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# Price Instability, Risk, and Storage: Revisited

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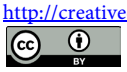



## Abstract

This paper considers the case where price instability is brought about by demand shocks where unlike most of the earlier literature it was due to supply instability. The results are based on a classical welfare economics framework as this is the case for much of the analysis on price instability. Our conclusions are very different from those derived from the earlier literature that includes the recent work by Schmitz & Chegini (Schmitz & Chegini, 2020), Schmitz (Schmitz, 2021). We show that there can be a net gain from price instability. Given that both consumers and producers prefer price instability, there is no need for storage. Hence, storage leads to a second-best situation. The debate over whether the private or public sector should engage in storage does not arise. Our results clearly show that the net cost and benefits from a stabilization policy critically depend on the nature of the price instability.

## Keywords

Price Instability, Risk, Storage

## 1. Introduction

The discourse on price stability and societal benefits is at least as early as the 1960s with various papers contributing to the narrative. For example, Oi (Oi, 1961) discussed producer preferences for price instability, while Waugh (Waugh, 1944) focused on consumer preferences in this regard. Massell (Massell, 1970) and Samuelson (Samuelson, 1972) put forward the notion of society's preference for price stability. The relatively newer work by Schmitz & Chegini (Schmitz & Chegini, 2020) focuses on the role of storage in achieving price stability. They also conclude like the earlier literature that there is a net benefit for society from storage. However, they emphasized that private storage rather than that carried out by the government leads to maximum net welfare benefits.

The narrative on price instability was enriched further by Turnovsky, Shalit & Schmitz (Turnovsky et al., 1980) and, Shalit & Turnovsky (Schmitz et al., 1981). To complement the theoretical framework of price instability, the empirical counterpart of supply-driven models is developed by Finkelshtain and Chalfant (Finkelshtain & Chalfant, 1991) and Barrett (Barrett, 1996). However, this variant of literature on commodity price risk highlights the preference for price instability when the budget share for the commodity is low (Deschamps, 1973; Hanoch, 1977; Newbery & Stiglitz, 1982). The dual role of agricultural households as a consumer and producer simultaneously does not constrain their risky behavior (Barrett, 1996; Finkelshtain & Chalfant, 1997).

This paper considers price instability that comes about because of demand shocks. This analysis uses classical welfare economics. It includes both a closed and open model of trade. In both cases, price instability is preferred to stability.

## 2. Literature Review

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, Schmitz, 2018; 2016; Kennedy et al., 2019; Kennedy et al., 2020; van Kooten et al., 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 et al., 1980; Schmitz et al., 1981).

The support of government holding of stock comes from developing or least developed countries, where the argument is that 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).

Earlier models build upon the assumption of complete price certainty from the producer's point of view. Thus, the producers are fully aware of the price at the time of harvesting (Schmitz & Chegini, 2020). This ex-ante information affects their storage decision. Their findings show that producers prefer price instability because they have a stake to gain from self-storage. This preference develops when producers can utilize their self-storage to stabilize consumption prices and quantities. In such instances, production activities are connected to, yet distinct from, storage activities.

These findings are reinforced later by assuming price certainty is linked to the producer and society's preference towards price risk (Schmitz, 2021). Unlike models that assume price certainty, this paper makes a clear distinction between decisions made before an event (ex-ante) and the outcomes observed after the event (ex-post). This model assumes that producers make decisions based on a planned supply curve where supply shocks arise from deviations in production

from this curve rather than from a shift in supply schedule. Notably, the risk model developed generates results that mirror those in the case of price certainty regarding the impact of price stability on consumers, producers, and society. The conclusion is interesting and distinct from others that overall benefits derived from stabilization through storage under price certainty are equivalent to those underprice risk.

## 3. Research Methodology

The research methodology in this paper is based on classical welfare economics as many of the papers are on this topic including Oi (Oi, 1961), Waugh (Waugh, 1944) and Massel (Massel, 1970). This framework is reviewed elsewhere in several papers including Currie, Murphy and Schmitz (Currie et al., 1971); Just, Hueth and Schmitz (Just et al., 1982); Schmitz, Schmitz, & Dumas (Schmitz et al., 1997); McClintock (McClintock, 2020); Emran & Schmitz (Emran & Schmitz, 2022) and Schmitz, Moss & Schmitz (Schmitz et al., 2023). Our initial analysis relies on the demand and supply framework to identify the response of market parameters due to the disruption of market demand in a closed economy setting. However, we add an additional component by introducing structural change and allowing trade in the latter model.

We begin the price instability model without trade. But in reality, most of the agricultural commodities are traded. Therefore, it is necessary to introduce the trade aspect into the closed model to capture the dynamic effects.

## 4. Theoretical Model

### 4.1. Price Instability (No Trade)

The earlier literature (Schmitz et al., 2022) usually assumes that price instability is a result of supply shocks.

**Figure 1(a)** shows the impact of supply shock on price stability assuming no storage is present. The initial price is $P_0$ and the quantity is $q_0$. With a positive supply shock, the supply curve shifts from $S_0$ to $S_1$. The price falls from $P_0$ to $P_1$. On the contrary, a negative supply shock shifts the supply curve from $S_0$ to $S_2$ causing the price to rise from $P_0$ to $P_2$. Thus, price instability can result in an increase in an increase in the quantity to $q_1$ (increase) or $q_2$ (decrease). In the absence of storage, with a reduction of price, the gain to the producer from price instability is $\{(fgq_1q_0)-(icfe)\}$. In contrast, the presence of storage will stabilize the price at $P_0$ when the supply shock occurs. Suppose $q_0q_1$ is stored and released in period 2. With storage the consumption price remains at $P_0$ even though the associated supply is $S_1$. Thus, storage stabilizes the consumption price but not production price. Producers gain in terms of increased revenue as a result of storage when supply increases, $\{(P_0cfP_1)-(fgq_1q_0)\}$. For $S_2$ there is a loss equal to $\{(P_2hiP_0)-(icq_0q_2)\}$. As a result, producers gain from price stability is $2*(icfe)$. In this case, storage mainly stabilizes consumption but not production.

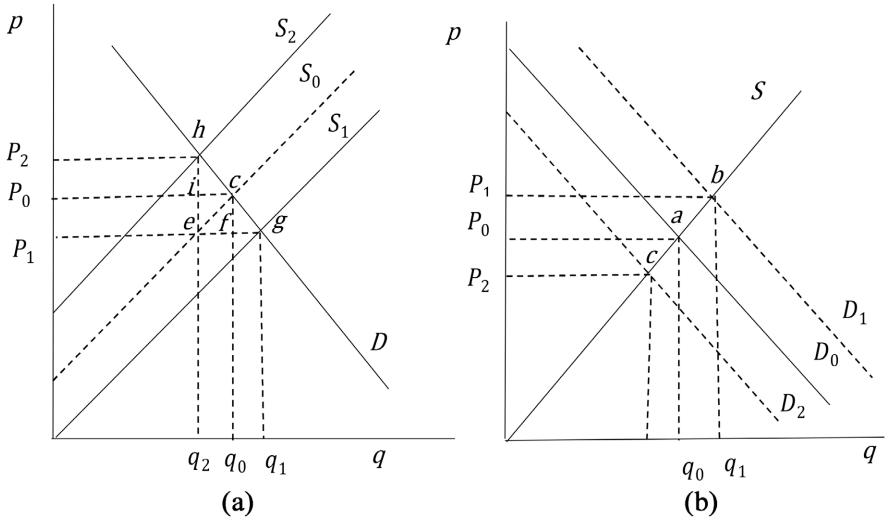


**Figure 1.** Model: Price instability and shocks. (a) Price instability and supply shocks; (b) Price instability and demand shocks.

Consider now the case where price instability is caused by demand shocks. With price stability, price is $P_0$ and production is $q_0$ in **Figure 1(b)**. With demand shocks $D_1$ and $D_2$, the high price in period is $P_1$ and the low price in period 2 is $P_2$. In this case, producers prefer price instability to stability since $(P_1P_2ab) > (P_0P_2cb)$. Hence, storage within by the government or by producers is the second-best solution.

### 4.2. Price Instability, Storage and Structural Change

The earlier literature on instability focuses on supply shocks. We consider the case where price instability is due to demand shifts in the presence of structural change in production. Structural change models are discussed in detail in (Schmitz et al, 2022).

Consider **Figure 2** when a structural change, supply from $S$ to $S_1$ in the presence of price instability from demand shocks. The net gain for producers is $\{(bfed) - (P_1'P_u'ba) - (P_2'P^*he)\}$ which is the effect of storage. Producers lose. The net loss from storage for producers is (given $P_2'$) is $\{(P_u'P_2'gd) - (P_2'P^*ig)\} = (bgd)$.

### 4.3. Price Instability (With Trade)

We now consider price instability in the context of trade. This topic was first discussed using classic welfare tools (excess demand and supply schedules) by Hueth and Schmitz (Hueth & Schmitz, 1972). Their primary focus was on price instability and trade due to supply shocks.

In **Figure 3** the total supply of good is $S_w$ and demand is $D_w$. The corresponding price and quantity are $P_0$ and $q_0$. The export supply is given by $S_A$. The supply in the importing country is $S_B$ giving a total supply of $S_w$. The domestic export demand is $D_w$. For simplicity, we assume zero demand in the exporting

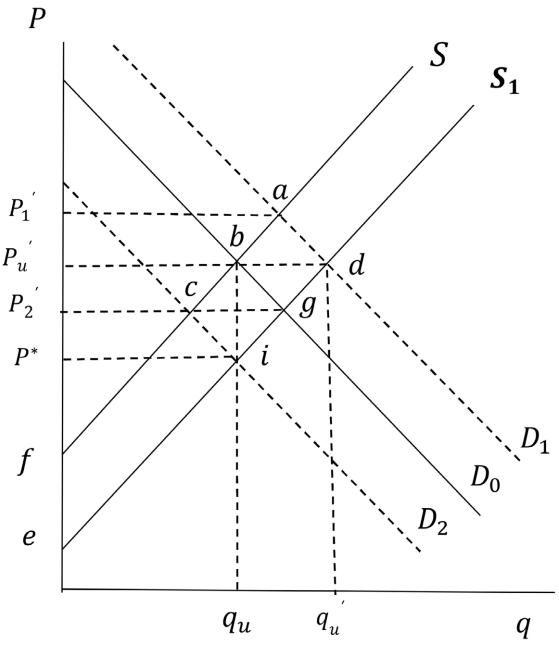


Figure 2. Storage and structural change.

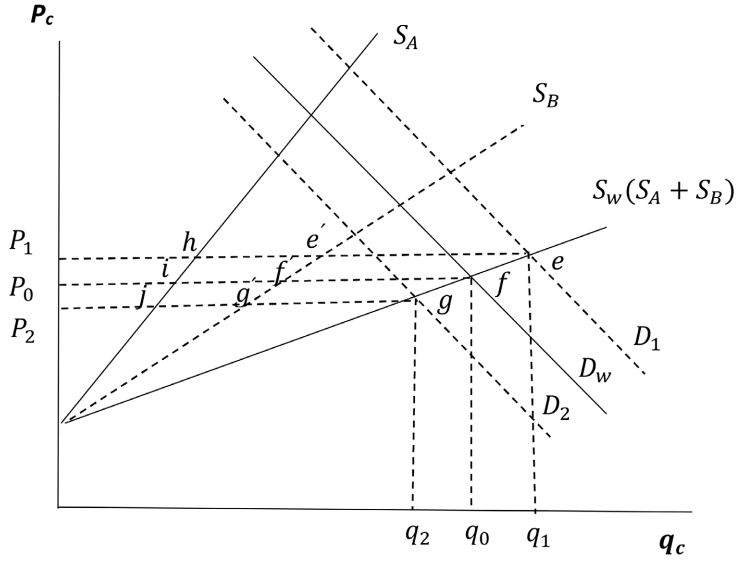


Figure 3. Price instability and trade.

country. The free trade price in the absence of price instability is $P_0$ and consumption is $q_0$. Exports total $q_1$. Consider now the impact of price instability generated by $D_1$ and $D_2$. The high price and quantity is $P_1$, $q_1$. The low price and quantity is $P_2$, $q_2$. With price instability, from a world perspective ($S_w$) producers gain $\{(P_1P_0fe)-(P_0P_2gf)\}$ from instability. Of the total export producers gain $\{(P_1P_0ih)-(P_0P_2gf)\}$..

## 5. Research Results

Our results show that when price instability is generated by demand shocks ra-

ther than by supply shocks (the case in much of the earlier literature) price instability is preferred by both producers and consumers. Therefore, there is a net gain from price instability. There is no need for commodity storage. In the presence of structural changes in supply under demand shocks, the same conclusion holds that the price instability is preferred to price stability. The gains from instability are magnified when structural change is added to our framework.

## 6. Conclusion

This paper considers the case where price instability is brought about by demand shock where unlike most of the earlier literature, it was due to supply instability. Our conclusions are very different from those derived from the earlier literature. First, there is a net gain from price instability in the absence of storage. Second, storage leads to a second-best situation. Third, both consumers and producers prefer price instability. Our results clearly show that the nature of the price instability critically determines the net cost and benefits from stabilization policy.

## Conflicts of Interest

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

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