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# Societal Gains from Price Stability: Does Risk Matter?

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## Abstract

The theory of commodity storage and price stabilization has a long history. Schmitz & Chegini (2020) develop a price stabilization model under complete price certainty and conclude that storage, when carried out by producers, provides net societal benefits. Schmitz (2021) relaxes these assumptions, in a price risk model that distinguishes between producer ex ante decisions and ex post outcomes. Producers are assumed to make production decisions ex ante using a planning supply curve but ex post the outcome is different than that expected. In the price risk model, deviation from the planning supply curve is caused by supply shocks that are generated from production shocks, rather than from the shift in supply curves, as assumed in the price certainty models. The risk price model generates identical welfare results to the model developed under complete price certainty. With storage, society on net prefers price stability over instability.

## Keywords

Price Stability, Risk

## 1. Introduction

A formal treatment of societal gains from price stability dates back to at least to the early 1960s. Since then, many papers have appeared on this topic. These include Oi (1961) on producer preference for price instability and Waugh (1944) on consumer preference for price instability. Samuelson (1972) argued that society prefers price stability to instability. This was also demonstrated by Massell (1970). The role of storage is discussed as a means to bring price stability. (The importance of storage, for example, is magnified due to the substantial agricultural losses resulting from the Russian invasion of Ukraine). More recently, Schmitz & Chegini (2020) expand the result on storage and draw a strong conclusion that private storage is preferred to public storage[1]. Schmitz (2021) expands the traditional model of storage and finds that there is very little difference on the welfare effects of storage.

Earlier papers on price instability assumed complete price certainty on the part of producers thus the time of planting producers knew with certainty the production quantity and price at harvest (Schmitz & Chegini, 2020). As shown by Schmitz & Chegini (2020), in the price certain case where price instability is brought about by supply shocks, producers prefer an unstable production price when they can engage in self-storage in order to stabilize consumption price and quantity. In this case, production activities are related to but independent from storage activities.

Schmitz (2021) expands upon the results of the price certain case and presents a model that examines producer and societal preferences in the case of price risk (i.e. price uncertainty). The paper distinguishes, unlike models of price certainty, between ex ante decisions and ex post outcomes. Producers are assumed to make production decisions using a planning supply curve. Supply shocks are generated from production deviations from the planning supply curve rather than from the shift in supply curves. Interestingly, the risk model developed generates results identical to the price certainty case on the impact of price stability on consumers, producers, and society. The conclusion is interesting in that the net benefits from stabilization brought about by storage under price certainty are equivalent to the net benefits under price risk.

This paper compares the welfare effects of both the price certainty model and the price uncertainty case. We find, interestingly, that the welfare effects are identical. Also, in both models, optimal storage is carried out by the private sector, not the government.

## 2. Theoretical Considerations

**1) Stabilization under price certainty**

**a) Price certainty without producer storage**

**Figure 1** compares the case of price certainty to price risk. In **Figure 1(a)** (price certainty case), demand is given by D and initial supply is given by $S$. The expected prices and quantities are $p_1$ and $q_1$ in period 1 and $p_2$ and $q_2$ in period 2. In the absence of storage, price instability is brought about by supply shocks $S_1$ and $S_2$.

As discussed below, producers gain from both price instability in production and from price stability in consumption. Producers prefer price instability over

[1]In many less developed countries, governments engage in food stockholding activities where a major objective is food security. However, in our model food security is not implicitly considered. Storage under food insecurity is taken up elsewhere (Schmitz & Kennedy, 2016; Kennedy, Schmitz, & van Kooten, 2019; Kennedy, Schmitz, & van Kooten, 2020; Schmitz, 2020; van Kooten, Schmitz, & Kennedy 2020). In addition, our model does not consider the multiproduct case where, using a utility maximization framework, consumers, like producers, prefer stability for a subset of the total commodity bundle consumed and produced (Turnovsky, Shalit, & Schmitz, 1980; Schmitz, Shalit, & Turnovsky, 1981).

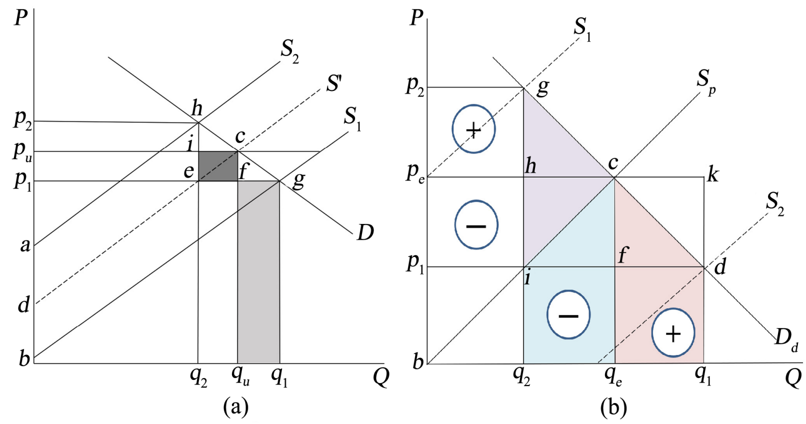


**Figure 1.** Price certainty vs price risk. (a) Price certainty; (b) Price risk.

stability (Schmitz, 2018a, 2018b; Schmitz et al., 2022) as $\{(p_1bg) + (p_2ah)\} > 2(p_udc)$. The net welfare gain to producers is shown by the two different shaded areas $\{(fq_uq_1g) - (iefc)\}$.

**b) Price certainty with producer storage**

In **Figure 1(a)** (price certainty case) price instability is due to supplies $S_1$ and $S_2$ that generate quantities $q_1$ and $q_2$. In the absence of storage, the gain to producers from price instability is $\{(fq_uq_1g) - (iefc)\}$. Now consider storage and its effect on price stability. Suppose that $q_1q_u$ is stored in period 1 and released in period 2. With storage, the consumption price is $p_u$ (but we emphasize that the consumption price is with reference to supply $S_1$ and $S_2$ and not $S_0$). Storage, in this case, stabilizes the consumption price, but not the production price. For $S_1$, there is a gain in total producer revenue as a result of storage, $\{(p_1p_ufc) - (q_1q_ugf)\}$. For $S_2$, there is a loss of $\{(p_2p_uih) - (q_2q_uci)\}$. Therefore, producers gain from price stability $2(iefc)$ when storage stabilizes consumption but not production.

The producer gain from price stability due to storage is $\{(iefc) + (iefc)\}$. The gain from production instability is $\{(fq_uq_1g) + (iefc)\}$. Therefore, the gains to producers from price stability is $\{(iefc) + (iefc)\} + \{(fq_uq_1g) - (iefc)\}$.

Even if one does not consider the gains from production instability, there is still a positive gain to producers from price stability. Importantly, there is no need for government to undertake storage to create price stability since it is in the best interest of producers to engage in their own storage activities. However, this is often not possible in less developed countries where producers have inadequate storage. This is often why governments engage in storage activities.

**2) Price stabilization under price risk**

**a) Price risk without producer storage**

In **Figure 1(b)**, unlike in the price certainty case, suppose in period 1 that due to abundant rainfall, output is $q_1$ that exceeds expected production $q_e$. The price falls from $p_e$ to $p_1$. In this case, total revenue (TR) is $(p_1bq_1d)$ while the total cost (TC) is $(p_ebq_ec)$. Producers lose $\{(p_ep_1fc) - (fq_eq_1d)\}$. The gain to consumers is $(p_ep_1dc)$. The net societal gain is $(cq_eq_1d)$.

In period 2, due to drought, output falls to $q_2$ which is less than the expected output $q_e$. The price increases to $p_2$ which is above the expected price $p_e$. As a result, total revenue (TR) is ($p_2bq_2g$), while TC remains at ($p_ebq_ec$). The negative effect on producers is {($p_2p_ehg$) − ($hq_2q_ec$). The loss to consumers totals ($p_2p_ecg$). The net societal loss is ($gq_2q_ec$).

**i)** Periods 1 and 2 (Net Producer Loss)

Over the two periods, there is a net loss to producers from a price variability of 2($hifc$) or {($hifc$) + ($p_ep_1ih$)}. There is a consumer gain of ($cid$). The relative losses to producers from price risk depend on price demand elasticities. The more elastic the demand, the greater will be the loss in period 2 relative to period 1, but there remains a loss in each period. Also, under elastic demand, the producer loss is greater; therefore, it is in the interest of producers to use storage to create price stability.

**ii)** Periods 1 and 2 (Net Consumer Gains)

In this model, consumers lose from price stability while producers gain. In period1, consumers gain ($p_ep_1dc$), while, in period 2, they lose ($p_2p_ecg$). On net, consumers lose ($cid$).

**iii)** Combined Effects of Price Instability

In the absence of storage in period 1, the net effect of price instability is ($cq_eq_1d$) and for period 2($gq_2q_ec$). The combined effect is ($gic$).

**b) Price Risk with Producer Storage**

We now consider the effect of storage that is used to bring about price stability. Earlier models were incorrect in arguing that storage brings about complete price stability. In this framework, storage can only bring about partial price stability (Schmitz, 2018a). Under achievable storage, the price is completely stabilized.

When ($q_eq_1$) is stored in the abundant supply period and released in the short supply period, price is stabilized at $p_e$. The effects are as follows:

Producer gain from stabilization = ($hifc$) + ($cfdk$) (1)

Consumer loss from stabilization = −($p_2p_ecg$) + ($p_ep_1dk$) (2)

where $(p_2p_ecg) = (\text{hifc})\ and\ (p_ep_1dk) = (\text{cfdk})$.

Net gain from stabilization ($gic$) is identical to the price certainty model.

## 3. Overview

Both models lead to the conclusion that under both price stability and price risk, private entities will undertake storage, mitigating the necessity for storage by government, as it is in the best interest of producers to maximize profit through storage. Also, the welfare effects derived from our price risk model are similar to the price certainty case. This is because the degree of price and quantity variations is the same in both models given the probability distribution underlying both models. In our two-period model, assigning same probability distribution makes the price risk model equivalent to the price certainty case. Future work should assign probability weights so that the results of price risk model won't be equivalent to the price certainty model.

## 4. Discussion and Conclusion

In the case of price uncertainty, Schmitz (2021) demonstrates that, similar to the price certain case, in many price uncertain scenarios, it is in a producer's best interest to engage in self-storage; however, the degree of incentive depends upon the type of product being produced. Potential producer loss for a relatively price inelastic product is far greater than potential losses for a price elastic product. As such, the incentive for producers to engage in self-storage increases when price elasticity of demand for a given commodity is highly inelastic.

Considerable efforts have been made in linking food security to storage (CFARE, 2023). The classical models, like those above do not take into account food security as an explicit objective of stockholding activities. Future work should build models where the objective of storage includes food security.

Traditional storage models also do not take into account the possibility of producer hedging through future commodity markets (Hirschleifier, 1989; Feder, Just, & Schmitz, 1980). Price hedging activities by producers, in conjunction with optimal storage strategies may reduce producer risk. Prior to harvest, producers hedge part of their crop through contracting with grain buyers. This includes multinational corporations like Cargill Inc. and Bunge Ltd. (who use futures trading to manage risk), keeping in mind that there is considerable controversy over whether or not futures trading gives rise to increase price instability (Miljkovic & Olson, 2023).

The support of government holding of stock comes from developing or least developed countries, where the argument is how private stockholding is suboptimal. Further research should rigorously model the joint presence of government and private stockholding. It is our hypothesis that an increase in stock holding by the government will partly drive out the private storage activities and give rise to suboptimal results (Tangermann, 2011; Gilbert, 2012; Jayne, 2012).

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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