Background. The paper analyzes a setting in which a manufacturer (he) and a retailer (she) face uncertain demand. The manufacturer designs a supply contract and offers it to the retailer. The retailer has an information advantage in the form of a private demand forecast signal, which allows her to stock more efficiently according to the terms of the supply contract. Because the manufacturer is not privy to the forecast signal, he cannot set the most efficient contract terms and thereby faces an information disadvantage causing him to incur a hidden-information cost. Specifically, the terms he designs end up too unfavorable (favorable) if the forecast signal turns out low (high). We propose a temporary contract adjustment (TCA) mechanism that allows the manufacturer to augment various types of contracts to either reduce or completely eliminate the hidden-information cost.

The manufacturer augments a particular type of contract with the TCA mechanism by designing the contract with two sets of terms: pre-signal terms and post-signal terms. The pre-signal terms, which expire before the signal is received, are designed to make the retailer take some action before she observes the signal (e.g., order some stock and/or pay a relatively high fixed transfer). The post-signal terms make her take another action after she privately observes the signal (e.g., order more

\footnote{Definition. In this paper, the term “hidden-information cost” refers to the difference in profits that the manufacturer achieves when he optimally designs a particular type of contract after observing the forecast information versus when he optimally designs the same type of contract without observing the forecast information.}
stock and/or pay a second fixed transfer if the signal is sufficiently high). The hidden information cost is reduced or fully eliminated because of this unique feature of the mechanism of engaging the retailer twice – once before and once after she receives the forecast information.

**Results Overview.** We illustrate the TCA mechanism by augmenting two popular types of supply contracts: a simple wholesale price contract and a two-part tariff contract. The results show that, when applied to wholesale price contracts, the TCA mechanism partially (fully) eliminates hidden-information cost when the retailer’s private forecast is refined (coarse). When applied to two-part tariff contracts, the TCA mechanism fully eliminates the hidden-information cost regardless of the nature of the retailer’s private forecast. In general terms, by applying the TCA mechanism to a (weaker) wholesale price contract, the manufacturer can achieve the effect of *free, partial information revelation* as if he observes a coarse version of the retailer’s private forecast. By applying the TCA mechanism to a (stronger) two-part tariff contract, the manufacturer can achieve the effect of *free, full information revelation* (i.e., full-information profits) as if he fully observes the same version of the forecast, without the retailer directly sharing her private information.

**Model.** To develop these results, we model a manufacturer (he) who sells his good through a retailer (she), who must first stock the good before she can sell it. Consumer demand is stochastic and follows some prior probability distribution that is common knowledge. In addition, we consider a demand forecasting system in the form of a signal that allows any player who observes it to update his/her belief from the prior to a posterior distribution. The retailer always gets to observe the signal. After observing the signal but before observing the realized demand, she sets her stocking level. After observing the realized demand, she sets the retail price. We analyze three main games: (1) a *common signal game*, where both the manufacturer and the retailer observe the forecast signal; (2) a *private signal game*, where only the retailer is privy to the signal; and (3) a *temporary contract adjustment (TCA) game*, where only the retailer is privy to the signal and the manufacturer implements the TCA mechanism by designing the contract with both pre-signal and post-signal terms.\(^3\)

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\(^2\)A Coarse forecast has a binary signal space in the form of “high” or “low” signals. A refined forecast contains any arbitrary number of signals.

\(^3\)The manufacturer does not need to know exactly when the retailer will receive the forecast. He only needs to know the time window in which she receives it. He makes the pre-signal terms expire before the window begins.
The common signal game serves as a benchmark and represents the manufacturer’s \textit{full-information} outcome. The private signal game highlights how he incurs a hidden-information cost compared to the common signal game. The TCA game highlights how the mechanism allows the manufacturer to eliminate or reduce the hidden-information cost. The pre-signal terms engage the retailer before observing the signal and induce her to make a decision under high uncertainty. As a result, she ends up over-invested when the signal turns out low. The post-signal terms engage her after the signal, allowing her to make use of the information and purchase additional stock efficiently depending on the forecast signal. This ability to utilize the forecast information allows the manufacturer to set more efficient prices and/or extract higher fixed transfers. It is important to note that designing the \textit{same} contract that engages the retailer only before or only after she receives the forecast information is a special, sub-optimal case of the TCA mechanism. On the one hand, if the manufacturer designs a contract that induces the retailer to act \textit{only} after she observes the signal, he cannot force her to bear high uncertainty and over-invest. In such case, he fully incurs the hidden-information cost. If he designs a contract that induces the retailer to act \textit{only} before she observes the signal, the value of the signal information will be lost and he will not be able to set his terms as efficiently.

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Later, she can place a second order according to the post-signal terms whenever she receives the forecast.