Attitudes to Price Risk and Uncertainty: The Earnest Search for Identification and Policy Relevance

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Abstract

After several decades of neglect, the food crises of 2007-2008 and 2010-2011 have brought food price volatility back on the policy agenda. The study of price volatility, however, is really the study of price risk and uncertainty as they relate to individuals, households, and firms. Because the study of behavior in the face of risk and uncertainty has mostly focused on behavior in the face of *income* risk and uncertainty, we first review the theoretical and empirical literatures on behavior in the face of price risk and uncertainty. Then, because policy recommendations are only as good as the empirical findings on which they are based, and because market-level phenomena such as price risk do not lend themselves well to randomization, we discuss the ways in which experimental economics can inform our understanding of price risk. Finally, because expected utility—the workhorse model used to study behavior in the face of risk and uncertainty—fails to account for a number of behaviors, we discuss how insights from behavioral economics could be incorporated into the study of price risk, with the ultimate goal of generating more policy-relevant findings.

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1 Introduction

The food crises of 2007-2008 and 2010-2011 were a one-two punch to the international food system. Between 2006 and 2008, the Food and Agriculture Organization (FAO) of the United Nations' food price index—a summary measure of the price of food worldwide—increased by 38 percent, and it increased by 27 percent between 2009 and 2011 (FAO, 2015).[1] Consequently, both food crises saw policy makers scramble to mitigate the effects of price spikes, and if the food crisis of 2007-2008 took the world by surprise, the food crisis of 2010-2011, which came after a drop in food prices due to the Great Recession of 2008, was even more unexpected.

With the benefit of almost five years of hindsight, it is easy to minimize the effects of those two food crises, especially now that food prices almost back down to their 2006 level (FAO, 2015). The fact remains, however, that the food crises of 2007-2008 and 2010-2011 caused many in the media and among policy makers to characterize food crises as episodes of high food price volatility. Economists, however, knew that all that talk of food price volatility conflated the related concepts of rising food price levels (i.e., a significant increase in the mean of the food price distribution) and of actual food price volatility (i.e., a significant increase in the variance of the food price distribution). In other words, although it was immediately obvious that the food crises were associated with increases in the mean of the distribution of food prices, whether those food crises were associated with increases in the variance of the distribution of food prices remained an open question. Yet policy makers the world over pressed on with a host of measures aimed at stabilizing food prices—that is, by adopting policies whose ostensible goal was the elimination of fluctuations, both upward and downward, around the food price trend, such as buffer stocks, administrative pricing, variable tariffs, marketing boards, and so on (Bellemare, Barrett, and Just, 2013).

Though economists are well acquainted with the effects of rising food prices on net buyers of food and on net sellers of food (Deaton, 1989), the

[1] All food price figures discussed in this section are the authors' own calculations using the FAO's real (i.e., deflated) food price index.

effects of food price volatility have received much less attention in the literature, which often more accurately refers to price volatility as price risk or price uncertainty.[2]

Our contribution in this paper is thus threefold. First, we provide a concise review of the literature on the attitudes of economic agents—viz. consumers, producers, and agricultural households—to price risk, surveying a literature that began with Waugh (1944). Recall that the best measure of welfare available to economists is the indirect utility function $V(p, y)$, which is defined over a vector of prices p as well as income y. Traditionally, the study of attitudes to risk and uncertainty has focused on attitudes to *income* risk, i.e., on V_{yy}. There is an entire vector of prices p, however, regarding whose risk and uncertainty economic agents have specific preferences, i.e., V_{pp}. Our review of the literature provides a unified treatment of the effects of price risk and uncertainty—a topic that has now preoccupied agricultural and applied economists for a few generations.

Second, given the inherent difficulty that lies in accurately identifying price risk preferences with observational (i.e., survey) data, we discuss how experimental methods can be used in the lab and in the field to identify price risk preferences much more cleanly than the observational methods used so far. Indeed, the best available empirical evidence relies on (i) household survey data that are often measured with error as well as (ii) research designs that are less than ideal given their nonexperimental nature. To improve upon those methods, it is imperative for agricultural and applied economists who study price risk to start relying on experimental methods.

Third, given the important policy implication of the welfare impacts of price risk and uncertainty, we briefly discuss how the major insights of behavioral economics could be applied to the study of behavior in the face of price risk and uncertainty. Incorporating those insights into the study of price risk and uncertainty will enhance the realism of the theoretical models used to study price risk as well as the applicability of their empirical findings, and thus improve the policy relevance of this strand of research.

[2] For the remainder of this paper, we will use the expressions "price risk" and "price uncertainty" interchangeably to refer to the phenomenon often referred to as price volatility. When discussing Knightian uncertainty, i.e., uncertainty whose probability distribution is unknown, we will use the expression "price ambiguity."

2 Price Risk and Uncertainty: A Review

In this section, we critically review the progress made so far studying price risk and uncertainty, both theoretically and empirically. We review what theoretical predictions have been made on the welfare effects of price risk for consumers, producers, and agricultural households. Throughout this discussion, we pay attention to how the key underlying assumptions have evolved.

2.1 Consumers

Waugh (1944) was the very first to examine the welfare impacts of price volatility. Based on a geometrical presentation of consumer surplus, he argued that consumers are better off under price variability than under a price stabilized at its mean. A key assumption behind Waugh's result is that consumption can be allocated freely among different time periods. Samuelson (1972), however, argued that Waugh's theorem cannot apply by showing that it is not feasible to keep a price's mean stable as its volatility increases. He also argued that it is impossible for both consumers and producers to gain from price instability, and any government operation to deliberately create price volatility will likely result in a deviation from competitive equilibrium and, in turn, from Pareto optimality, causing a welfare loss for consumers, producers, or both.

Income Risk Preferences and Consumer Demand. Both Waugh (1944) and Samuelson (1972) mostly relied upon graphical analyses of Marshallian consumer surplus, thereby ignoring the concept of risk aversion. Stiglitz (1969) was the first to connect the theory of consumer demand with that on risk preferences, and he analyzed the relationship between consumer risk preferences with multiple commodities and shapes of income-consumption curves. He showed that risk neutrality at all incomes and price ratios is associated with linear income-consumption curves. And if all income-consumption curves are linear, there exists a cardinal utility representation linear in income. These results are important, because they allowed us to infer unobservable consumer risk preferences from observable Engel curves.

Indirect Utility Function Approach. A key issue in investigating the relationship between risk aversion and a demand function is that risk aversion is a property defined over a cardinal utility function, whereas a demand function can be defined from an ordinal utility function. Consider that a consumer has a utility function $U(x_1, ..., x_n)$ defined over n commodities. An indirect utility function $V(y, p_1, ...p_n)$ (where y is income and p_i is the price of the ith commodity) is obtained from maximizing the utility function subject to a budget constraint $\sum_{i=1}^{n} p_i x_i = y$. The indirect utility function does not only allow one to measure economic welfare by not having to depend upon the graphical concept of consumer surplus, it also allows one to connect risk aversion with the demand function.[3] Also, the indirect utility function is homogeneous of degree zero in y and p, which allows one to conduct a unit-free analysis. Using these properties of the indirect utility function, Deschamps (1973) analyzed the connection between risk aversion and the demand function, showing which utility functions satisfy the following properties: (i) absolute risk aversion is a function of income but not of prices; and (ii) absolute risk aversion is independent of compensated price variation (or, independent on each indifference curve). He further showed that utility functions with constant relative risk aversion satisfies the former case, but did not show the utility and demand functions for the latter case. Hanoch (1977) completed Deschamp's analysis by showing what forms of utility and demand functions satisfy the latter property.

Price Risk Preferences. The welfare effects of price volatility (alternatively, the benefits of price stabilization) are more directly assessed by consumer's risk preferences towards prices. An important contribution of Hanoch's (1977) was the analysis of the relationship between income risk preference and price risk preference. He showed that (i) a necessary condition for a consumer to be price risk-loving is that relative risk aversion over income be less than 2; and that (ii) a consumer can never be price risk-averse with respect to all commodities. Turnovsky et al. (1980) evaluated the benefits from price stabilization in terms of the convexity and concavity of indirect utility function with respect to prices. In case of stabilizing the price of a single commodity, just as $V_{yy} < (>)\, 0$ indicates that the consumer loses (gains) from volatility in income, $V_{pp} < (>)\, 0$ indicates that the consumer loses (gains) from volatility in price of the commodity. With this as a starting point, they showed that a consumer's preference for price stabiliza-

[3] Absolute and relative risk aversion are defined as $-\frac{V_{yy}}{V_y}$ and $-y\frac{V_{yy}}{V_y}$, respectively. V_y and V_{yy} respectively indicate the first and the second derivatives of the indirect utility function with respect to income. The demand function x_i can also be derived from the indirect utility function via Roy's identity, i.e., $x_i = -\frac{V_{p_i}}{V_y}$.

tion is a function of: (i) the income elasticity of demand for the commodity; (ii) the price elasticity of demand for the commodity; (iii) the budget share allocated for consumption of the commodity; and (iv) the coefficient of relative risk aversion. Based on this framework, they show that the desirability of price stability is positively associated with higher income risk aversion, but is negatively associated with higher price and income elasticities, and for plausible values of the parameters (i)-(iv), it is theoretically possible that a consumer is price risk-loving, especially when the budget share allocated for the commodity is small and income risk aversion is low. Thus, preference for commodity price volatility can vary across economic environments.[4]

Turnovsky et al. (1980) also showed that the consumer surplus framework which Waugh (1994) relied upon is valid as an accurate measure of the welfare effect only when the magnitudes of (ii) and (iv) are identical. Their analysis was extended to the case of stabilizing the prices of multiple commodities.

2.2 Producers

Various researchers have developed theories of the competitive firm under price uncertainty. Oi's (1961) was among the earliest such studies. Oi challenged an intuition that price instability is undesirable for firms, and showed (by geometrical presentation) that "price instability is a virtue rather than a vice," which results in greater total profits for firms in a perfectly competitive market. The shortcoming of Oi's analysis, however, was the implicit assumption that firms can predict future prices perfectly, or can adjust their output instantaneously. Nelson (1961) distinguished the concept of price "variation" from that of price "uncertainty," emphasizing that firms' ability to predict prices may not be perfect. Nelson then showed that, the better the firm is able to predict future prices, the more elastic its supply curve becomes. Tisdell (1963) also relaxed Oi's assumption of perfect prediction and proved that, if a firm has to produce prior to knowing the prices, the expected profit is smaller with price instability than with price stability, and that the expected profit declines as price variability increases. Given price uncertainty and imperfect prediction, Tisdell also suggested an optimal strategy that maximizes expected profit, which is to produce at a level where expected

[4] On this Barrett (1996, p. 202) writes that "price risk aversion might exist among poor agrarian populations even though it is generally thought unlikely in wealthier, industrial countries."

price equals marginal cost.

Impact of Profit Risk Aversion. Oi (1961) and Tisdell (1963) assumed that firms maximize expected profits, thereby assuming that firms are (profit) risk-neutral. In later studies, researchers adopted the expected utility approach in which firms maximize a von Neumann-Morgenstern utility function, and took into account the cases of non-linear utility functions. Penner (1967), in his paper on the effect of corporate taxes when prices are uncertain, considered cases of risk-neutral and risk-averse firms separately. McCall (1967) compared profit risk-loving, risk-neutral, and risk-averse firms, and showed that, under price uncertainty, the optimal output for the risk-averse firm is no larger than the optimal output for the risk-neutral firm, which is no larger than the optimal output for the risk-loving firm. Baron (1970) generalized Penner and McCall, and showed that, when price is a random variable, optimal output is non-decreasing in the degree of Arrow-Pratt risk aversion. Baron also showed that, under price uncertainty, a risk-averse firm produces at a level less than the long-term equilibrium at which marginal cost equals to average total cost. Baron thus argued that a risk-averse firm will produce less than the Pareto-optimal level of output, whereas a risk-neutral firm will produce at the Pareto-optimal level.

Impact of Output Price Uncertainty. Baron considered price uncertainty as given, and focused on the effect of profit risk aversion on firm output. Sandmo (1971), however, considered profit risk-aversion as given, and focused on the impact of price uncertainty on output. In his paper, Sandmo proved that the risk-averse firm's optimal output under price uncertainty is less than its optimal output under price certainty.

Impact of Marginal Increases in Price Uncertainty. Sandmo discussed the concept of a "stretch," or mean-preserving spreads, but he was unable to determine the direction of the impact of an output price distribution stretch on output. This was done by Batra and Ullah (1974) who proved that the firm's optimal output is decreasing in marginal increases in price uncertainty, under the additional assumption that absolute risk aversion is decreasing. Epstein (1978) later generalized these studies on the marginal impact of price uncertainty by adopting the definition of increasing risk by Rothschild and Stiglitz (1970). Epstein showed that it is possible to yield a result contradictory to Batra and Ullah's under DARA if the coefficient of relative risk aversion exceeds unity.

Ex Post Output Flexibility. Whether a firm has to produce all its output before knowing the output price, or whether it can perfectly predict the price was another important factor that determines the results. Leland (1972) generalized Baron (1970) and Sandmo (1971) by extending to the cases of (i) quantity-setting firms and price-setting firms; (ii) ex ante and ex post decision making (regarding output and price); and (iii) risk-averse and risk-neutral firms. Turnovsky (1973) relaxed the assumption that production decisions are irreversible, and allowed for the cases in which the firm can modify its production decision at extra cost after the actual selling price is realized. The key result was that with ex post output flexibility, a change from risk-neutrality to risk-aversion does not necessarily decrease output, and can actually *increase* the planned output depending upon the shape of the cost function. Epstein (1978) showed that the results of Sandmo (1971) (on the effect of price uncertainty) and Batra and Ullah (on the effect of marginal increase in price uncertainty) may be altered with ex post output flexibility.

Addressing Preferences. Schmitz et al. (1981) revisited Oi (1961), who had claimed that price instability was desirable for producers, but they considered the notions of risk aversion and expected utility. Schmitz et al. (1981) is differentiated from the previous studies because the authors use the indirect utility function $V(\cdot)$ in their analysis of producers, just as Turnovsky et al. (1980) did for their analysis of consumers. By doing so, they Schmitz et al. (1981) assess the benefit of price stabilization to producers by directly addressing its impact on preferences, rather than just analyzing its impact on the level of output. According to Schmitz et al.'s analysis, whether a producer prefers price stability depends on the convexity or concavity of $V(\cdot)$ with respect to output price, which in turn is determined by (i) the price elasticity of supply; (ii) the profit margin; and (iii) the coefficient of relative risk aversion. Based on this framework, they showed that, in case of a single-product firm, Oi's results hold if the firm is profit risk-loving, and if the firm is risk-averse, then it may prefer price stability.

To summarize the discussion so far, assumptions on (i) ex post output flexibility; (ii) risk aversion of producers (i.e., second-order properties of the utility function); (iii) changes in risk aversion according to the level of profit (i.e., third-order properties of the utility function); and (iv) whether a firm produces a single product or multiple products all determine the welfare of firms under price uncertainty. Consequently, different assumptions on these properties also change the optimal level of output the firm should produce under price uncertainty.

2.3 Agricultural Households

The theories regarding the welfare effects of price risk discussed so far have analyzed consumers and producers separately. The typical agricultural household, however, consumes some of its own outputs. Given this important characteristic of agricultural households, economists have combined consumer and producer approaches to price risk and have thus studied the consequences of price risk for agricultural households.

Finkelshtain and Chalfant (1991) noted that agricultural households face multivariate risk, because both the prices of the commodities it consumes and its income are random. This is unlike the case of the firm analyzed by Sandmo (1971), in which price volatility is only realized in the form of profit volatility. Finkelshtain and Chalfant thus incorporated the concept of marketed surplus (i.e., a household's production minus its consumption) into Sandmo's model to analyze the behavior of agricultural households. They set up a model in which an agricultural household producing a farm output maximizes its expected utility defined over consumption of a portion of the farm output, an aggregate market good, and leisure. A key assumption is that the decision-making process involves two-periods: In the first period, the household makes its leisure and output decisions, and in the second period (i.e., after the uncertain prices are realized), it makes its consumption decision.

Finkelshtain and Chalfant developed an alternative to the traditional risk premium (Pratt, 1964). The traditional risk premium is defined as the maximum amount of income an individual is willing to pay to stabilize his income at its expected value, *given that income is the only random variable*. The alternative measure developed by Finkelshtain and Chalfant is defined as the maximum amount of income an individual is willing to pay to stabilize his income *when both income and price are random*. Therefore, Pratt's measure of risk premium is a special case where price is fixed at its mean value. When expressed algebraically using a Taylor approximation, this alternative measure of risk premium is comprised of Pratt's traditional measure of (income) risk premium plus an additional term associated with the stochastic interaction between income and prices. Based on their framework, Finkelshtain and Chalfant showed that production under price uncertainty can be greater (or equal to, or smaller) than the certainty output, thereby showing that the result of Sandmo (1971) is a special case in which the wealth effect of price volatility dominates the consumption effect.

2.4 Empirical Evidence on Price Risk and Uncertainty

Though there is a vast theoretical literature on the welfare effects of price risk and uncertainty, there exists only a handful of empirical studies on the topic. Appelbaum and Ullah (1997) used nonparametric methods to estimate the first four moments (i.e., mean, variance, skewness, and kurtosis) of price distribution in the printing and publishing industry as well as in the stone, clay, and glass industries. Then, applying duality, they rejected the assumption of income risk neutrality of firms. In the data, however, they could not observe output under price certainty. Therefore, they estimated certainty output imposing restrictions on parameters derived from duality and compared it with actual output level under price uncertainty. Based on this comparison, they conclude that output is smaller when price is uncertain, which supported Sandmo's prediction.

Barrett (1996) investigated the role of price risk as an explanation for the inverse farm size-productivity relationship observed in Madagascar. Adapting the derivations in Finkelshtain and Chalfant (1991), he modified Turnovsky et al.'s (1980) theoretical model of pure consumers to account for the agricultural household context, and derived the coefficient of price risk aversion of a household producing and consuming single commodity (in this case, rice). Barrett estimated this coefficient across six landholding strata, corresponding to the smallest to the largest amounts of landholdings, and he showed that the estimated coefficient is larger for the smallest (i.e., net buyer household) farms, which is a sufficient condition for the overemployment of labor that leads to the existence of an inverse farm size–productivity relationship.

Bellemare, Barrett, and Just (2013) extended the theoretical framework of Barrett (1996) to the case of several commodities in order to investigate the welfare effects of price stabilization in rural Ethiopia. They defined and estimated the matrix of price risk aversion of agricultural households for seven crops. They also derived a measure of willingness to pay (WTP) for price stabilization. Based on this framework, they showed that the average Ethiopian rural household is price risk-averse and is willing to give up about 18 percent of its income to stabilize the commodity prices, and that WTP for price stabilization is increasing in household income. Similarly, Mason and Myers (2013) derived the welfare implications of price stabilization by looking at the effects of the Zambian Food Reserve Agency on maize markets, finding that it is relatively wealthier farmers who benefit from more stable maize prices.

3 The Role of Experimental Designs

The most general measure of price risk aversion for a single commodity is the estimable coefficient of price risk aversion derived by Barrett (1996), which is such that for any economic agent (i.e., consumer, producer, or household),

$$A = -\frac{M}{p}[\beta(\eta - R) + \epsilon], \tag{1}$$

where M denotes the agent's marketable surplus of the commodity (which can be positive, zero, or negative depending on whether the agent is a net seller of the commodity, autarkic with respect to it, or a net buyer of the commodity), $p > 0$ denotes the price of the commodity, β denotes the commodity's share $\frac{pM}{y}$ of the agent's budget (wherein y denotes income, and wherein β can also be positive, zero, or negative), η denotes the income-elasticity of the agent's marketable surplus of the commodity, ϵ denotes the price elasticity of the agent's marketable surplus of the commodity, and R denotes the agent's coefficient of relative (income) risk aversion.[5]

As noted in Bellemare, Barrett, and Just (2015), the difficulty so far with estimating coefficients of price risk aversion has been that extant studies have had to rely on observational data in order to obtain an estimate $\widehat{A}$ of A. Given the nonexperimental nature of survey data, it is difficult to make the case that the estimates of β, η, R, and ϵ that go into making $\widehat{A}$ are identified (i.e., causal), and the estimation of A often requires making a number of ad hoc assumptions.[6]

Faced with the task of identifying price risk preferences, one might be tempted to reach for the gold standard of randomized controlled trials (Duflo,

[5] This framework has been extended to the case where agents consume or produce several commodities by Bellemare, Barrett, and Just (2013), but we focus on the single-commodity case for simplicity in this paper.

[6] See McBride's (2015) comment on Bellemare, Barrett, and Just (2013) and the reply by Bellemare, Barrett, and Just (2015) for how changing only one of those ad hoc assumptions can change qualitative results.

Glennerster, and Kremer, 2007). The problem with that approach, however, is that it would be practically impossible to randomly assign the marketable surplus, price, and income of the agents involved so as to cleanly identify their coefficients of price risk aversion. Moreover, randomizing market-level variables such as prices remains difficult, if not impossible.

A second-best approach involves the use of lab or lab-in-the-field experiments, an area in which there has been no work besides recent work by Lee, Bellemare, and Just (2015). In such experiments, subjects can be cast in the role of consumers, producers, or agricultural households who respectively have to make utility maximization decisions, profit maximization decisions, or both in the face of uncertain commodity prices.

In Lee, Bellemare, and Just (2015), whose experimental design mimics the theoretical model in Sandmo (1971), subjects play the role of firm managers who have to maximize profit in the face of output price risk. Contrary to Sandmo's theoretical prediction, according to which a move from a certain price to an uncertain price whose mean is equal to the certain price causes producers to hedge against price risk by producing less than they would in the certainty case, Lee, Bellemare, and Just's results find that the presence of price uncertainty causes experimental subjects to produce *more* at the margin, but that subsequent increases in uncertainty (i.e., mean-preserving spreads) cause them to decrease how much they choose to produce.

The experimental methods used by Lee, Bellemare, and Just (2015) can and should be extended in several ways. First and foremost, they should be applied to the study of choice in the face of price risk by consumers and agricultural households.

Second, Bellemare, Barrett, and Just (2013) having shown that the households in their data generally not only care about the variance of each price, but also about the covariance between any two prices in their data, experimental methods should be applied to the study of price risk over more than one commodity.

Third, researchers should pay particular attention to the potentially differential effects of price risk (i.e., an uncertain price whose distribution is known) and price ambiguity (i.e., an uncertain price whose distribution is unknown), as Lee, Bellemare, and Just (2015) have found that the two can have very different effects on experimental subjects placed in the role of producers.

Fourth, researchers should study the demand for insurance against price risk in the lab by developing experimental games wherein subjects face uncertain gambles over the prices they face, but also have the possibility of buying price risk insurance.

Lastly, the obvious shortcoming of such experimental studies is that they lack external validity. That is, their findings generally only apply to the specific pool of subjects who have taken part in an experiment, who are often undergraduate students. As such, researchers should strive to replicate their own experiments in as many different contexts as possible in the context of a single research project. Whether this means running the same experiment with college students and business executives, with college students and smallholder farmers in a developing country, with undergraduate and graduate students, etc. obviously depends on the application, but for the study of price risk preferences, which matter most in agricultural settings in developing countries, where insurance markets are highly fragmented or altogether absent, involving smallholder farmers from developing countries seems ideal.

4 Insights from Behavioral Economics

The foregoing laid out a research agenda to cleanly identify price risk preferences and behavior in the face of price risk and uncertainty according to the neoclassical paradigm. Researchers in psychology, economics, and related fields, however, have identified some systematic departures from the predictions of the neoclassical model in the 1970s and 1980s, they have developed alternatives to neoclassical model in the 1990s and 2000s, and they have begun empirically testing the predictions of those new theoretical models around the mid-2000s, three waves of research which have added up to form the field of behavioral economics.[7]

Because the empirical study of behavior in the face of price uncertainty has been rather limited, it is perhaps no surprise that the issue has been ignored by behavioral economists. Yet there are many areas where behavior in the face of price uncertainty and behavioral economics could intersect. In the spirit of Timmer (2012), who looked at how behavioral economics can inform our understanding of food security, this section explores what a behavioral research agenda on behavior in the face of price risk might look like.

[7] See Rabin (1998) and Camerer and Loewenstein (2004) for reviews on the first two waves of research, and Della Vigna (2009) for a review of the third wave of research.

Reference-Dependent Utility and Loss Aversion. Kahneman and Tversky's (1979) article on prospect theory, which is now the stuff of core courses in most graduate programs in agricultural and applied economics, identified several departures from standard models. Among those are the fact that reference points appear to matter (i.e., utility is reference-dependent), and that a monetary loss always translates into a greater welfare loss than an equivalent monetary gain translates into a welfare gain (i.e., people are loss-averse). Moreover, Kahneman and Tversky (1979) found that people seem to behave as if risk-loving over losses, and they behave as if risk-averse over gains. These phenomena deserve to be investigated in the area of price risk, taking into account the net buyer–autarkic–net seller division. Lee, Bellemare, and Just (2015) found some evidence that people make bolder choices (i.e., they expose themselves to more price risk by producing more) when they experienced a loss in the previous round, and they make more conservative choices (i.e., they expose themselves to less price risk by producing less) when they experienced a gain in the previous round. Though this is far from a clean test of prospect theory in the context of price risk, it suggests that prospect theory might also have something to say about price risk, and the phenomenon deserves systematic investigation.

Judgment under Uncertainty. One of the most fruitful areas of research in behavioral economics has doubtless been the search for better explanations for behavior than the workhorse expected utility model of neoclassical economics. Those better explanations are rooted in the fact that, here too, people make systematic mistakes and make decisions based on heuristics, all of which adds up to behavior that often resembles little (or not) the predictions of expected utility theory. People do not always know the probability distributions behind the uncertainty they face—that is, choices are made in the face of ambiguity rather than risk—and even when they know those probability distributions, they sometimes have a hard time processing that information, making inferences based on what has been referred to as the Law of Small Numbers (Rabin, 2002) or seeking confirmatory evidence for what they already believe in (Rabin and Schrag, 1999). In Lee, Bellemare, and Just (2015), for example, subjects fail to behave according to expected utility theory when they face price risk, and they appear to respond sharply to price ambiguity by making inferences based on very few realizations of the price distribution.

Intertemporal Choice. In order to hedge against or speculate over price risk and uncertainty, consumers, producers, and agricultural households will often store some commodities, and several theoretical models explore the causes and consequences of storage (see Wright and Williams, 1984 and 2005). Yet behavioral economists have identified a number of departures from the neoclassical model of intertemporal choice. Chief among those is the existence of present-biased preferences (O'Donoghue and Rabin, 1999) and related self-control issues. Intuitively, individuals tend to have a sharp preference for the present which, in the absence of commitment devices, leads them to adopt sub-optimal behavior when the future arrives. For example, an individual whose preferences are present-biased—in other words, a individual with self-control issues—might overconsume today some of the food she has stored for the lean season, which leads to issues of food insecurity when the lean season finally arrives (Laibson, 1998; Harris and Laibson, 2001).

Fairness and Social Preferences. Finally, it turns out that, in contrast to what the neoclassical model typically assumes, people care about fairness and are averse to inequity (Yaari and Bar-Hillel, 1984; Charness and Rabin, 2002). Though this aspect of behavioral economics might seem a priori of less relevance to the study of attitudes to price volatility, the fact that different economic agents (i.e., individuals, households, and firms) have different net positions (i.e., net buyer, autarkic, net seller) vis-à-vis the market for those commodities whose prices fluctuate may cause some agents to bear the consequences of price volatility while others reap benefits from it, i.e., the former are hedgers, while the latter are speculators. Bearing in mind that very distinction, many in the media and among policy makers were quick to blame speculators for the food crises of 2007-2008 and 2010-2011, and historically, speculators have often had a bad reputation of holding to certain assets purely to profit from market fluctuations. As such, an investigation of the political economy of food crises which takes into account the impacts of food price volatility on heterogeneous households and firms, the response of governments, and the importance of social preferences might help guide policy makers when the next food crisis hits.[8]

[8] That said, Bellemare (2015) finds that, for the period 1990-2011, it was rising food prices that caused food riots, and that increases in food price volatility were not systematically associated with social unrest.

5 Summary and Concluding Remarks

In this article, we have reviewed the economic literature on behavior in the face of price risk and uncertainty and, on that basis, we have laid out the foundations of a research agenda on price risk and uncertainty which relies on experimental methods and incorporates the insights of behavioral economics.

As with many other market-level economic phenomena, the tools of randomization are of limited usefulness when it comes to studying price risk and uncertainty. In order for empirical findings to be policy relevant, the inferences derived therefrom need to be credible and based on the clean (i.e., causal) identification of empirical relationships. Though quasi-experimental methods—that is, methods relying on natural experiments or plausibly exogenous instrumental variables—hold some promise on that front, we believe that experimental methods are best-suited to cleanly identify consumer, producer, and household preferences and behavior in the face of price risk and uncertainty, though we certainly recognize that those methods can be limited in their external validity.

Likewise, incorporating insights from behavioral economics can also enhance the policy relevance of research findings from the study of behavior in the face of price risk and uncertainty. Though expected utility theory has been the workhorse model in economics when it comes to studying risk and uncertainty, behavioral economists have identified systematic departures in behavior relative to what expected utility predicts. Between the internal consistency provided by expected utility theory and the greater realism afforded by behavioral economics, policy relevance most likely is predicated on the latter.

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