APPENDIX

Out-of-Sample Forecast Performance for Monthly Futures-Based Price Forecasts

As presented in section 5, we estimate Equations 1, 2, 4, and 5 and calculate percentage errors from these forecasts to actual prices using Equation 6. These percentage errors are then used to evaluate the out-of-sample predictive performance of each alternative model to that of Hoffman's benchmark model (see Tables A1).

The test of bias, conducted based on the MPE statistic (see Table A1), show that both the Hoffman benchmark model and alternative models occasionally generate biased forecasts. Specifically, Hoffman model over-predicts cotton farm prices at short forecast horizons (1–5 months ahead), while the forecasts from alternative model specifications under-predict prices at mid to longer horizons (mostly 6–12 months ahead). This pattern is also evident in Figure A1 Panel A.

The dynamics of the MAPE and RMSPE statistics across forecast horizons and models (see Panel A of Figures A2 and A3, and Table A1) show that the errors from Model 1, moving average with basis deviation term, escalate very quickly starting from a one-month ahead horizon, and exceed Hoffman's benchmark forecast errors significantly. Model 2 forecast errors tend to be smaller than the Hoffman model errors for all forecast horizons when MAPE is considered a forecast performance metric. Similarly, when using the RMSPE statistic, Model 2 produces lower prediction errors than Hoffman's benchmark model, except for six– and seven–months ahead horizons. Model 3 forecast errors tend to be perform similar to that of Model 2 both for MAPE and RMSPE statistics. Short-term forecasts have smaller errors than longer-term forecasts across all models.

In fact, moving to regression models for cotton spot price projection resulted in up to 29%⁸ accuracy gain for one-month ahead forecasts generated using Model 2 with an average gain of 12% across all forecast horizons. Model 3 performance was also satisfactory, with a maximum gain in accuracy of about 28% for 12-month ahead forecasts and an average gain in accuracy of 12% across all forecast horizons. On the other hand, Model 1's overall performance is relatively poor, with an average loss in accuracy of 81% across all forecast horizons. These findings indicate that regression-based specifications (i.e., Models 2 and 3) that relax the fixed parameter assumptions implied in the Hoffman model lead to significant improvements in cotton price forecast accuracy. Such improvement in regression-based approaches can partially be attributed to the model's capability to adjust its coefficients according to specific market conditions.

Modified Diebold-Mariano (MDM) and Encompassing Test

The results discussed above showed that there are differences in accuracy between the proposed and the benchmark forecasts. The MDM test results presented in Table A1 indicate whether these differences are statistically significant. These results show that Model 2 leads to a significant increase in forecast accuracy in 11 out of 12 forecast horizons, whereas Model 3 produces significantly more accurate projections at shorter (1 - 2 months) forecast horizons. On the other hand, Model

⁸This value is calculated as (1-RMSPE-ratio) * 100%.

1 results in a statistically significant deterioration in accuracy in almost all forecast horizons (10 out of 12).

In addition to accuracy, we test whether forecasts generated using the benchmark model contain all information provided in the alternative specifications. The results of the encompassing test for futures-based monthly price forecasts, shown in Table A1, reject this hypothesis for all three alternative models at all forecast horizons. This finding suggests that the forecasts from our proposed models include additional information missing from the Hoffman model and, therefore, offer an improvement over it.

Sensitivity Analysis for Futures-Based Price Estimates

As discussed in sections 1 and 2, cotton futures prices spiked and reached an all-time high in 2011 due to perceived supply shortages in the global market. This resulted in a significant deviation of basis from its historical average, creating an outlier in our dataset. To evaluate the sensitivity of our results to such unanticipated market conditions, we re-estimated the models after removing futures prices from the outlier period of August 2010 to August 2011. By the construction of our dataset, the 2011 futures prices are used to forecast farm prices both in 2011 and 2012. For instance, the 12-month ahead forecast for February 2012 will use the March 2012 futures contract prices observed in February 2011. Therefore, before conducting sensitivity analysis, we removed data from September 2010 until August 2012 (24 observations). Overall, the results of the analysis presented in Tables A2 as well as in Figures A1 – A3 Panel B are consistent with that of the full sample. As before, regression-based Models 2 and 3 produced more accurate and stable forecasts, as shown by lower RMSPE and positive and significant MDM statistics.

						Ч	Forecast Horizon	izon				
Evaluation Criteria	1	3	çî	4	ъ	9	2	×	6	10	11	12
						Hoffman Model	odel					
MPE	-2.497^{**}	-2.441^{**}	-2.110^{**}	-1.860^{**}	-1.563^{*}	-1.278	-1.193	-1.131	-1.049	-1.075	-0.936	-0.870
MAPE RMSPE	$9.877 \\ 15.482$	$9.634 \\ 14.846$	$9.434 \\ 13.931$	$9.901 \\ 13.697$	10.429 14.039	$11.172 \\ 14.681$	11.759 15.314	12.489 16.099	13.097 16.936	$13.788 \\ 17.854$	14.362 18.557	14.996 19.298
				2	fodel 1: BD	EV Moving	Model 1: BDEV Moving Average Model	odel				
MPE	0.865	1.025	1.609	2.151	2.872	3.426^{*}	4.168^{*}	4.578^{**}	5.557^{**}	4.134^{*}	3.334^{*}	6.112^{**}
MAPE	10.131	10.792	12.182	12.925	14.456	15.812	17.081	18.458	19.756	18.984	18.651	21.724
RMSPE	18.329	19.941	21.350	22.934	26.967	28.021	32.240	33.812	39.682	31.983	27.307	46.714
MDM	-0.230	-0.835	-2.178^{**}	-2.193^{**}	-2.449^{**}	-2.867^{***}	-2.788***	-2.830^{***}	-2.675^{***}	-2.838***	-3.230^{***}	-2.219^{**}
Encompassing	0.691^{***}	0.637^{***}	0.521^{***}	0.447^{***}	0.387***	0.326^{***}	0.280^{***}	0.231^{***}	0.206^{***}	0.205^{***}	0.191^{***}	0.196^{**}
				Model	2. Regressi	ion Model w	Model 3: Beoression Model with Nearby Contract	Contract				
					0		· · · · ·					
MPE	0.570	0.649	0.691	0.929	1.231	2.906^{**}	3.112^{***}	3.339^{***}	2.821^{***}	3.506^{***}	4.198^{***}	4.797^{***}
MAPE	8.343	8.193	8.404	8.808	9.345	10.571	10.966	11.369	11.784	12.230	12.668	12.934
RMSPE	11.010	10.680	10.671	10.857	11.407	17.344	16.396	15.835	14.851	15.540	16.136	16.649
MDM	2.026^{**}	2.021^{**}	1.650	1.810^{*}	1.837^{*}	1.956^*	1.931^{*}	2.074^{**}	1.713^{*}	1.813^{*}	1.891^{*}	2.189^{**}
Encompseina	***0700			****0000	***00000		****	***101 0		***0000	****** 0 0	***100 0

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	/ations at ea iis deviation , and MDM
2.070^{**} 0.900^{***}	per of observands for bas parage error,
MDM Encompassing	Note 1: The number of observations at each horizon is 228. Note 2: BDEV stands for basis deviation term. MPE represents mean percentage error. MAPE stands for mean absolute percentage error, RMSPE represents the root mean square percentage error, and MDM stands for the Modified Diebold-Mariano test.

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MPE

Model 3: Regression Model with BDEV term

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Note 3: The bolded values in MAPE and RMSPE indicators show that compared to Hoffman model a specific alternative model produces lower forecast errors.

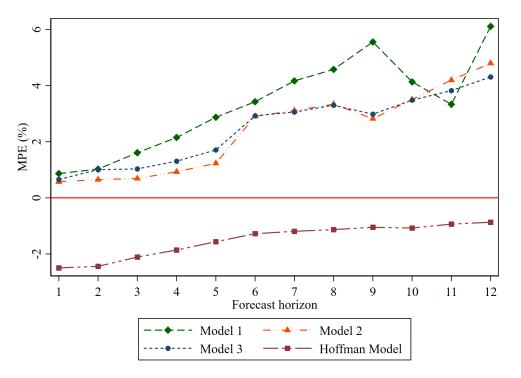
Note 4: The null hypothesis for the test of bias states that the MPEs are not statistically different from 0.

Note 5: We conduct MDM test against Hoffman benchmark. The null hypothesis for the 2-tail test states that the two forecasts have similar forecast accuracy. Note 6: The null hypothesis for the encompassing test states that the benchmark model forecast contains all the information provided by the alternative model forecasts. Note 7: Statistical significance of a two-tailed test is indicated with the asterisk: *p < 0.10, **p < 0.05, ***p < 0.01.

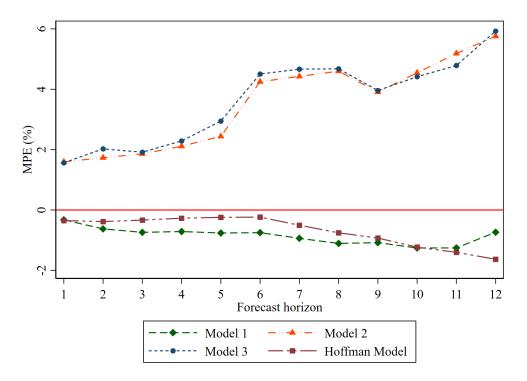
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$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	APE	8.150	8.615	9.435	10.201	11.434	12.476	12.990	14.055	14.573	15.086	15.714	16.636
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$ \begin{array}{c} 0.00 \\ 0.527^{**} & 0.499^{**} & 0.430^{**} & 0.370^{**} & 0.340^{***} & -3.342^{***} & -2.858^{****} & -2.909^{****} & -2.033^{****} & 0.276^{*****} & 0.271^{****} & 0.226^{*****} & 0.303^{*****} & 0.276^{******} & 0.276^{******} & 0.271^{*****} & 0.232^{*****} & 0.276^{*******} & 0.276^{********} & 0.276^{*******} & 0.276^{*******} & 0.276^{*******} & 0.276^{*******} & 0.276^{*********} & 0.276^{*************} & 0.276^{***************} & 0.237^{************************************$	RMSPE	11.777	11.947	12.488	13.797	15.262	16.557	17.487	19.000	20.109	20.537	21.599	23.785
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	ADM Incompassing	-0.570 0.527^{***}	-1.347 0.499^{***}	-2.405^{**} 0.430 ***	-2.534^{**} 0.370^{***}	-3.444^{***} 0.340^{***}	-3.342^{***} 0.313^{***}	-2.858^{***} 0.323^{***}	-2.999^{***} 0.271^{***}	-2.431^{**} 0.262^{***}	-2.023^{**} 0.303^{***}	-1.877^{*} 0.276^{***}	-1.940^{*} 0.264^{***}
	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	I				Model		on Model wi	th Nearby C	ontract				
$ \begin{array}{ cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{llllllllllllllllllllllllllllllllllll$	1PE	1.597^{***}	1.732^{***}	1.861^{***}	2.113^{***}	2.439^{***}	4.250^{***}	4.427^{***}	4.600^{***}	3.906^{***}	4.545^{***}	5.186^{***}	5.759^{***}
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	APE	5.848	5,883	6.310	7.325	8.352	10.148	10.821	11.433	11.715	12.016	12.207	12.156
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	MSPE	797.7	7,667	8.053	9.185	10.584	17 524	16 494	15,838	14.548	14.998	15.244	15.374
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		/ 600***	***C19 V	A 200***	5 470***		**V10 0	1 0.07*	1 066*	0 1 1 2 **	C R71**	***400 6	F - 0.010 で
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$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	ITE 1.564^{***} 2.026^{***} 1.916^{***} 2.946^{***} 4.507^{***} 2.960^{***} 4.416^{***} 4.787^{***} $5.$ $IAPE$ 6.066 5.888 6.353 7.401 8.723 10.338 11.010 11.492 11.776 11.913 1 $MSPE$ 8.187 7.838 8.182 9.362 10.945 15.031 15.159 14.107 14.543 14.841 1 MDM 3.705^{***} 4.362^{***} 0.936^{***} 1.088^{***} 0.782^{***} 0.736^{***} 2.736^{***} 3.766^{***}					Moc	lel 3: Regree	ssion Model	with BDEV	term				
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8.187 7.838 8.182 9.362 10.945 15.031 15.139 14.107 14.543 14.841 3.705*** 4.362** 4.111*** 3.145*** 1.287 1.178 1.156 1.586 2.497** 2.872*** 3.376***	$ \begin{array}{llllllllllllllllllllllllllllllllllll$	IAPE	6.066	5.888	6.353	7.401	8.723	10.338	11.010	11.492	11.395	11.776	11.913	12.343
3.705^{***} 4.362^{***} 4.111^{***} 3.145^{***} 1.287 1.178 1.156 1.586 2.497^{**} 2.872^{***} 3.376^{***}	IDM3.705***4.362***4.111***3.145***1.2871.1781.1561.5862.497***2.872***3.376****3.36***3.76"Incompassing0.881***0.916***0.921***0.881***0.881***0.721***0.7721***0.7721***0.7721***0.7721*** </td <td>IMSPE</td> <td>8.187</td> <td>7.838</td> <td>8.182</td> <td>9.362</td> <td>10.945</td> <td>15.031</td> <td>15.339</td> <td>15.159</td> <td>14.107</td> <td>14.543</td> <td>14.841</td> <td>16.018</td>	IMSPE	8.187	7.838	8.182	9.362	10.945	15.031	15.339	15.159	14.107	14.543	14.841	16.018
	Incompassing 0.881*** 0.916*** 0.921*** 0.881*** 0.808*** 0.797*** 0.782*** 0.781*** 0.756*** 0.736*** 0.721*** 0.721*** 0.746 the outlier time frame of August 2010 - August 2011. The sensitivity analysis, we chose to drop futures prices of the outlier time frame of August 2010 - August 2011. The 2: The number of observations at each horizon is 204. The 3: BDEV stands for basis deviation term. MPE represents mean percentage error. MAPE stands for mean absolute percentage error, RMSPE re to a mean square percentage error, and MDM stands for the Modified Diebold-Mariano test. The holded values in MAPE and RMSPE indicators show that compared to Hoffman model a specific alternative model produces lower forecas to 5: The null hypothesis for the test of bias states that the MPEs are not statistically different from 0. The 6: We conduct MDM test against Hoffman benchmark. The null hypothesis for the 2-tail test states that the two forecasts have similar forecast a be 7: The null hypothesis for the encompassing test states that the benchmark model forecast contains all the information provided by the alternation forecast a base 7: The null hypothesis for the encompassing test states that the benchmark model forecast contains all the information provided by the alternation forecast a base 7: The null hypothesis for the encompassing test states that the benchmark model forecast contains all the information provided by the alternation forecast a base 7: The null hypothesis for the encompassing test states that the benchmark model forecast contains all the information provided by the alternation forecast and the forecast contains all the information provided by the alternation forecast and the forecast contains all the information provided by the alternation forecast contains all the information provided by the alternation forecast contains all the information provided by the alternation forecast contains all the information provided by the alternation forecast contains all the information provided by the alternation forec	4DM	3.705^{***}	4.362^{***}	4.111^{***}	3.145^{***}	1.287	1.178	1.156	1.586	2.497^{**}	2.872^{***}	3.376^{***}	3.394^{***}
0.881^{***} 0.916^{***} 0.921^{***} 0.881^{***} 0.797^{***} 0.782^{***} 0.781^{***} 0.756^{***} 0.736^{***} 0.721^{***}	ote 1: For sensitivity analysis, we chose to drop futures prices of the outlier time frame of August 2010 - August 2011. 54 2: The number of observations at each horizon is 204. 54 3: BDEV stands for basis deviation term. MPE represents mean percentage error. MAPE stands for mean absolute percentage error, RMSPE re 55 are root mean square percentage error, and MDM stands for the Modified Diebold-Mariano test. 56 4: The bolded values in MAPE and RMSPE indicators show that compared to Hoffman model a specific alternative model produces lower forecas 55 5: The null hypothesis for the test of bias states that the MPEs are not statistically different from 0. 56 6: We conduct MDM test against Hoffman benchmark. The null hypothesis for the 2-tail test states that the two forecasts have similar forecast a 56 7: The null hypothesis for the encompassing test states that the benchmark model forecast contains all the information provided by the alternati	Incompassing	0.881^{***}	0.916^{***}	0.921^{***}	0.881^{***}	0.808^{***}	0.797^{***}	0.782^{***}	0.781^{***}	0.756^{***}	0.736^{***}	0.721^{***}	0.666^{***}
	Note 5: The null hypothesis for the test of bias states that the MPEs are not statistically different from 0. Note 6: We conduct MDM test against Hoffman benchmark. The null hypothesis for the 2-tail test states that the two forecasts have similar forecast accuracy. Note 7: The null hypothesis for the encompassing test states that the benchmark model forecast contains all the information provided by the alternative model	he root mean squ ote 4: The bold	uare percer ed values in	n MAPE and	and MDM : 4 RMSPE i	stands for th ndicators sh	e Modified l ow that com	Diebold-Mar. 1pared to Ho	iano test. ffman model	l a specific al	lternative m	odel produc	tes lower for	ecast error
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Figure A1: Mean Percentage Errors (MPE) of Farm Price Forecasts by Forecast Horizon Panel A: Full Sample



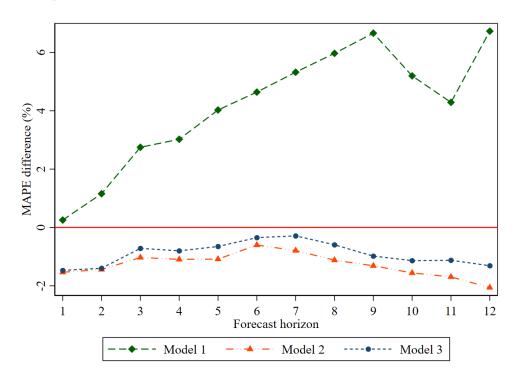
Panel B: Sensitivity Analysis (excludes 2011 futures price data)



Note 1: The figure above plots the accuracy statistics of the MPE criterion (detailed in Equation 9) across models and horizons. Within each horizon, we test if the MPEs are significantly different from zero. Respective models are as detailed in Section 3.

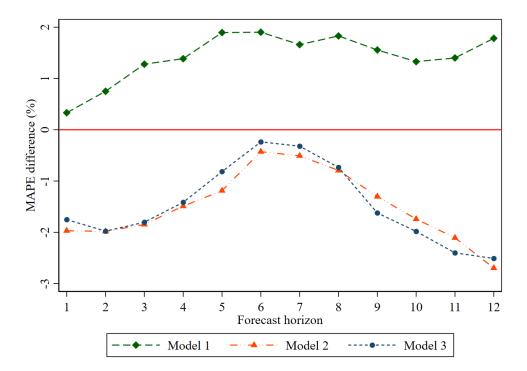
Note 2: Model 1 represents the moving average approach with basis deviation term. Model 2 represents the regression model with basis deviation term.

Figure A2: Mean Absolute Percentage Errors (MAPE) Difference of Farm Price Forecasts by Forecast Horizon



Panel A: Full Sample

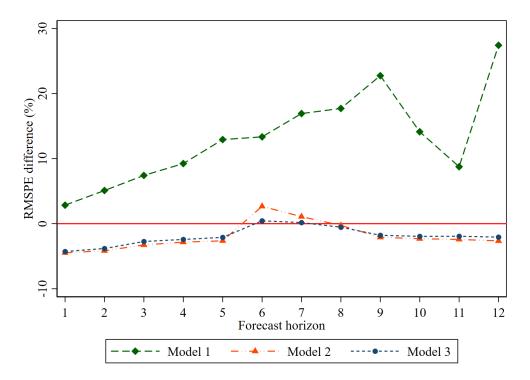
Panel B: Sensitivity Analysis (excludes 2011 futures price data)



Note 1: This figure shows the differences in MAPE statistics between alternative model forecasts and Hoffman's model projections. A negative (positive) MAPE difference indicates that the alternative model produces more (less) accurate forecast than the Hoffman model.

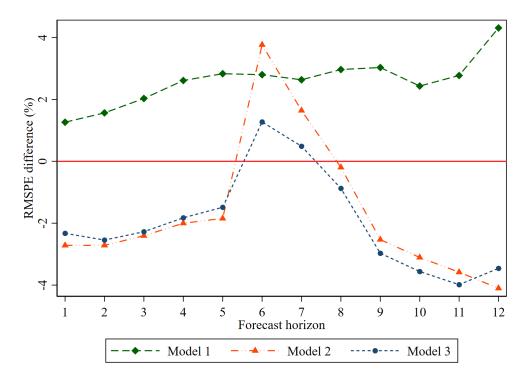
Note 2: Model 1 represents the moving average approach with basis deviation term. Model 2 represents the regression model with nearby futures prices. Model 3 represents the regression model with basis deviation term.

Figure A3: Root Mean Squared Percentage Errors (RMSPE) Difference of Farm Price Forecasts by Forecast Horizon



Panel A: Full Sample

Panel B: Sensitivity Analysis (excludes 2011 futures price data)



Note 1: This figure shows the differences in RMSPE statistics between alternative model forecasts and Hoffman's model projections. A negative (positive) RMSPE difference indicates that the alternative model produces more (less) accurate forecast than the Hoffman model.

Note 2: Model 1 represents the moving average approach **3**% h basis deviation term. Model 2 represents the regression model with nearby futures prices. Model 3 represents the regression model with basis deviation term.