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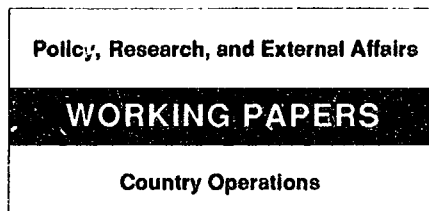
Should Price Reform Proceed Gradually or in a “Big Bang?”

Sweder van Wijnbergen

In a big bang. Under gradual decontrol, speculation and hoarding create shortages which make reformist governments vulnerable to early perceptions of failure — a strong argument *against* gradualism in the decontrol of prices.

* An earlier version of this paper has been circulated under the title *Intertemporal Speculation, Shortages, and the Political Economy of Price Reform*.

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Should countries such as Poland or the USSR move toward more flexible prices gradually or in a "big bang?"

Why is it that governments committed to eventual price flexibility so often seem to be unable to let go of "temporary" controls?

Why, after price increases early in a program of price controls, does output often rise at the same time that shortages seem to increase?

Van Wijnbergen argues that intertemporal speculation, hoarding, and the political economy of price control help explain these puzzles.

The interaction between shortages and the political vulnerability of reformist governments to early perceptions of failure is a strong argument *against* gradualism in the decontrol of prices.

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or in a "Big Bang?"

by
Sweder van Wijnbergen*

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1 Introduction

How should prices be decontrolled, slowly or in a big bang? Why is it that Governments committed to eventual price flexibility so often seem to be unable to let go of "temporary" controls? How can one explain that after price increases early in a program of price controls, one often sees output rise while at the same time shortages seem to increase also (Bresser (1987), Ortiz (1990))? This paper argues that intertemporal speculation, hoarding and the political economy of price reform go a long way towards explaining all these puzzles. We show that the interaction between shortages and political vulnerability of reformist governments to early perceptions of failure make for a strong argument against gradualism in the decontrol of prices.

Price controls have a long and disreputable history. Direct controls have often been used as substitutes for, rather than complements of, regular fiscal and monetary restraint; they thus ended up suppressing rather than curing inflation. More recently they have seen more sophisticated use, as transitional devices in a series of stabilization programs that also encompassed orthodox components (Mexico and Israel are successful examples).

The literature on price controls is thin. The microeconomic case against them is unassailable, so the literature that exists focuses on the question of whether their use can be justified on macroeconomic grounds. Dornbusch and Simonsen (1987) point to private coordination failures as a rationale for price controls after a tightening of monetary policy. Persson and van Wijnbergen (1989) show that the use of price controls can lower the cost to a government with credibility problems of signaling its true type, and thus the transitional unemployment costs of stabilization programs (cf also van Wijnbergen (1989) for arguments along this line). Calvo (1988) points out that credibility problems present a prima facie case for policy intervention. Mistaken beliefs cause a wedge between marginal rates of substitution and true rates of transformation and thus present a distortion.

This paper abstracts from the question of why price controls are used. Instead it asks a different question, one that is perhaps of greater practical importance. Assume that, for reasons good or bad, price controls are in place; how should they be terminated? How to escape from a period of controls? Both the coordination failure and the signaling approach suggest at most temporary

use of controls, in order to minimize output losses on the transition path towards lower inflation. Should in such an approach controls be abolished "cold turkey" or can a case be made for gradualism? The issue is in fact of much wider importance; all of Eastern Europe has been living under price controls, imposed for a very different reason. How should countries like Poland or the USSR move towards price flexibility, gradually or in a "big bang"?

Two factors complicate the issue and are at the core of this paper. In many cases price controls focus on commodities like basic grains, commodities that are eminently storable and can thus be used in intertemporal speculation. This seems to have been acute in for example Brazil, where in 1985 a series of price controls were introduced which were very much seen as temporary. Bresser (1987), who was the finance minister at the time, states: "There was shortage of merchandise in stores at the [same] time that stocks were accumulating in the factories".

The second factor is that opposition to rapid dismantling of controls is often based on claims of low supply response, and greatly bolstered if a strong supply response indeed fails to materialise. This is especially relevant in places like Eastern Europe, where experience with price responsive markets is limited. A less benign argument also lends support to a link between low supply response and opposition to relaxing controls. Shortages create rents, and rents will attract lobbyists in favor of continuation of those policies that create the rents.

We show the difficulties that these two factors create for gradual decontrol of prices. We endogenise the probability of a collapse of the reform program along the lines of the recent literature about the impact of political considerations on economic policy (see in particular Alesina and Cukierman (1990)) and show that such endogeneity in the presence of intertemporal speculation leads to a strong case against gradualism. Our core result is a forceful argument against gradual decontrol: we show that the smaller the initial price increase is, the lower the *observed* supply elasticity and the greater the probability that the program of reform will in fact be abandoned.

2 Intertemporal Speculation and the Supply Response to Gradual Price Deco rol.

2.1 The Basic Model

Assume a simple traded/non-traded disaggregation, with the country a price taker in international markets. The traded sector uses labor only, and at constant returns to scale; thus the real wage is fixed in terms of traded goods at say w . In the non-traded sector, production technology exhibits decreasing returns to scale, for example because there is a fixed factor in the background (say land); unit costs are therefore an increasing function of output. There are a large number of producers in the N sector, so that each individual producer has a negligible impact on the price, or, in the case of operative price controls, on aggregate shortages. Producer i 's output today equals Y_i , and output tomorrow y_i . Labor is the only variable factor. Each producer faces exactly the same technology and prices; there is complete symmetry. The cost function for current (future) production equals $C(c)$:

$$C = C(w, Y_i), C_w > 0, \frac{Y_i C_Y}{C} > 1 \quad (1)$$

$$c = c(w, y_i), c_w > 0, \frac{y_i c_y}{c} > 1$$

Capital letters represent first period variables and lower case letters second period variables. Decreasing returns imply increasing marginal costs, therefore C_{YY} and c_{yy} are both strictly positive. We will at one point in Section 5 assume that, at least over the price range considered, marginal costs increase, but at a constant or decreasing rate: $C_{YYY}, c_{yyy} \leq 0$. This guarantees that marginal costs increase at most linearly as output increases. For marginal costs to be bounded, the third order derivatives have to become strictly negative at some stage, but this condition is unnecessarily stringent if imposed over the entire feasible output range. We return to what the impact of this assumption is in Sections 4 and 5. Total output Y is the summation over all i of individual producers' output Y_i .

Output produced today (Y_i) can be sold today or stored for sale tomorrow. Since there are only two periods, output produced tomorrow (y_i) will

be fully so tomorrow. There is a storage technology ϕ : goods put in storage today, S_1 , are related to goods available from storage in period 2 according to the technology ϕ :

$$S_2 = \phi(S_1); \phi(0) = 0, 0 < \phi' \leq 1 \quad (2)$$

If $\phi' = 1$, the only cost of holding inventories S for speculative reasons is the interest income foregone on the income that selling in period one would have yielded. With $\phi' < 1$, part of goods stored goes to waste due to factors such as spoilage, pests and so on. Alternatively, there might be positive direct marginal costs of storage (direct as opposed to the indirect, opportunity cost of interest foregone on the money tied up in goods in storage).

The market clearing price in period 1 (2) is P^* (p^*). Controls are imposed in the non-traded sector only. Before the announcement of decontrol, prices were set at $P_0 = p_0 < P^*$, p^* . A cold turkey approach to decontrol implies the announcement of immediate transition to market prices in both periods. Gradual decontrol implies a price increase in period 1 that falls short of going to market prices: $P_g < P^*$; while a full move to market prices is announced for period two.

Call ρ the probability that the decontrol program will be abandoned. We assume that when the program of gradual decontrol is abandoned in period 2, the controls will be kept at their level of period 1, i.e. in that case $p_g = P_g$. A collapse of the cold turkey decontrol program does not have such an obvious default position; we assume that if the cold turkey program collapses, prices in period two will be set at the pre-decontrol level p_0 .¹ In the next section we will derive ρ endogenously by linking it to aggregate shortages. But there are too many producers and consumers for any individual agent to believe he or she can influence aggregate quantities. Thus both producers and consumers take ρ as given, although they are aware of the link between aggregate quantities and ρ .

¹ One could alternatively have assumed the same level as obtains under a collapse of the gradual regime; this would lead to the same results.

Producers

Consider the producer problem when a gradual decontrol program has been announced. The producer has to choose today's output Y and level of inventories S before knowing whether the Government will implement its announcements for period two or whether the program will collapse halfway.² However second period output can be chosen after period 2 Government policies have become clear. The second period production decision is thus a simple static optimization problem:

$$\begin{aligned} \text{No collapse: } & \text{Max}_{y^*} p^*(y^* + \varphi(S)) - c(w, y^*) \\ \text{Collapse: } & \text{Max}_{y_c} P_g(y_c + \varphi(S)) - c(w, y_c) \end{aligned} \quad (3)$$

where S is inherited from period one and thus not a decision variable anymore. This leads to the standard first order conditions:

$$c_y(y^*) = p^*; c_y(y_c) = P_g \quad (4)$$

Thus expected second period output equals:

$$\mathcal{E}_g y = \rho y_g + (1 - \rho) y^* \quad (5)$$

Clearly, $c_y(\mathcal{E}_g y) \neq \mathcal{E}_g p$ unless $c_{yyy} = 0$.

In period one producers have to choose output Y and the part of output put in storage S , knowing that in period two they will follow the rules laid out in equ. (4). This leads to the following maximization problem:

$$\begin{aligned} \text{Max}_{Y, S} & (Y - S)P_g - C(w, Y) + \delta \mathcal{E}((y + \varphi(S))p - c(w, y)) \\ & \text{subject to } 0 \leq S \leq Y \end{aligned} \quad (6)$$

δ is the market discount factor: $\delta = 1/(1+r)$ with r the real interest rate in terms of traded goods. δ is exogenous as we assume open international capital markets. \mathcal{E} is the expectations operator. $\mathcal{E}p$ equals:

² Subscripts i are omitted where that can be done without causing confusion.

$$\begin{aligned} \mathcal{E}_g p &= (1 - \rho) p_g^* + \rho P_g; \text{ Gradual Decontrol} \\ \mathcal{E}_{ct} p &= (1 - \rho) p_{ct}^* + \rho P_c; \text{ Cold Turkey} \end{aligned} \quad (7)$$

In general $p_g^* \neq p_{ct}^*$ for reasons explained below. We will however omit the subscript where this does not lead to confusion. The Lagrangean problem associated with (6) equals:

$$\begin{aligned} \text{Min}_{\lambda, \mu} \text{max}_{Y, S} L &= P_g(Y - S) - C(w, Y) + \delta \mathcal{E}_g (p(y + \varphi(S)) - c(w, y)) \\ &+ \lambda S + \mu(Y - S) \end{aligned} \quad (8)$$

with associated first order conditions:

$$\begin{aligned} C_Y &= P_g + \mu \\ -P_g + \delta \varphi' \mathcal{E}_g p + \lambda - \mu &= 0 \end{aligned} \quad (9)$$

The first order conditions in equ. (9) indicate that output will be increased until its marginal cost equals the value of an extra unit of output. This latter value equals the price plus, in the first period only, any additional shadow price picked up by inventories if they are constrained by the fact that additions to inventories cannot exceed total production (i.e. $C_Y > P_g$ when $\mu > 0$). As to inventories, they are increased or decreased so as to equalise the value of an extra unit of output today (P_g) with the discounted value of an extra unit tomorrow ($\delta \varphi' \mathcal{E}_g p$). Of course if inventories hit a corner solution (0 or Y), that equality cannot be brought about and either λ or μ becomes positive, driving a wedge between the marginal benefit of an extra sale today versus an extra sale tomorrow. Clearly, higher prices lead to higher output in each period:

$$\frac{dY}{dP_g} = C_{YY}^{-1} > 0; \quad \frac{dy^*}{dp_g^*} = c_{yy}^{-1}(y^*) > 0; \quad \frac{dy_c}{dP_g} = c_{yy}^{-1}(y_c) > 0 \quad (10)$$

The analysis for "cold turkey" decontrol follows along similar lines; just replace P_g by P^* and \mathcal{E}_g by \mathcal{E}_{ct} throughout.

Consumers

The consumer chooses between Traded (T) and Non-Traded (NT) goods each period, and allocates expenditure over today and tomorrow. Aggregate consumer behavior is approximated³ by an expenditure function; in the absence of rationing, this function gives the minimum level of expenditure to reach welfare level U at the given intra- and inter- temporal relative price structure:

$$\begin{aligned}
 E &= \text{Min } P^*A^h + A^f + \delta(p^*a^h + a^f) \\
 &\text{subject to: } U((A^h, A^f), (a^h, a^f)) \geq U \\
 &= E(\Pi(P^*, 1), \delta\pi(p^*, 1), U)
 \end{aligned} \tag{11}$$

A^i (a^i) is real consumption of good i in period one (two). The derivatives of E with respect to prices yield the Hicksian demand functions (Dixit and Norman (1980)). Π and π are exact price indices for current and future consumption corresponding to the utility structure underlying (8). We assume that Π and π are compatible with the assumption of unchanging static preferences across periods.

However, when price controls are binding, consumer demand is not met at quoted prices. In that case we can define virtual prices, which are the prices at which consumers would willingly consume the rations allocated to them (see Neary and Roberts (1980)):

$$\begin{aligned}
 P_v &: \frac{\partial E(\Pi(P_v, 1), \dots)}{\partial P} = A_R^h \\
 P_v &: \frac{\partial E(\dots, \pi(p_v, 1), U)}{\partial p} = a_r^h
 \end{aligned} \tag{12}$$

where A_R^h is the ration allocated in period 1 and a_r^h the ration allocated in

³ This is an approximation for two reasons. First, as introduced below, consumers have heterogenous expectations about supply elasticities and hence, presumably, about future prices. This introduces an aggregation error. Second, one should use the certainty equivalent of the second period price rather than the expected value. Since the indirect utility function is convex in prices, the two are not the same. The difference cannot be signed a priori, however, and will be ignored.

period 2. Under the preference structure assumed so far, it is easy to show that:

$$P_g < P^* < P_v ; p_g < p^* < p_v \quad (13)$$

Consumer behavior is furthermore restricted by the intertemporal budget constraint consumers face. In the case of gradualism, that constraint equals:

$$Y_T + P_g (Y - S) - C + \delta (\mathcal{E}_g^p (y + s) - c) = E \quad (14)$$

while under a cold turkey approach we get:

$$Y_T + P^* (Y - S) - C + \delta (\mathcal{E}_{cc}^p (y + s) - c) = E \quad (15)$$

Y_T is output in the traded good sector. The welfare gain due to a small increase in the ration is proportional to the wedge between controlled and virtual prices (Neary and Roberts (1980)):

$$E_U \frac{dU}{dA_R^h} = (P_v - P_g) \quad (16)$$

For given collapse probability ρ (which will be endogenized in the next section), the model is closed in each period by either a market clearing equation for the NT market in case market prices prevail, or by an equation defining virtual prices if price controls are operating and binding. The latter case is described by equations (12). Without price controls, market prices follow from NT goods market equilibrium:

$$\begin{aligned} Y - S &= \frac{\partial E}{\partial P} \\ y + \varphi(S) &= \frac{\partial E}{\partial p} \end{aligned} \quad (17)$$

If controls operate in one period, and market prices in the other, the appropriate sub-equations from (9) and (14) need to be selected.

2.2 Aggregate Supply Response, Hoarding and Gradualism.

To bring out the structure of the problem, consider first a simplified setup, without direct costs of inventory holding: $\phi' = 1$, and thus $s = S$. Assume there is enough curvature in the cost functions to always guarantee positive output in each period. But for positive Y it is clear that λ and μ cannot be positive simultaneously: If $Y > 0$, S cannot simultaneously be at the 0 and Y boundary. Consider first the case where $\lambda > 0$, $\mu = 0$. The first order conditions then simplify to:

$$C_Y = P_g; C_Y = \mathcal{E}_g P \quad (18A)$$

$$\frac{\delta \mathcal{E}_g P}{P_g} = 1 - \frac{\lambda}{P_g}; \lambda > 0 \quad (18B)$$

Since $\lambda > 0$, there is no inventory holding: $S = 0$, and all output is produced for sale in the period in which it is actually produced.

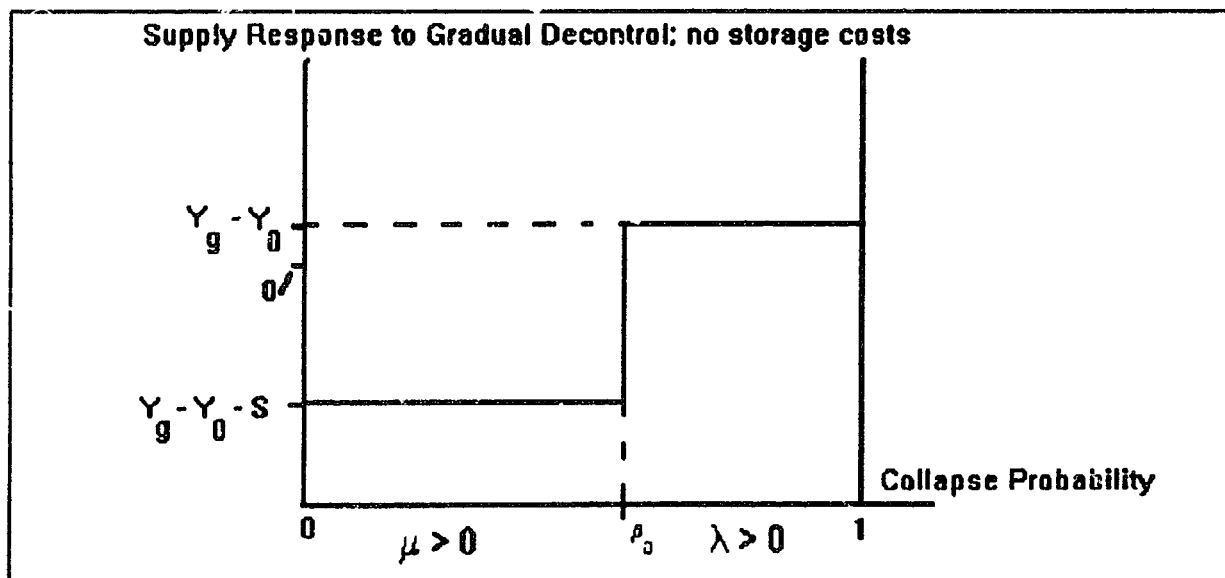


Figure 1

The output levels clearly depend on the actual or (for period two) the expected level of prices. Call the output level produced for initial price P_g

and in the absence of any production for inventories Y_g . Because $C_Y > 0$, $P_g > P^0$ implies $Y_g > Y_0$. Thus, if $\lambda > 0$, there is a positive supply response to the program (Fig.1). (18B) indicates under which circumstances this will in fact happen: the expected rate of price increase has to be lower than the nominal rate of interest. In case of full credibility ($\rho = 0$), this implies that relative price of the controlled commodity cannot rise faster than the world real rate of interest.

Consider next the case where $\lambda = 0$, $\mu > 0$. In this case the first order conditions become:

$$C_Y = P_g + \mu; C_Y = \mathcal{E}_g P \quad (19A)$$

$$\frac{\delta \mathcal{E}_g P}{P_g} = 1 + \frac{\mu}{P_g} > 1 \quad (19B)$$

In this case, output in period one is in fact higher, from (19A), because $C_{YY} > 0$ and $\mu > 0$. Compare (18A) and (19A) and note that first period marginal revenue in 19A is higher with $\mu > 0$, leading to higher output in this case. But, in a rather extreme reversal from the $\lambda > 0$ case, all of it is stored for the future period: $\mu > 0 \Rightarrow S = Y$. So although output is in fact higher, supply actually reaching the market has completely dried up; all output is hoarded for sale in the future, when prices will be even higher. The reason for it becomes clear from (18B): prices are actually rising faster than the rate of interest ($\mu > 0$), thus making storage for future sale more profitable than producing for the current market. ^{4/}

Since $\mathcal{E}_g p$ depends on the collapse probability ρ , that collapse probability has an important impact on which regime will actually prevail. Figure 1 ties the different solutions together as a function of ρ . It shows the aggregate supply response, for given first period price increase, as a

⁴ In the borderline case where prices rise at exactly the rate of interest, $\lambda = \mu = 0$, and producers are indifferent between selling today versus hoarding. It is natural to assume that in that case the demand side will determine the outcome, i.e. no hoarding, since consumers are rationed in period 1. This case is much more important in the case analyzed below, with direct costs of holding inventories.

function of the credibility of the program. A higher ρ indicates a lower credibility of the program. The diagram indicates that, as ρ increases, it reaches a threshold level ρ_0 at which the expected rate of price increase falls to below the rate of interest as the likelihood that the second stage will not be implemented goes up. Above that threshold, the incentive for hoarding falls away and, while output does not increase, the share of it that reaches the market does. With very low credibility (very high ρ), there is no reason to produce for inventories, which leads to a smaller increase in output but everything is delivered to today's market. Thus the *observed* supply response is positive. However, in the opposite case, with high probability of success (low ρ), the likelihood of high future prices is high, and with it the incentive to hoard. Therefore in the case of a low ρ , the *observed* supply elasticity is in fact negative.

Consider next the more realistic case with positive physical costs of storage, $\phi' < 1$. We assume that there are positive marginal costs to storage, and that they increase with the amount stored. It becomes harder and harder to protect supplies from animals, pests, spoilage or theft as they become bulkier. Formally, these assumptions imply $\phi' < 1$ and $\phi'' < 0$. This leads to the first order conditions listed in eqs. (20A-B):

$$C_y = P_g + \mu; c_y(y^*) = P^*; c_y(y_c) = P_g \quad (20A)$$

$$\frac{\delta\phi' \mathcal{E}_g P}{P_g} + \frac{\lambda - \mu}{P_g} = 1 \quad (20B)$$

Fig.2 below helps in understanding the solution to the set of equations listed in (20A-B). It lists on the vertical axis the rate of return on holding inventories, $\zeta = (\delta\phi' \mathcal{E}_g p)/P_g$, as a function of S , the amount of inventories held. Contrary to the case we just analyzed ($\phi' = 1$), S does have an impact on this rate because changes in S change marginal storage costs ϕ' . As the amount stored increases, marginal storage costs rise. Therefore the rate of return on holding inventories falls with the amount stored (the downward sloping curve in Fig.2). Call the intersection between this curve and the horizontal line at $1 - S^*$. At that point the rate of return on inventories equals the rate of

interest. Note that contrary to the $\phi'=1$ case, this equality only holds at S^* ; consequently producers want to hold S^* , rather than being indifferent between selling today or tomorrow as was the case for $\lambda=\mu=0$, $\phi' = 1$.

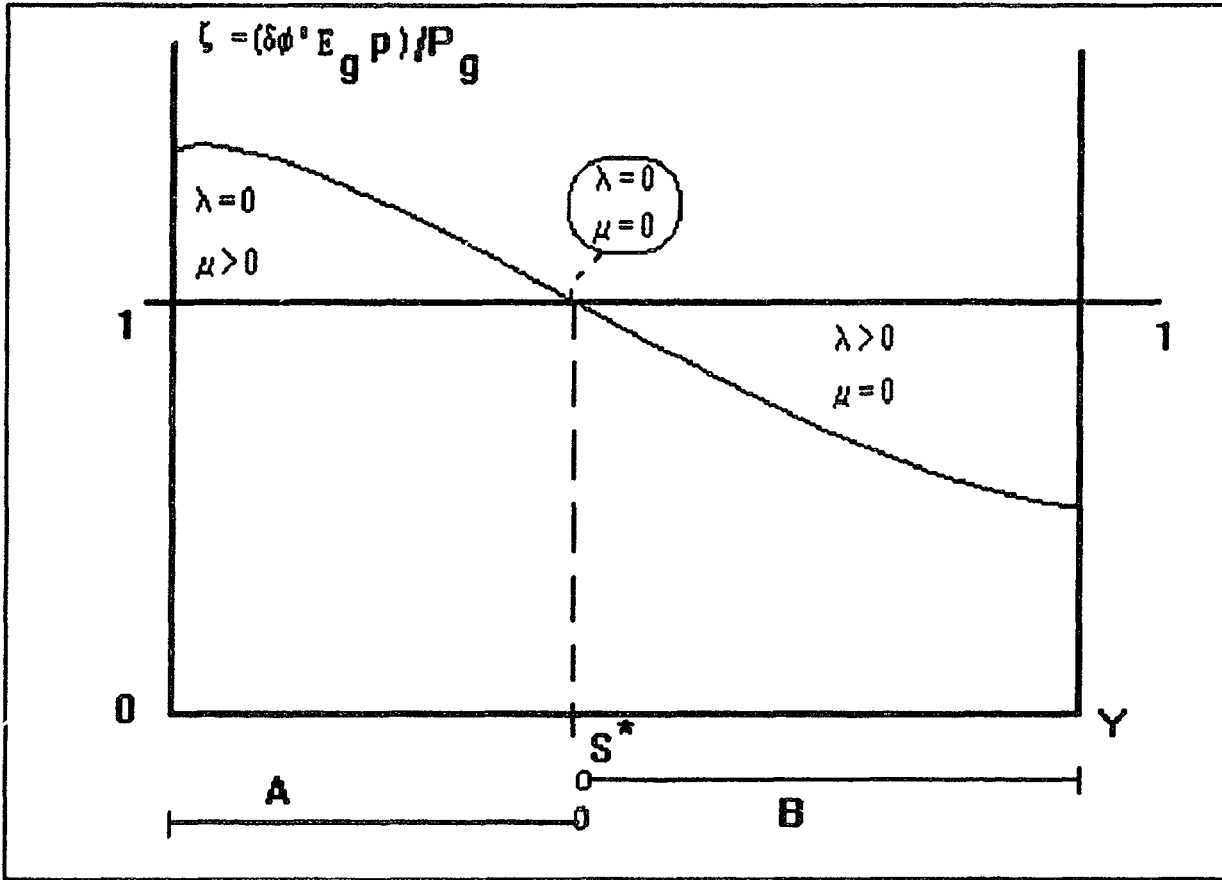


Figure 2

In turn, from (20B) it follows that in the region to the left of S^* , labeled "A" in fig. 2, $\mu > 0$ and $\lambda = 0$. Analogously, to the right of S^* , in the region labeled "B", $\lambda > 0$ and $\mu = 0$. But that suggests that regions A and B cannot be solutions to the equations (20A-B): $\mu > 0$ implies $S = Y > S^*$, which is inconsistent with being in A to begin with. A similar argument rules out region B. Thus, if there is an intersection at all, the solution to (20A-B) is $\lambda = \mu = 0$, $S = S^*$, $Y = Y_g$.

If there is no intersection for any $S \in (0, Y_g)$, one of the corner solutions will obtain. If for all possible values of S , $\zeta < 1$, there will never be any inventory holding since prices are expected to rise too slowly. This is only relevant for price reforms from a relatively undistorted starting

point. We will therefore not consider this case any further. At the other extreme is the case where for all feasible S , ζ remains above 1. This means that prices are expected to rise rapidly at any level of inventories, more than enough to offset high marginal storage costs. In that case all current output⁵ will be hoarded.

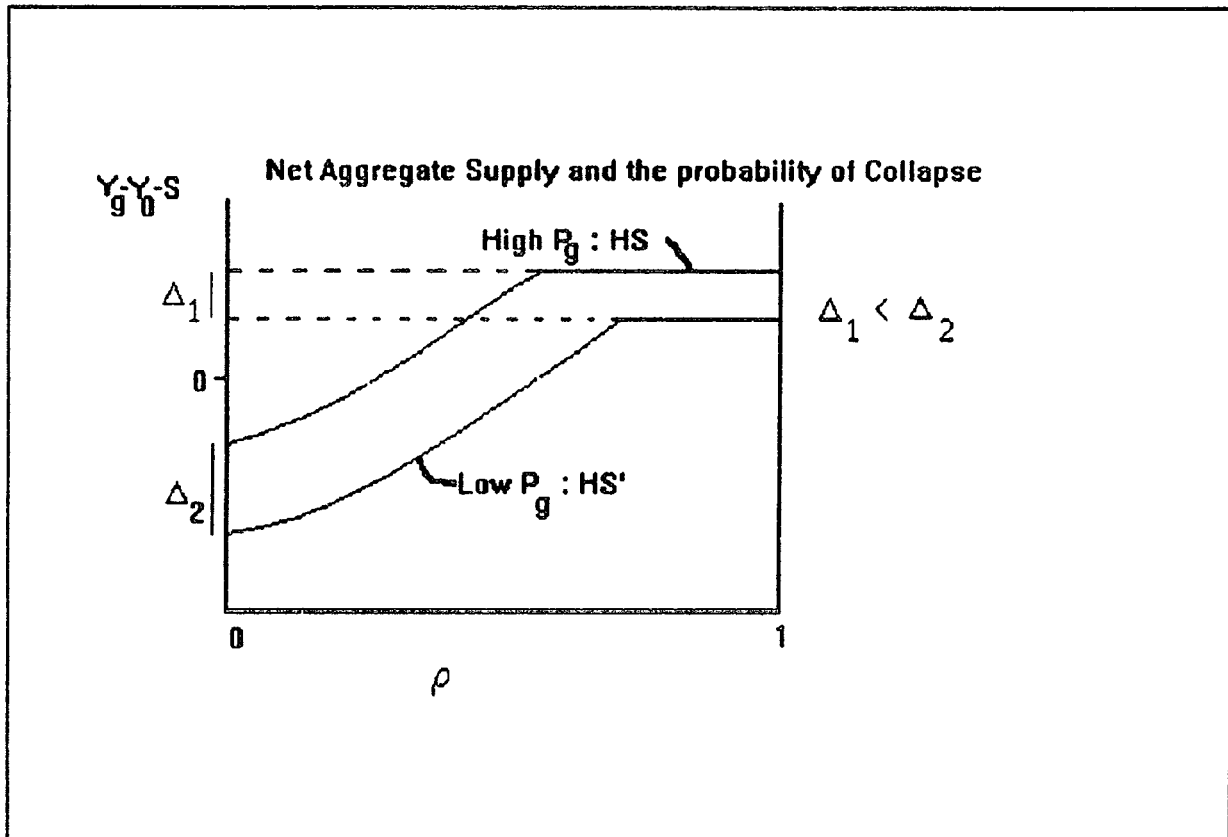


Figure 3

Consider S^* and the $\lambda=\mu=0$ case in more detail (Figure 3). Differentiating (20B) indicates the relation between the optimal level of hoarding S^* and the collapse probability ρ :

$$\frac{dS}{d\rho} \bigg|_{\frac{\partial \psi}{\partial P_g} P_{-1}} = \frac{\psi'(P^* - P_g)}{\psi'' \mathcal{E}_g P} < 0 \quad (21)$$

⁵ Which will exceed Y_g since $C_Y = P_g + \mu > P_g$.

Clearly, expected prices depend on the likelihood the private sector attaches to the reform being abandoned. A greater likelihood of collapse implies a greater likelihood of no price rise between today and tomorrow, and thus reduced hoarding incentives. On the other hand, reduced storage (lower S) reduces marginal storage costs and thus increases the return on inventory holding. As credibility declines and ρ moves up, hoarding declines and thus, odd as it may sound initially, the observed supply response $Y - S$ actually increases. This is indicated by the upward sloping line labeled HS (for Hoarding Schedule) in Figure 3. In fact if credibility is low enough, a corner solution may be reached where no intertemporal speculation is profitable and the corner solution associated with $\lambda > 0$ is reached (the flat segment in Figure 3). This is clearly the case for the extreme outcome of no credibility at all ($\rho = 1$). At $\rho = 1$, prices are in fact not expected to rise at all, there will therefore not be any hoarding and the HS curve intersects the $\rho = 1$ axis at Y_g .

Compare next two different stabilization programs, each "gradualist": prices are moved partially in period one but fully liberalized in period two. However, one program is more gradualist than the other in that the initial price response is smaller ("Low P_g " versus "High P_g "). First of all, a higher first period control price P_g increases the optimal level of first period output for given incentives to hoard (cf equ. (9)). This means that the flat part of the hoarding schedule (where hoarding is zero and output at Y_g), shifts up by the increase in Y_g :

$$\Delta_1 = \frac{dY_g}{dP_g} = C_{YY}^{-1} > 0 \quad (22)$$

Also, higher initial prices mean lower percentage capital gains once the market is liberalized. Thus the incentive to hoard will, ceteris paribus, decline:

$$\left. \frac{dS}{dP_g} \right|_{\rho = csc} = \frac{(\rho + \xi_g P/P_g) \phi'}{\phi'' \xi_g P} < 0 \quad (23)$$

Therefore:

$$\Delta_2 = \Delta_1 - \left. \frac{dS}{dP_g} \right|_{p_{cst}} > \Delta_1$$

$\Delta_2 > \Delta_1$ means that the curved segment of the diagram in fact shifts up more than the flat part. This implies that the point where hoarding becomes unprofitable moves to the left (cf Fig. 3, move from the "low P_g " schedule HS towards the "high P_g " schedule HS'). Also, with a higher P_g , there will be less first period rationing, and hence less spill over into the market for second period home goods (note that $E_{pp} > 0$). Thus p^* will be lower, further reducing hoarding incentives and hence shifting the area where $\lambda = 0$ further to the left. The main result is that, for given collapse probability ρ , bolder decontrol programs (larger initial price increases) will lead to less hoarding, larger increases in output, and as a consequence, much less problems with shortages.

However, this result is conditional on a given collapse probability and thus carries little weight as long as we do not know what happens to the collapse probability in response to a bolder program of price decontrol. This question is dealt with in the next section.

3 Shortages and the Probability of Reform Failure

The analysis presented in the previous section was incomplete in that the probability of collapse, which features both in consumers' savings and producers' hoarding decisions, was kept exogenous. In most of the literature, credibility of stabilization programs or more generally of policy reforms is either also kept exogenous (Calvo (1988), van Wijnbergen (1989)) or hits a corner solution (full credibility or none at all) in a separating equilibrium (Persson and van Wijnbergen (1989), Vickers (1988)). Assuming exogenous credibility clearly limits the usefulness of the analysis severely, since the impact of any policy will depend very much on whether it is likely to be sustained or not. Persson and van Wijnbergen (1989) use the signaling equilibrium approach, which goes to the other extreme by only considering policies that from an incentive compatibility view point are fully credible. However, the Mexican experience with extreme fiscal orthodoxy backed up in a

later stage by more "heterodox" elements (cf Ortiz (1990)) suggests that the clean solution promised by their separating equilibria is in fact hard to achieve.

In pioneering papers, Ize and Ortiz (1987) and Dornbusch (1989) attempted to endogenise credibility in a macroeconomic setting, linking credibility to various macroeconomic variables. The equilibria they consider have many *prima facie* plausible features. But their reliance on what is basically an arbitrary relation between program credibility and macro variables makes one wonder whether that relation itself, for all its empirical plausibility, would not be affected by economic policy. Thus a more rigorous approach to the determination of program credibility is called for, an approach that maintains the same theoretical rigor as the signaling equilibrium approach, but allows for some of the fuzziness that seems so hard to avoid in practical policy making. In this paper we break new ground by drawing on recent innovations in the analysis of the impact of political considerations on economic policy to find a solution to this problem.^{6/}

Intuition suggests a link between aggregate shortages in the early stages of the program and the likelihood that the program will be abandoned halfway (i.e. that controls, contrary to announcements, are not lifted in period two). There are of course many ways in which a reform program can be aborted. Government officials may be bribed by lobbyists seeking the rents created by the price controls. A Balance of Payments crisis may make it impossible to continue the exchange rate policy on which many such de-control programs are built. The political opposition may gather strength if the initial results are disappointing. Which specific mechanism is most relevant probably depends on the circumstances in the country under consideration; but one would expect similar results for each. In this paper, we focus on political opposition, arguably the most relevant one if one has Eastern Europe in mind.

At the beginning of period 2, before the Government can implement the second stage of its reform program, we assume it has to face a vote which will determine whether it can continue or whether the opposition takes over.

⁶ See Cukierman and Liviatan (1990) for an interesting, although very different, approach to the same problem.

Alternatively, in a less democratic interpretation, the Government may be forced to change its course of economic policy if unrest due to economic discontent becomes too widespread. Call the probability that this happens ρ . We showed in the previous section that ρ has a substantial impact on first period hoarding behavior. The key question then is, what determines ρ ?

Assume that voters are divided in their assessment of whether free markets will indeed outperform a controlled economy in supplying goods to consumers. The opposition argues that supply elasticities are too low to expect any benefits from price decontrol. We parametrise this divergence of views by assuming that voters have different priors on the aggregate supply elasticity in the NT sector.^{7/} There is a continuum of voters, indexed by s . For analytical convenience, we assume that each voter's prior can be represented by the normal/inverted- Γ distribution commonly used in Bayesian analysis. This distribution retains its structure as new data are used to update it (i.e. it is a natural conjugate distribution).

Define $\alpha = (d(Y-S)/dP)^8/$, and call the prior and posterior density function of voter s $p_{pr}(\alpha(s))$ and $p_{po}(\alpha(s))$ respectively. α_{pr} is the prior's mean and α_{po} the mean of the posterior distribution. Voters enter period one with a particular prior distribution, formed in periods before, and observe output response in period one. They use that information to update their prior into the posterior distribution used to form (rational) expectations about the likely election outcome in period 2. Voters are ranked in ascending order of α_{pr} . Voters for whom $\alpha(s) > 0$ vote in favor of the Government, and voters for whom $\alpha(s) \leq 0$ vote against it.^{9/}

There is straight majority voting, therefore the median voter, s_m , casts

⁷ The traded sector is not really an issue since there what is not supplied domestically can be imported.

⁸ Purely presentational reasons make it more convenient to define α as $d(Y-S)/dP$ instead of as the elasticity $(P/(Y-S))*d(Y-S)/dP$. For lack of a better word we will nevertheless occasionally use the word elasticity when we have α in mind, although of course $d(Y-S)/dP$ is not an elasticity.

⁹ Any other cut-off level leads to similar results as long as the supply response can exceed or fall short of the cut-off level chosen. The appendix indicates how a cut-off level can be derived directly from voter welfare maximization.

the decisive vote.¹⁰ Voters know their own preferences and form rational expectations about economic aggregates, but they do not know every other voter's preferences. In particular they do not know the magnitude of $\alpha(s_m)$, the median voter's estimate of the supply elasticity. Voters' beliefs on the magnitude of $\alpha(s_m)$ can be summarized by a density function f . We assume f to be the same across voters.¹¹ Since the median voter determines the election outcome, the probability that the Government will be voted out before it can implement the second part of its gradual decontrol program equals the probability that $\alpha(s_m) < 0$:

$$\rho = Pr(\alpha_{sm} < 0) = \int_{\alpha_{sm} = -\infty}^0 f(\alpha_{sm}) d\alpha_{sm} \quad (25)$$

All voters use Bayes' rule to update their priors. Thus if a supply response different from a voter's prior is observed in the first stage of the program, voters revise their prior; it is straightforward to show that:

$$\begin{aligned} \alpha_{po} &= \psi \alpha_{pr} + (1 - \psi) \left(\frac{Y_g - Y_0 - S}{P_g - P_0} \right) \\ &= \alpha_{pr} + (1 - \psi) \left(\left(\frac{Y_g - Y_0 - S}{P_g - P_0} \right) - \alpha_{pr} \right) \end{aligned} \quad (26)$$

with $0 < \psi < 1$. ψ determines the relative weight of old and new information in forming the posterior out of the prior and the likelihood of the current observation. The precise expression for ψ can be found in Zellner (1974) and depends on the subjective relative variances in the prior distribution and the likelihood function. Note that the voter will not assume a zero variance in the likelihood function for the period 1 events even though all uncertainty in

¹⁰ It is not implausible to assume that a vote early in a major reform program is going to be dominated by whether voters do or do not support the program. With such a single issue contest, median voter models are thought to be plausible descriptions of how voting mechanisms are likely to work (cf Enelow and Hinrich (1984) or Hillman (1990)).

¹¹ A similar device to introduce uncertainty about election outcomes is used in Alesina and Cukierman (1990).

the model refers to period 2. Bounded rationality makes him consider only current price information in assessing the period 1 supply response, so he will still observe what looks to the econometrician as positive variance, as inventory fluctuations trigger prediction errors in his static producer model.

To assess how hoarding in period 1 ^{12/} affects the probability of collapse of the program of price decontrol, we need to focus on how the updating process will affect $f(\alpha_m)$. After all, while voters do not know each other's individual preferences, they do know from each other that each voter updates using equ. (26). With Bayesian updating, updating will shift $f(\alpha_m)$ such that f contracts towards the voter who has a prior mean equal to the elasticity actually observed in period 1. But the voter with zero prior mean is more relevant, since 0 is the cut-off point for the voting procedure.

Equ. (26) shows that the voter at 0 will shift up, down or stay where he is depending on whether the observed supply elasticity in period 1 is positive, negative or zero. All voters whose prior mean exceeds the supply elasticity observed with hoarding revise their estimate of the supply elasticity downward. Thus if enough hoarding takes place to make the net supply response negative, f shifts to the left (i.e. its mean falls) and more weight is concentrated in the part of f defined over $(-\infty, 0)$. The probability of collapse therefore increases if there is enough hoarding to actually cause a net negative supply response:

$$\begin{aligned}
 f(\alpha_{sm})' &= f(\alpha_{sm} + \Delta_{sm}); \Delta_{sm} = (1 - \psi) \left(\frac{Y_g - Y_0 - S}{P_g - P_0} - \alpha_{sm} \right) \\
 \Rightarrow \rho(Y_g - Y_0 - S) - \rho(0) &= \int_{\alpha_{sm} = -\infty}^0 (f(\alpha_{sm})' - f(\alpha_{sm})) d\alpha_{sm} \\
 &= \int_{\frac{Y_g - Y_0 - S}{P_g - P_0}}^0 f(\alpha_{sm}) d\alpha_{sm} \\
 &> 0 \text{ if } (Y_g - Y_0 - S) < 0 \\
 &< 0 \text{ if } (Y_g - Y_0 - S) > 0
 \end{aligned} \tag{27}$$

A positive supply response leads to an upwards revision of α_{prior} by at

¹² More accurately, anticipated hoarding in period 1. Note that all agents form rational expectations about all aggregate variables in the economy.

least all voters whose prior had a negative mean. (27) also shows that in that case the integral of $f(\alpha_s)$ from minus infinity to zero decreases. A downward revision of ρ after a negative net supply response, but an upward revision of ρ after a positive net supply response, leads to the negative relation between ρ and net aggregate supply response represented by the schedule VDS, for Voters Dissatisfaction Schedule, in Fig. 4 below.

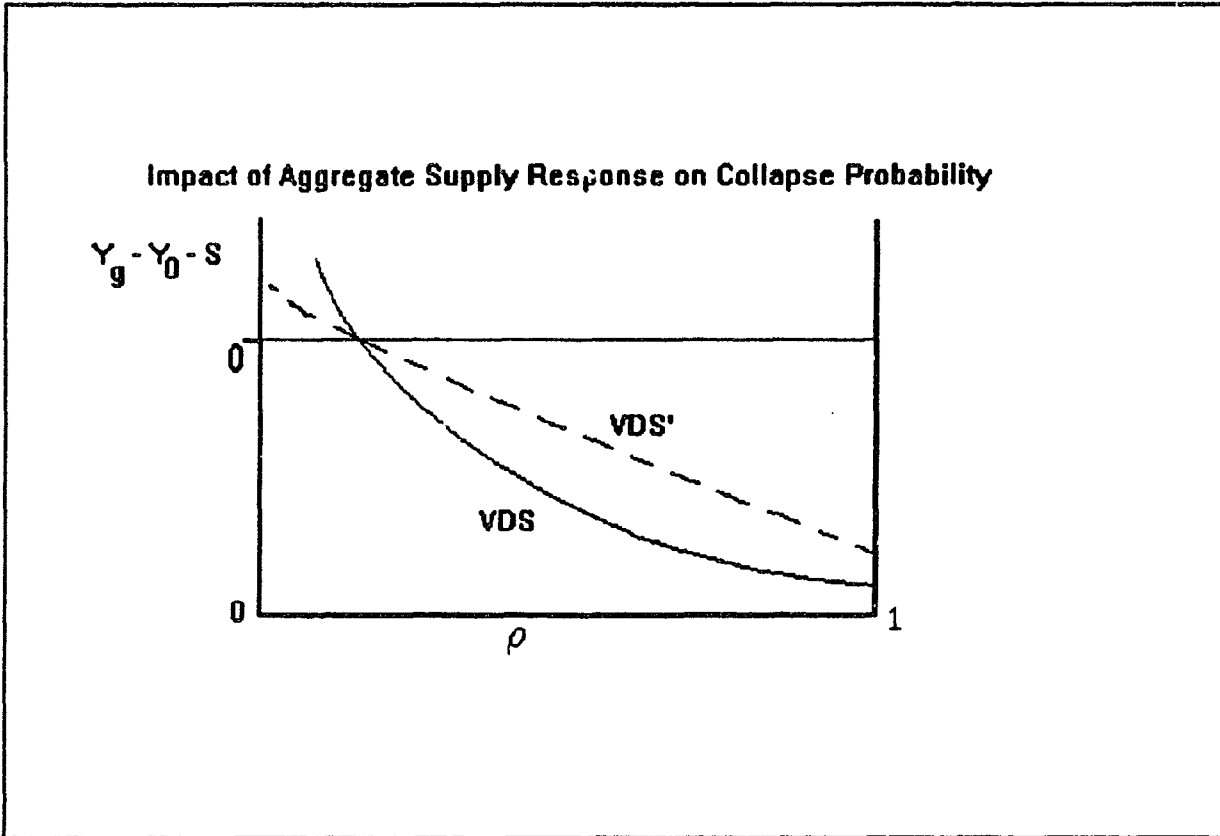


Figure 4

Which way will this locus shift when a more gradual reform is implemented (i.e. a smaller price increase $(P_g - P_0)$ in period 1)? Using the expression for $\rho(0)$ and differentiating (27) indicates the answer:

$$\frac{\partial \rho(S)}{\partial P_g} = \frac{f\left(\frac{Y_g - Y_0 - S}{P_g - P_0}\right) (Y_g - Y_0 - S)}{(P_g - P_0)^2} \quad (28)$$

$$\begin{array}{l} < 0 \\ > 0 \end{array} \Leftrightarrow (Y_g - Y_0 - S) \begin{array}{l} < 0 \\ > 0 \end{array}$$

In interpreting equ. (28), consider again the voter with zero prior mean first. Assume that in response to the smaller price increase enough hoarding takes place to just offset the increase in output (which itself is smaller than under the larger price increase). Equ. (26) indicates that the zero prior mean voter will then once again not change his prior. This means that after a low price increase the voters dissatisfaction schedule VDS' will go through the same point at zero net supply response as it will after a high price increase (compare VDS and VDS' in Figure 4); $\rho(0)$ will not be affected.

For any given net supply response larger than zero, the same quantity response to a smaller price change implies a larger elasticity and thus a larger upward revision from any given prior. This in turn implies a larger shift to the right of the probability density function f and hence a steeper decline in ρ (see the part of VDS' above 0 in Figure 4). A similar line of reasoning applies to the case of negative supply response. Any given negative response represents a more negative supply elasticity than the corresponding one for the high P_g case since for the same quantity response the price change is smaller. This implies a larger shift to the left (downward revision of prior means) and thus a higher collapse probability in the low P_g case than in the high P_g case. All this makes for a counterclockwise rotation of the VDS schedule, to VDS' in Figure 4, in response to a more gradualist (lower P_g) decontrol program. ^{13/}

4 Gradualism, Intertemporal Speculation and the Political Economy of price Reform

With the two building blocks (the Hoarding Schedule HS and the Voters Dissatisfaction Schedule VDS) derived, we are ready to examine the consequences on credibility and aggregate supply response of a gradual price decontrol program (Figure 5 below).

¹³ Note that equ. (28), being a derivative, gives the response of ρ to a larger P_g .

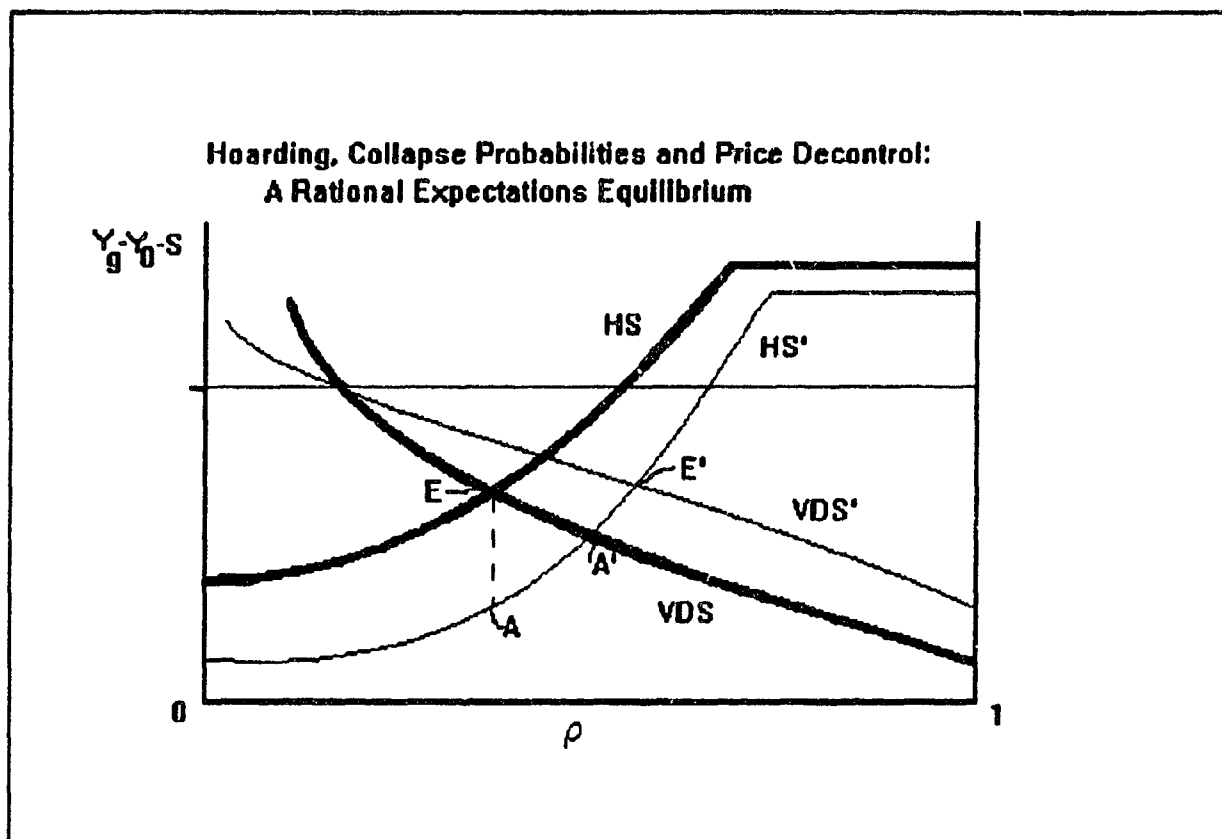


Figure 5

HS in Figure 5 indicates, for given collapse probability ρ , how much producers choose to hoard. A higher collapse probability leads to lower expected future prices and thus gives less of an incentive to hoard. The HS locus therefore slopes up. But more hoarding lowers the perceived supply elasticity and therefore the voters' assessment that the program is failing; this in turn increases the probability that the Government will be voted out. Thus the political economy schedule VDS slopes downward (Figure 5).

Rationality requires that the probability of program collapse used in producers' hoarding decisions will indeed come out if those hoarding decisions are in fact implemented. This will be the case at E, the intersection of the Hoarding Schedule and the Voters Dissatisfaction Schedule. Thus E represents a rational expectations equilibrium for a given gradual decontrol policy that sets first period prices at P_g and promises to liberalise in period 2. At ρ_E , producers hoard S_E for a total (negative) supply response $Y_{g,E} - Y_0 - S_E$. In

turn, such a negative supply response leads to a private revision of the collapse probability that exactly matches ρ_E . Thus E is an internally consistent equilibrium: producers take intertemporal decisions based on an assessment of the collapse probability that is in fact consistent with the likely political response to initial reform failure given those producers decisions.

The equilibrium at E has many plausible features. Output in fact rises, as current prices do increase.¹⁴ Thus the initial unemployment costs of such a decontrol will be quite small or even absent. However, in spite of increased output and higher prices, net supply actually reaching the market declines as producers increase inventories, hoping for later capital gains. As a consequence, shortages develop, to the point that the net *observed* supply elasticity is in fact negative. This in turn generates pressure against the decontrol policy, increasing the probability that the program will have to be abandoned for a prolonged period of controls before the final deregulation phase is reached.

Consider the consequences of a more cautious start of the program (a lower initial period level of the controls). A lower initial price, for given collapse probability ρ , results in larger capital gains once prices are liberalized. Thus for given ρ , hoarding will in fact increase (HS shifts down to HS' in Figure 5. If ρ would not change, the new equilibrium would be at A in Figure 5. Of course more hoarding implies a more negative perceived supply elasticity, which in turn leads to a higher ρ . Thus, if the VDS schedule itself would not shift, a new equilibrium would emerge at A', with more hoarding and higher collapse probability: $\rho_{A'} > \rho_E$. But there is more: for given net aggregate supply response, a lower elasticity is implied, because it is in response to a smaller price change; priors thus get revised downwards more than they would under the less gradual decontrol program and the collapse probability increases (VDS shifts out to VDS'). Thus the new equilibrium is at E', with an unambiguously higher probability of collapse: $\rho_{E'} > \rho_{A'} > \rho_E$. Thus

¹⁴ See Ortiz (1990), Bresser (1987) and Helpman (1989), covering respectively Mexico, Brazil and Israel. The Brazilian and Mexican stabilization programs of respectively 1986 and 1988 fit the assumptions made here particularly well: there were substantial price increases at the beginning of what was announced as a temporary use of price controls (Bresser (1987), Ortiz (1990)).

a more gradual approach to price decontrol actually increases the collapse probability.

But, although there will be an unambiguously lower output response to more gradual decontrol (since the initial price is lower), the impact on net aggregate supply is less clear. On the one hand, there is more hoarding for given ρ since the capital gain then increases; but on the other hand there will be less hoarding because ρ in fact increases, thus reducing the likelihood that this larger capital gain will in fact materialise. However, it is clear from Figure 5 that the net supply response inclusive of hoarding will remain negative if it was so to begin with.

The same machinery can be used to assess "cold turkey" decontrol approaches. Under a cold turkey approach, prices are immediately and fully liberalized. Thus if the approach is maintained, prices will be market determined in both periods. Under the assumptions made, the first period free market price P^* will equal the second period price p^* . Thus without credibility problems, there would be no hoarding, as waiting for tomorrow will not bring higher prices to offset storage and interest costs. Credibility problems in fact strengthen this result. If $\rho > 0$, there is a positive probability that second period prices will be lower than first period prices, in case controls get reimposed, which would lead to capital losses rather than gains on inventories carried into period 2. Thus with a "cold turkey" approach, hoarding incentives work the other way: there are strong disincentives to hoard.

If dis-hoarding would be possible, a cold turkey approach would thus lead to a very large observed net supply response, much larger than under gradualism. This is because in that case, if there is any credibility problem at all, goods will in fact be pulled out of inventories, for sale today rather than tomorrow. But dishoarding is not possible in our set-up, so under "cold turkey" decontrol, the case with zero inventory build up ($\lambda = 0$) will always obtain. This means that the line labeled HS_{ct} in Figure 6, a horizontal line at $Y_{ct} - Y_0 > Y_g - Y_0 > 0$, represents the cold turkey case. Thus the first result on the comparison between cold turkey and gradualism: there will be no hoarding under the cold turkey approach.

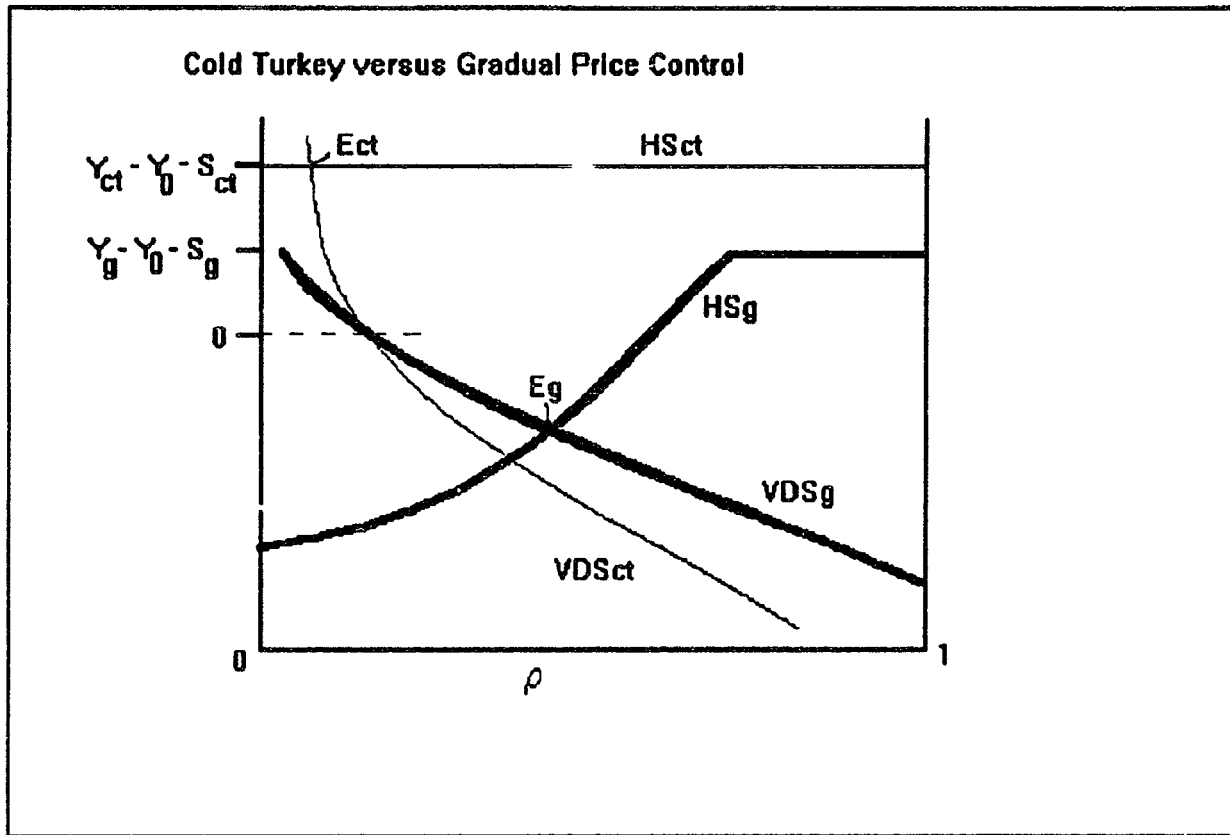


Figure 6

The second clear result relates to credibility (the equilibrium value of ρ). Since $P^* > P_g$, the VDS schedule rotates further, clockwise and still crossing the same zero point (compare VDS_{ct} with VDS_g in Figure 6). The cold turkey equilibrium is at the intersection of VDS_{ct} and HS_{ct} , at E_{ct} . Since there is no hoarding under a cold turkey approach, there will be a high observed supply elasticity and thus a low probability of program collapse ρ_{ct} (lower, for example, than $\rho(0)$).

For comparison of the cold turkey decontrol strategy with a gradualist approach, consider two possible configurations for the latter. If the initial distortion is so small that there would be no hoarding at all in the gradual case either (i.e. $\lambda = 0$ and net supply equals Y_g), $C_{YYY} < 0$ would imply a smaller supply response per unit of price increase than observed under the CT approach. This in turn would imply a larger assessed probability of collapse. So even if there is no hoarding under gradualism (mild initial distortions and $\lambda = 0$), gradual programs will be less credible as cold turkey programs if C_{YYY}

< 0 . Moreover, since $\lambda=0$ cases have been excluded (we only consider severely distorted cases), there will always be hoarding under gradualism. Therefore there is more of a downward revision (or less of an upward revision) of the supply elasticity than in the $\lambda = 0$ case, reinforcing the result just derived for the $\lambda = 0$ case. In terms of Figure 6, HS_g falls below the line $Y_g - Y_0$ at least for its initial segment, and cuts VDS_g more to the right. But a lower observed supply elasticity implies a higher likelihood of program collapse!

If a negative initial supply response obtains for at least the lower ranges of ρ (HS cuts the left vertical axis below 0), the results obtain unambiguously, for any sign of C_{YYY} : since the cold turkey equilibrium is to the left of $\rho(0)$ while the gradualism equilibrium in that case is to the right of $\rho(0)$, the collapse probability under gradualism will always be higher, whatever the sign of C_{YYY} is (cf Figure 6). Thus cold turkey programs will unambiguously be more credible than gradual programs that actually cause increasing shortages in their initial phase ($\rho_{Eg} > \rho(0)$); and even if gradual programs do not cause increasing shortages ($\rho_{Eg} \leq \rho(0)$), cold turkey decontrol programs will still be more credible if $C_{YYY} < 0$.

5 Conclusion

This paper abstracts from the question of why price controls are used. Instead it asks a different question, one of great practical importance. Assume that, for reasons good or bad, price controls are in place; how should they be terminated? How to escape from a period of controls? Both the coordination failure and the signaling approach suggest at most temporary use of controls, in order to minimize output losses on the transition path towards lower inflation. Should in such an approach controls be abolished "cold turkey" or can a case be made for gradualism? The issue is in fact of much wider importance; all of Eastern Europe has been living under price controls, imposed for a very different reason. How should countries like Poland or the USSR move towards price flexibility, gradually or in a "big bang"?

Two factors complicate the issue and are at the core of this paper. In many cases price controls focus on commodities like basic grains, commodities that are eminently storable and can thus be used in intertemporal speculation. Second, and as we will show, not unrelated, opposition to rapid dismantling of

controls is often based on claims of low supply response, and greatly bolstered if a strong supply response indeed fails to materialise. This is especially relevant in places like Eastern Europe, where experience with price responsive markets is limited. A less benign argument also lends support to a link between low supply response and opposition to relaxing controls. Shortages create rents, and rents will attract lobbyists in favor of continuation of those policies that create the rents.

We show the difficulties that these two factors create for gradual decontrol of prices. We endogenise the probability of a collapse of the reform program along the lines of the recent literature about the impact of political considerations on economic policy (see in particular Alesina and Cukierman (1990)) and show that such endogeneity in the presence of intertemporal speculation leads to a strong case against gradualism. Our core result is a forceful argument against gradual decontrol: we show that the smaller the initial price increase is, the lower the *observed* supply elasticity and the greater the probability that the program of reform will in fact be abandoned.

These results imply that the policy that makes most sense from a microeconomic point of view (decontrol immediately) is also advisable from a macroeconomic point of view. Credibility problems, which are at the core of the transitional output losses that characterize most stabilization programs, will be much less under a cold turkey approach and so will therefore transitional unemployment.

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Appendix: Consumer Welfare and Price Decontrol

Consider a voter facing, as consumer, price decontrol. Differentiating his budget constraint around the pre-reform situation leads to a simple expression for his welfare as a function of prices and quantities:

$$\begin{aligned} E_U \frac{dU}{dP_0} &= -A_R^h + (P_V - P_0) \frac{dA_R^h}{dP_0} \\ &= -A_R^h + (P_V - P_0) \alpha \end{aligned} \quad (\text{A.1})$$

For given ration size, price increases unambiguously lower welfare as there is only a negative income effect. However, higher prices may increase aggregate supply which increases welfare at given prices as long as virtual prices exceed posted prices, hence the second term in (A.1).

(A.1) can be used to solve for the value of α at which price changes yield no welfare impact either way, α_c :

$$\alpha_c = \frac{A_R^h}{(P_V - P_0)} \quad (\text{A.2})$$

Welfare maximizing voters will vote yes or no depending on whether their posterior α_{po} is greater or smaller than α_c . α_c is greater than or equal to zero depending on whether the initial ration is greater than or equal to zero. The size of α_c has no qualitative impact on any of the results as long as it allows interior solutions (i.e. between 0 and 1) for ρ .

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