}_0 + \beta\mu_0 - g\} - \alpha(\rho+1)\pi + \{\gamma\theta\varepsilon - \alpha\varepsilon(\rho+1)\}x] \tag{19}$$

[16] Asada (2006) examined the inflation targeting policy in a dynamic Keynesian model with debt accumulation. However, he mainly focused on the expected rate of inflation in the model.

The system formed with (19) and (12) has a steady state solution $\dot{p}_0 = m_0 - ((g - \beta\mu_0)/\alpha)$ and $\dot{m} = m_0$. The stability condition is $\varepsilon\{\gamma\theta - \alpha(\rho + 1)\} < 0,$ which necessarily holds if (15) is satisfied.

Now suppose that the supply rule is to be used to tackle the disinflationary tendency with a higher inflation target, say π'. In that case, $\pi' = \dot{p}_0$ and $m_0 = \pi' + ((g - \beta\mu_0)/\alpha)$.

Recall that the steady state inflation without the countercyclical policy is $\dot{m} = \pi^* + ((g - \beta\mu_0)/\alpha)$. Hence we have $m_0 - \dot{m} = \pi' - \pi^*$. The higher the inflation target the higher is the long run rate of money supply m_0 compared to the pre-policy rate $\dot{m}$.

What effect will this have on the bubble? It depends on the new target rate in relation to the prevailing inflation rate when the policy is adopted. Let $\dot{x}_{19}$ and $\dot{x}_{13}$ denote $\dot{x}$ on the trajectories (19) and (13) respectively. Then

$$
\begin{aligned}
\dot{x}_{19} - \dot{x}_{13} &= \frac{1}{(1-\beta\mu)}[\alpha m_0 + \alpha\rho\pi' - \alpha\dot{m} - \alpha\rho\pi - \alpha\varepsilon\rho x] \\
&= \frac{\alpha}{(1-\beta\mu)}[m_0 + \rho\pi' - \dot{m} - \rho(\pi + \varepsilon x)] \\
&= \frac{\alpha}{(1-\beta\mu)}[m_0 + \rho\pi' - \dot{m} - \rho\dot{p}] \\
&= \frac{\alpha}{(1-\beta\mu)}[m_0 - \dot{m} + \rho(\pi' - \dot{p})].
\end{aligned}
$$

We have noted that $m_0 > \dot{m}$. If the policy is introduced when the current inflation rate $\dot{p} < \pi'$, then $\dot{x}_{19} - \dot{x}_{13} > 0$ implying that $\dot{x}$ and therefore $\dot{b}$ will be higher than earlier. Thus as the disinflation is combated, the bubble problem worsens.

The bubble could ease in this course of policy only if the prevailing inflation at the time of initiating the policy is sufficiently higher than the targeted inflation to ensure $m_0 + \rho(\pi' - \dot{p}) < \dot{m}$. Given that $m_0 > \dot{m}$, it would require not only $\pi' < \dot{p}$ but also a large ρ. This possibility appears unlikely because the context would generally demand setting

$\pi' > \dot{p}$.

Hence if a countercyclical money supply rule is effective in increasing the steady state inflation rate, it is more likely that it will worsen the bubble.

7. CONCLUSIONS

The model in this paper is based on a stylized view of the Japanese situation during the bubble period. The most important feature is the fact that while the bubble grew relying on the robust growth of the economy, the sectors where the bubble was occurring did not generate significant income effect for the rest of the economy. Firstly, the bubble assets did not embody much current value added. Secondly, the capital gains from the bubble were mostly spent on the same assets, thus preventing significant flow of income into the rest of the economy. The contribution of the bubble to the rest of the economy was a higher demand for portfolio money and some increase of interest rate resulting from increased borrowing.

The intuition of the model is fairly simple. The bubble continues by creating debt. The growth of debt increases the real demand for money, because lenders would want to maintain a desired ratio between bond and money holding. By creating speculative debt, income growth adds to money demand not only from ordinary income elasticity of transaction demand but also from increasing portfolio demand. Therefore a given growth rate of real money supply will generate an inflation rate lower than itself. To maintain an acceptably high inflation rate, the long run growth rate of money has to be large. Also it has to be large enough to compensate for extra demand arising from the fall in nominal interest rate, which lowers the debt-money ratio of lenders.

Since the demand for speculative assets grows cyclically, the real demand for money also grows cyclically. Hence a money supply rule that follows the growth rate can combat disinflation. But this would also ease the pressure on the interest rate, stimulate the growth rate of the real economy and thus worsen the bubble. If money supply is countercyclical to growth, it will discourage growth of the economy by firming up the interest rate, and thus have an effect on the bubble. But in this course, the baseline long run money supply has to be large to counter disinflation. The procedure will thus have to combine two usually opposed components of policy.

Targeting a high inflation rate with countercyclical money supply will, no doubt, achieve the target. But the effect on the bubble will depend on the effects of the policy on the growth rate of the economy — whether it increases or reduces the interest rate. We have seen that it depends on the relation between the target rate and the prevailing inflation rate at the time of initiating the policy.

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