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ABSTRACT

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As David Miles has emphasised, however, the existence of multiple equilibria is a necessary condition for costless and non-binding messages – so-called “cheap talk” – to act in this way. By way of microfoundations, we appeal to Peter Diamond’s classic model of search, where the positive externalities offered by ‘thick’ markets can generate different equilibrium levels of production.

What of the objection that “cheap talk” by the MPC may be used deliberately to mislead the Private Sector in order to assist the MPC achieve its objectives? We show that this is not true for symmetric inflation targeting, where ‘cheap talk’ selects the Pareto dominant equilibrium. (This contrasts with the case where high inflation is penalised, but not below target inflation).

JEL Classification: C72, E31, E52 and E58
Keywords: cheap-talk, coordination problems, equilibrium selection, monetary policy and multiple equilibria

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Macro coordination: Forward Guidance as 'cheap talk'?[1]

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Abstract

In the context of revived output growth and business confidence in the UK, we analyse *forward guidance* as a 'coordination device', indicating that monetary accommodation will be available for a welcome and long-awaited shift out of prolonged recession.

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1. Introduction

The dimensions of the UK 'productivity puzzle' can be seen by comparing recent developments with long-run trends. Let labour productivity be divided into two components: the contributions

from capital deepening and from TFP growth (the Solow residual). As shown in Table 1, over the last 25 years, each of these has contributed about 1% to the trend rise of 2% p.a. in labour productivity across the whole economy (col 1, in bold).

Per cent	Long-run avg. from 1978	2012 DQA			2013
		Q2	Q3	Q4	Q1
Labour productivity	**2.1**	-2.2	-2.4	-2.6	-1.9
Capital deepening	**1.1**	-0.1	-0.3	-0.3	-0.2
TFP growth	**1.0**	-2.0	-2.1	-2.3	-1.7

Table 1. Decomposition of whole-economy labour productivity capital deepening and the Solow residual

Recent experience, in the Great Recession since 2008, has been very different, with substantially negative figures for the Solow Residual and little positive contribution from capital deepening (except at the beginning of the recession when labour was shed and unemployment rose sharply by 2% to about 8% of the labour force). These two features are evident in the quarterly figures from 2012 Q2 shown in the table, where, instead of the one percent per year for each component, we see the contribution from capital deepening close to zero and that from TFP growth is substantially negative, around minus two percent.

We treat this as prima facie evidence that the economy lies inside the "production possibility frontier", customarily defined by an aggregate production function, including labour and capital, augmented over time by positive technical progress. As Miles (2013, p67) observes "[e]mployment declined, but by less than anticipated, in part because employers were mindful of the costs of rebuilding a workforce later, and workers accepted pay freezes to preserve their jobs." It has been suggested that many businesses transferred labour from "productive" to "less-productive" uses during recession. Recent evidence of revived output growth and business confidence, as discussed in Dale (2013), indicates a movement back towards the frontier, however. It is in this context that

we analyse *forward guidance* as a 'coordination device' promising monetary accommodation for this welcome and long-awaited shift back to normality.

The argument crucially depends on the existence of multiple equilibria in output levels for given factor endowments. This is, of course, a feature of the classic search equilibrium model of Peter Diamond (1982), although in his example multiple equilibria in production represented shifts in unemployment rather than labour productivity. Manning (1990) appeals to increasing returns to scale to generate multiple equilibria in terms of output and unemployment. A strong case of the existence of multiple equilibria is also made by Farmer (2013) in his paper entitled "The natural rate hypothesis: an idea past its sell-by date".

As in Miles (2013), our analysis involves comparing two alternative equilibrium paths for the economy, along each of which inflation is much the same. One we call *Stagnation*, with low productivity and high unit labour costs (and interest rates above the lower bound so as to avoid Stagflation); the other represents a *Recovery* path where high productivity growth keeps inflation at its target rate without any need to raise interest rates.

We indicate first how various outcomes result from different choices as to rates of productivity growth and interest rates. Then we specify objective functions for each player, assuming the Private Sector chooses the former and the MPC sets the latter, such that the two paths emerge as Nash equilibria of a policy game.

With illustrative calibration of key parameters, the Recovery path turns out to be Pareto superior to Stagnation, so what we have is effectively a "coordination" game with Pareto-ranked Nash equilibria. As a means to selecting the better equilibrium, it is often suggested that one of the players could send a message indicating its choice of action. If the message is costless to send and non-binding it is called *cheap talk.* Russell Cooper (1999, p.6) cites experimental evidence where it was found that "the Pareto-dominant equilibrium is achieved about 53% of the time from such one way communication".

In his discussion of 'cheap talk', however, Binmore (2007, p.68) sounds a warning note. 'We can talk to each other and agree to alter the way we do things.' he says, '[b]ut can we trust any agreement we might make?' He provides an illustration where there the message could be sent - not to secure shift from a bad to a good equilibrium - only to mislead the other player and to improve the payoff of the message-sender (who plans not to abide by his own message).

For the coordination game we consider below, where the MPC has a symmetric cost of missing the inflation target either because inflation is too high or too low, it turns out that the incentive to behave in this Machiavellian fashion is not operative. (But in an Annex we show how it might arise for a Central Bank that does not have symmetric costs, being more concerned with overshooting than with undershooting its target.)

2. Cheap Talk as a Coordination Mechanism

2.1 Four outcomes for labour productivity and inflation

Let ω denote the rate of wage inflation, π the rate of price inflation, γ the growth of labour productivity and r the policy rate. Assume price inflation reflects the excess of wage inflation over productivity growth:

$$\pi = \omega - \gamma$$

Let wage inflation be determined as a 'target rate', ω^*, modified by movements in the policy rate, so:

$$\omega = \omega^* - r$$

Later, the target rate of wage inflation will be specified as the MPC's inflation target, π^*, plus trend productivity, γ^* so $\omega^* = \pi^* + \gamma^*$; but for present we simply write:

$$\pi = \omega^* - r - \gamma$$

Assume that current real productivity growth can take one of two levels, $\gamma > 0$ or zero; and likewise the policy rate takes one of two levels, $r > 0$ or zero (to represent the lower bound). Then, given the target rate of wage inflation, ω^*, the rate of price inflation will depend simply on γ and r. If these are selected by the Private Sector and the MPC respectively, the *outcomes* for productivity and inflation can be expressed as in Table 2, where descriptive labels are attached as a mnemonic device:

	High policy rate	Low policy rate
Low productivity	0 , $\pi = \omega^* - r$	0 , $\pi = \omega^*$

growth	*"Stagnation"*	*"Stagflation"*
High productivity growth	$\gamma\ ,\ \pi = \omega^* - r - \gamma$ *"Recovery stymied by high policy rate"*	$\gamma\ ,\ \pi = \omega^* - \gamma$ *"Recovery with less inflation"*

Table 2. Four outcomes for productivity and inflation

2.2 Payoff functions for each of the players

To view these as the outcomes of a policy game requires *payoff functions* to be specified for each player. For simplicity, assume that the MPC cares only about reducing the deviation of inflation from its target level, π^*, so:

Payoff for MPC: $\quad -|\pi - \pi^*|$

Let private sector payoff increase with productivity growth, decrease with the policy rate and also with the interaction of the two, so

Payoff for PS: $\quad \gamma - r - \gamma r$

where the term $-\gamma r$ is introduced to capture the losses associated with unsold output when the Private Sector chooses high γ but policy-makers sets a high r.

Given the outcomes in Table 2, the payoffs for the two players are as shown in Table 3, following the convention that the payoff for the Private Sector (row player) is shown first, that for the MPC (column player) second:

	High policy rate ($r > 0$)	Low policy rate ($r = 0$)
Low productivity growth ($\gamma = 0$)	$-r, -\lvert\omega^* - r - \pi^*\rvert$	$0, -\lvert\omega^* - \pi^*\rvert$
High productivity growth ($\gamma > 0$)	$\gamma - (1+\gamma)r, -\lvert\omega^* - r - \gamma - \pi^*\rvert$	$\gamma, -\lvert\omega^* - \gamma - \pi^*\rvert$

Table 3. Payoff matrix.

2.3 Calibration – and the coordination game

Assume, as indicated above, that the target rate of wage inflation is the MPC's inflation target, π^*, plus trend productivity, γ^*, and that productivity recovers to match its trend rate, then the (High productivity, Low policy rate) will deliver price inflation at the MPC's target level. Assuming

assume specifically that $\pi^* = 2(\%)$, $\gamma = \gamma^* = 2$ and $r = 2$, then outcomes for productivity and inflation shown in Table 2 can be given numerically as follows:

	High policy rate	Low policy rate
Low productivity growth	$0\ ,\ \pi = 2$ "Stagnation"	$0\ ,\ \pi = 4$ "Stagflation"
High productivity growth	$\gamma = 2\ ,\ \pi = 0$ "Recovery stymied by high policy rate"	$\gamma = 2\ ,\ \pi = 2$ "Recovery with less inflation"

Table 4. Numerical outcomes for productivity and inflation.

where we use labels to characterise the nature of the outcomes in each cell.

With the same parameter values, the payoff matrix of Table 3 becomes the following:

	High policy rate ($r = 2$)	Low policy rate ($r = 0$)
Low productivity growth ($\gamma = 0$)	$\mathbf{-2,\ 0}$ ← "Stagnation" ↑	$\mathbf{0\ ,\ -2}$ ↓ "Stagflation"
High productivity growth ($\gamma = 2$)	$\mathbf{-4,\ -2}$ → "Recovery stymied by high policy rate"	$\mathbf{2\ ,\ 0}$ "Recovery with target inflation"

Table 5. Numerical payoffs in the policy game.

As indicated by the arrows in the Table, these payoffs may be used to find the best response of each player to strategies chosen by the other. It turns out that there are two Nash equilibria, where, by definition, neither player has the incentive to deviate: one is "Stagnation" in top left, the other "Recovery with target inflation" in bottom right, which are Pareto-ranked as the latter is preferred by both parties. The horizontal arrow in the top row, indicates that the best response for the MPC facing the risk of "Stagflation", due to faltering in productivity growth, would be to raise the policy rate even though this leads to "Stagnation", much as Paul Volcker did in US in the early 1980s. The horizontal arrow in the bottom row indicates that the best response for the MPC facing the risk of counteracting a recovery of productivity is to keep policy rates low, as David Miles (2013) argues in the CEPR ebook on Forward Guidance.

The vertical arrows indicate that, faced with low policy rates, the Private Sector will choose to increase productivity: but not if there is the threat of high rates.

2.4 Is the 'cheap talk' credible?

For coordination games with Pareto-ranked equilibria, there is a prima facie case for 'cheap talk', where the MPC can lead the way by promising low rates so as to encourage the Private Sector to increase productivity. This is one interpretation of what Forward Guidance is intended to do. But is this credible? Imagine that the game is stuck in the bad equilibrium and the MPC issues guidance to expect low policy rates. Might the MPC be playing a game – saying it will keep rates low even though it plans to raise them – simply as a device to get the private sector to help the MPC achieve its own targets?

The specific credibility problem just discussed will not arise if the payoff matrix has a structure where the message is what Farrell and Rabin (1996) call "self-signaling", meaning the message wouldn't be sent if the sender was planning to cheat! To see if forward guidance about low rates is "self-signaling" or not, we ask: if the MPC succeeds in persuading the Private Sector that it will maintain rates at the lower bound, does it then have the incentive to select high rates? The answer to this is No: because, as can be seen from the entries in the first column of Table 5, the payoff to the MPC will actually fall from 0 to -2 if the Private Sector switches to high productivity.

It is worth noting that the reason for the negative payoff for the MPC that arises in the (High productivity, High policy rate) case is that the boost to output would lead to price inflation falling below the target. The fact that this is not attractive to the MPC reflects the adoption of a symmetric inflation target, where undershooting is penalised equally with overshooting -- unlike the situation in the Eurozone where undershooting of the target generally seem less cause for concern[2].

Given the nature of this policy particular game, therefore, the claim that the private sector will not believe the statements from the MPC does not hold water. But in the Annex we show that a Central Bank that penalises overshoots in inflation more than undershoots may be tempted to send misleading messages.

[2] The recent ECB rate cut (on the 7th of November, 2013) to 25 bps, coming after this was first written, may indicate otherwise; but the action was apparently opposed by several influential members of the Executive Board.

3. Micro foundations for the policy game: adapting Diamond (1982)

The existence of multiple equilibria is a key feature of the macro coordination game described above. But what are the 'micro-foundations' that sustain such multiple outcomes? The answer, we believe, lies partly in the positive externalities offered by 'thick' markets: with models of search and matching, agents are more willing to produce and search if there are more people to meet and match.

In the classic Diamond (1982) paper, for example, the author 'drops the fictional Walrasian auctioneer and introduces trade frictions' to study trade coordination in a many person economy. After showing why there is more than one 'natural rate' of unemployment with trading frictions, Diamond suggests that 'one of the goals for macro policy should be to direct the economy towards the best natural rate'(p. 883). In what follows we use a stripped down version of his model to indicate how two such equilibria can emerge.

It is worth noting, however, that the Diamond model has a special feature we aim to relax, namely that it incorporates Say's Law: so supply automatically creates its own demand. How so? Trade is barter with 'all units ... swapped on a one-for-one basis and promptly consumed: consequently, with the demand of the employed being what they produce, and the demand of the unemployed being zero, a shift from a high to low unemployment equilibrium presents no problem of 'effective demand'. From a Keynesian perspective, however, with the marginal propensity to consume of less than one, some additional stimulus for demand will be needed to sustain such a shift – a lowering of the interest rate for example. That is how we see forward guidance, the promise that – in the face of greater supply (driven by higher private sector productivity) -- the monetary authorities will keep rates low enough to ensure there will be demand to match the recovery in productivity.

There has of course been a shift to higher unemployment in the UK since the crisis began; but it is the fall in labour productivity that has been far more striking. Accordingly we sketch an interpretation of the Diamond model with multiple equilibria in productivity rather than employment[3].

[3] Diamond(1982, p.884) notes that 'a similar model can be constructed with no unemployment and varying production intensity'.

3.1 Multiple equilibria in unemployment; and in productivity

In providing some micro foundations for the multiple equilibria of the policy game, we will simplify the Diamond (1982) model to a static setting, as follows.

Agents are identical ex ante and for convenience their number is of measure 1. They can choose to produce (employed) or not to produce output (unemployed). Assume the economy lasts for one period but with three stages. In stage 1, each agent has a random draw of the cost of production c from a probability density function (PDF) g(c), which is bounded below so $c \geq \underline{c} > 0$. Denoting the cumulative density function (CDF) as $G(c)$, therefore, $G(\underline{c}) = 0$ and $G'(c) > 0$. As an example, the cumulative density for an exponential PDF function is drawn as the schedule labelled $\underline{c}c$ in Figure 2, so the mapping from c to e along this schedule is simply $e = G(c)$. Note that for any given level of c on the vertical axis, the corresponding value of e represents the fraction of the population with production cost less than or equal to c.

In stage 2, given their cost of production, agents decide whether to produce one unit of output. But employed agents cannot consume their own output, so in stage 3 each has to exchange his/her output with another employed agent with matching probability of $b(e)$, where e represents the measure of employed agents. Those matched each consume their respective 1 unit of output, yielding utility of 1. Those not matched simply allow their output to rot, yielding utility of 0. As in Diamond (1982), we assume $b(0) = 0$, $b'(e) > 0$ and $b''(e) < 0$, i.e., the matching probability rises with the number of people in the market, but at a declining rate, as illustrated by the concave schedule $b(e)$ in Figure 2.

Assuming all agents are risk neutral, those who decide to produce in stage 2 will obtain the following utility

$$V = \max\{0, b(e) - c\} \qquad (1)$$

where $b(e)$ is the expected value of consuming 1 unit good after a successful exchange. (1) indicates that agents will produce only if expected benefit is greater than the known cost, i.e., $b(e) \geq c$ (and, of course, for any production to take place, it is necessary to have $\underline{c} \leq c \leq 1$). Note that agents will take $b(e)$ as given when making the production decision, i.e., they ignore the positive externality of their own private production.

As the schedule $b(e)$ is the benefit of production, and c is the cost of production, the intersection of these two schedules constitutes an equilibrium where benefit just covers the cost for the marginal

producer. As can be seen from the figure, multiple equilibria can emerge. In the case shown equilibrium at H Pareto dominates that at L. As e represents aggregate employment, Diamond (1982) suggests that L and H indicate two possible "natural rate of employment".

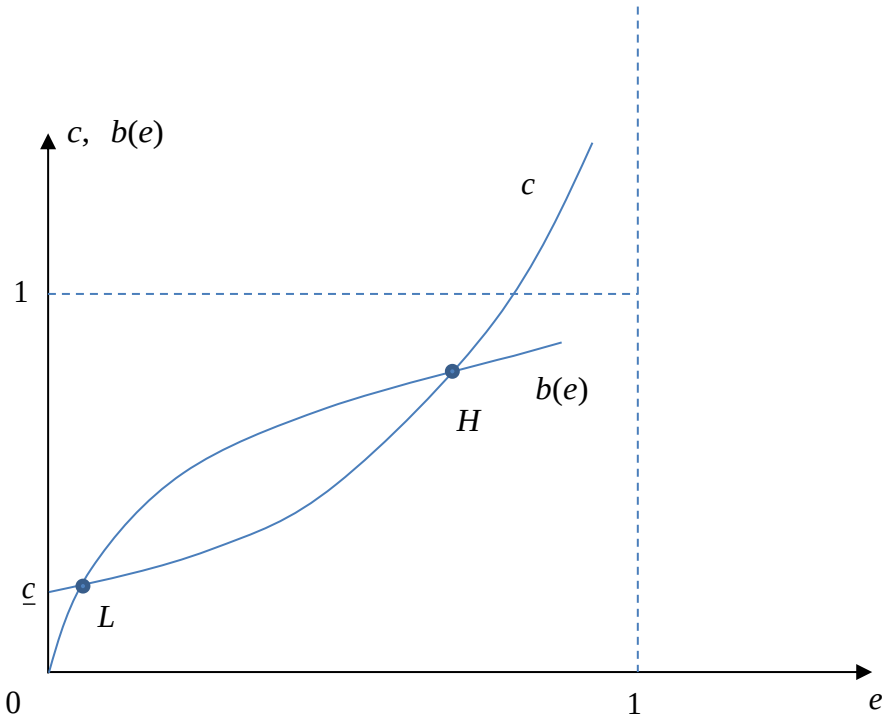

Figure 2. Search externalities and multiple equilibria.

[Technically, the equilibria may be derived as follows. Given (1), the fraction of agents employed at any given level of market clearing cost will be:

$$e = \int_{\underline{c}}^{c} g(x)dx = G[c] \qquad (2)$$

But if the cost of the marginal producer matches the benefit this implies

$$e = G[b(e)] \qquad (3)$$

where (3) is the fixed point equation determining equilibrium employment.

Equation (3) can be rewritten as

$$c \equiv G^{-1}(e) = b(e) \qquad (4)$$

where G^{-1} represent the inverse of G, and is the upper bound of the cost below which projects are undertaken. Since $G^{-1}(0) = \underline{c} > b(0) = 0$ and $\max G^{-1} = 1 \geq \max b(e)$, (3) has multiple equilibria as long as there is some e such that $G^{-1}(e) < b(e)$.]

3.2 Dropping Say's Law.

The assumption that the employed have purchasing power equal to the value of production while the unemployed have none is according to Diamond (1982, p.884). 'the counterpart in search equilibrium models of effective demand consioderations in disequilibrium models' He goes on to observe that 'the large difference of demand is a natural consequence of the absence of a capital market. [But] even with a capital market, there would remain demand differences beween individuals in the two states.'

For simplicity, assume the unemployed are unable to borrow (so consumption is constrained to benefits and past savings, if any[4]) but producers can place their savings in the capital market, with a marginal propensity to consume that depends, inversely, on the rate of interest. Then there will be a substantial difference of demand between the two individulas - but much less extreme than in the Diamond's model.

In this case, where the two levels of employment correspond to High and Low levels of output, the two equilibria can be represented as points on the IS curve shown in Figure 3, with a lower interest rate needed to ensure demand matches increased supply at the higher level of output.

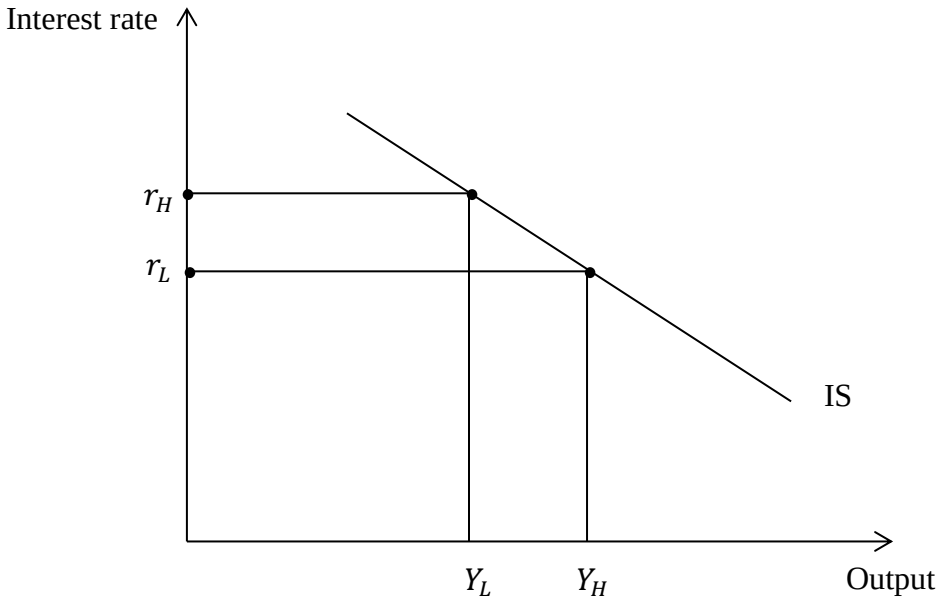

Figure 3. Ensuring demand matches increased supply by adjusting policy rates

[4] See, for example, Malinvaud (1985) or the three-state model of Algan and Ragot (2010).

3.3 Multiple equilibria in labour productivity?

As Diamond (1982, p.884) himself suggests, the equilibria outlined in Section 3.1 might also represent varying levels of production intensity for a given level of employment, an interpretation more relevant for our purpose. How might this go?

Assume, for example, that agents can either exert low effort and produce one unit of a nontraded good which can immediately be consumed, or put in more effort to produce a unit of a tradeable good which needs to be swapped before consumption. Let the net benefit of producing and consuming the nontradeable be denoted n and let c denote the private cost of producing for the market.

As before, let each agent first have a random draw of the cost of tradeable production c from a probability density function $g(c)$; then, given the private cost decides whether to produce for the market or not. If so, the traded output will need to be exchanged with another employed agent with matching probability of $b(e)$, where e represents the measure of agents who have decided to go to market.

Assuming all agents are risk neutral, those who decide to produce traded goods will obtain the following utility

$$V = \max\{n, b(e) - c\} \qquad (5)$$

Where n represents the utility of consuming n units nontradable and $b(e)$ is the expected value of consuming 1 unit tradable after a successful exchange. Equation (5) indicates that agents will produce and trade only if expected benefit less the private cost exceeds the net benefit from nontradeable production and consumption.

Thus all agents will be employed but there be the possibility of multiple equilibria, distinguished now, not by different levels of unemployment, but by different levels of labour productivity. (These equilibria are sketched in Figure 4.)

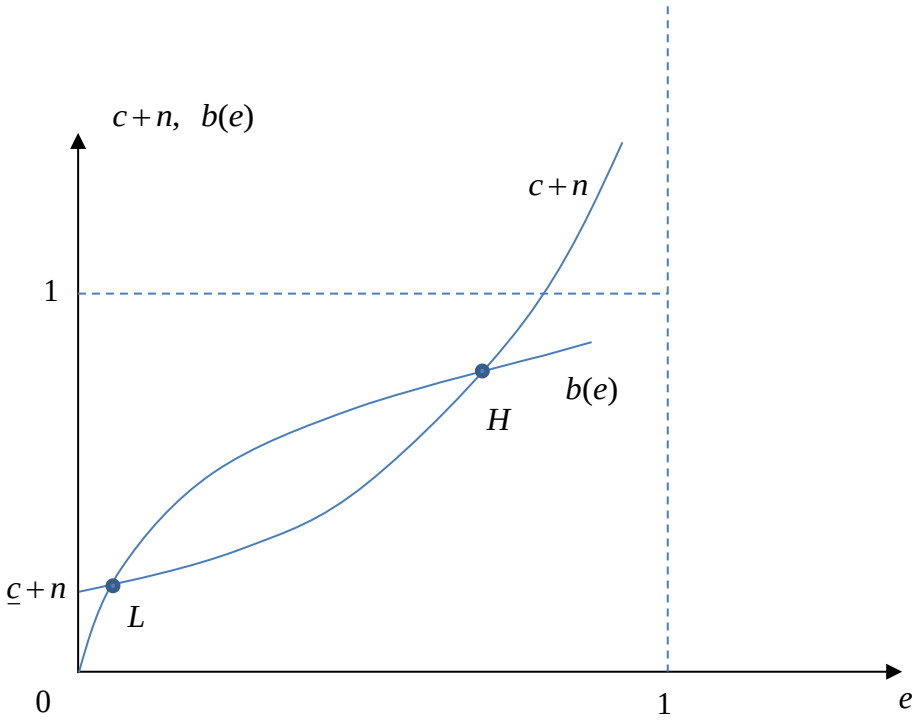

Figure 4. Search externalities and multiple equilibria in productivity.

If one thinks of an SME as a small subset of agents, then the two equilibria could represent different allocations of agents in SMEs as between more or less productive activities; with the shift of equilibrium corresponding to the reallocation of labour to 'more productive activities' -- as reported by Agents.

The Keynesian caveat that interest rate adjustments may be needed to ensure demand matches supply will still apply, however, even if we interpret the increase in output as an increase in productivity, with unemployment constant.

Conclusion

In this note we examine the notion that forward guidance is a "cheap talk" device to help select the Pareto-superior equilibrium in a coordination game. Specifically, the MPC can use the promise of monetary accommodation to encourage the Private Sector to increase labour productivity and so secure a non-inflationary recovery back to the production possibility frontier after the "train wreck" of financial crisis (as Miles (2013) describes it). Evidently, the existence of multiple equilibria in levels of production is a necessary condition for the "cheap talk" to have its desired effect. And we indicate how the search model of Diamond (1982) can be adapted for current purposes – including the need to adjust policy rates as between equilibria.

Another condition is that "cheap talk" not be open to abuse. In fact, the objection that "cheap talk" by the MPC may be used deliberately to mislead the Private Sector is not relevant to the illustration given in the body of paper -- a feature that depends on the symmetric nature of the MPC's objective function. The Annex looks at the case where "cheap talk" is not self-signalling.

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Annex. The case of the ECB?

Assume the payoff for ECB is

$$\begin{cases} -(\pi - \pi^*), if\ \pi - \pi^* > 0 \\ 0, otherwise. \end{cases}$$

So it is concerned about inflation above target but indifferent if inflation undershoots. If in addition, we choose the high policy rate as $r = 1$ but keep all the values of other parameters the same as the case in the text, this produces the following payoff matrix for the ECB.

	High policy rate ($r = 1$)	Low policy rate ($r = 0$)
Low productivity growth ($\gamma = 0$)	$\mathbf{-2}, \mathbf{-1}$ $\leftarrow$ "Stagnation" $\uparrow$	$\mathbf{0}, \mathbf{-2}$ $\downarrow$ "Stagflation"
High productivity growth ($\gamma = 1$)	$\mathbf{-4}, \mathbf{0}$ $\leftrightarrow$ "Recovery stymied by high policy rate"	$\mathbf{2}, \mathbf{0}$ "Recovery with target inflation"

Table 6. Payoff matrix for the ECB game.

As in the case of the MPC discussed in the text, there are two welfare-ranked Nash equilibria. But here forward guidance as to a low policy is not "self-signalling", so it is subject to the critique by Binmore that "cheap talk" may not be credible. One can see that if ECB plans to choose the high rate, it gains if it misleads the PS to believe it would choose the low rate. This reduces the effectiveness of using "cheap talk" as a mechanism to coordinate onto the welfare superior equilibrium.