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**Stochastic Analysis of World Cotton Outlook
Addendum to the 2007/08-2017/18 Baseline**

**Mohamadou Fadiga, Suwen Pan, Don
Ethridge, Darren Hudson, and Maria Mutuc**

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Stochastic Analysis of World Cotton Outlook Addendum to the 2007/08-2017/18 Baseline

Mohamadou Fadiga, Suwen Pan, Don Ethridge, Darren Hudson, and Maria Mutuc¹

The cotton market baseline analysis released in 2008 (Ethridge et al.) provided critical information about the future of the world cotton market over the next ten years (2007/02-2017/18). It is based on a deterministic approach that utilizes the world fiber model developed by the Cotton Economics Research Institute (CERI) at Texas Tech University (Pan et al. 2004). The world fiber model is a multi-country multi-sector partial equilibrium model that includes the world's 24 major cotton importing and exporting countries and regions. While the deterministic model provides the best available point estimates of potential market outcomes, it does not reveal information about the underlying variability of these markets over time.

The purpose of this stochastic analysis is to capture the underlying uncertainty of the world fiber market stemming from supply and demand shocks. The procedure yields confidence intervals for key variables in the world fiber market. In a sense, the stochastic analysis completes the previously released baseline analysis by incorporating the variation in key variables. The model accounted for production area heterogeneity in larger countries (China, India, and USA), substitutability between cotton and competing fibers, and linkages between raw fiber and the textile-manufacturing sector in both the U.S. and the rest of the world. Unlike the baseline analysis where the outputs are point estimates, the stochastic analysis generates multiple possible outcomes for each of the variables analyzed. These multiple outcomes are obtained by

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solving the world fiber model using simulated stochastic random draws from distributions of the exogenous variables considered as the primary sources of uncertainty in the model.

Procedures

The stochastic simulation follows the approach used in Binfield et al. (2002) and Fadiga *et al.* (2005). The world fiber model used in the baseline analysis is the foundation of this analysis as it is the structure used to analyze the impacts of uncertainty in key exogenous variables. The initial step is to identify sources of exogenous shocks. In this analysis, a primary source of uncertainty in the world fiber market is assumed to originate from yield variability. Yields around the world are subject to factors such as unpredictable weather, insect infestations, and other random events that affect production levels. As in Richardson *et al.* (2000), the empirical distributions of historical yield data for 29 cotton producing countries and regions between 1990 and 2007 are derived and linked to the projected yields of each country and region generated under the deterministic baseline analysis to construct the stochastic output ranges for each yield variable. The derived stochastic output ranges are simulated 500 times to generate 500 correlated random draws to be used as inputs into the world fiber model and solve for the key variables. The 500 solutions to the model at each point provide the basis for constructing 90% confidence intervals on the point estimates found in the baseline report. We believe 500 simulations are enough to generate enough dispersion while not rendering the size of the generated output difficult to manage.

The remainder of this paper provides a description of the results, which follows CERI baseline report format for consistency and includes U.S. cotton production, U.S. farm price, world cotton price, exports (U.S., Brazil, Australia, West Africa, and Uzbekistan), and imports

(China, Pakistan, Other Asia, and Turkey). The graphs describing the stochastic means of each year's 500 simulated draws and their associated 10th and 90th percentiles are presented. The tables used to construct these graphs are compiled in the appendix section.

Results

Cotton Production vs. Farm Prices and Net Return

To illustrate the importance of net return relative to farm price in determining cotton production in the U.S., we provide two scatter plots of the 500 stochastic outcomes of Southwest Dryland cotton production vs. U.S. farm prices (Fig. 1) and Southwest Dryland production vs. Southwest Dryland net return (Fig. 2) for the 2009/2010 marketing year. As Fig. 1 illustrates, the simulated outcomes show no particular pattern in the relationship between price and production, although a higher density of data points is noticeable between 75 and 105 cents a pound and production between 2.5 and 4 million bales. Fig. 2 shows an upward trend, indicating production responsiveness to higher net return and highlights the importance of farm programs among others in determining production level.

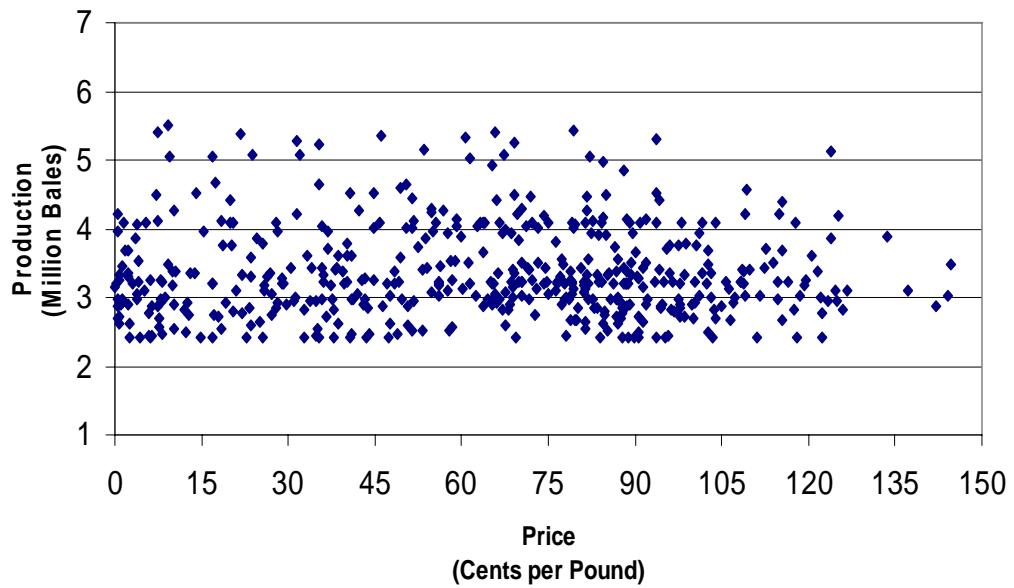


Fig. 1: Cotton Production vs. U.S. Farm Price.

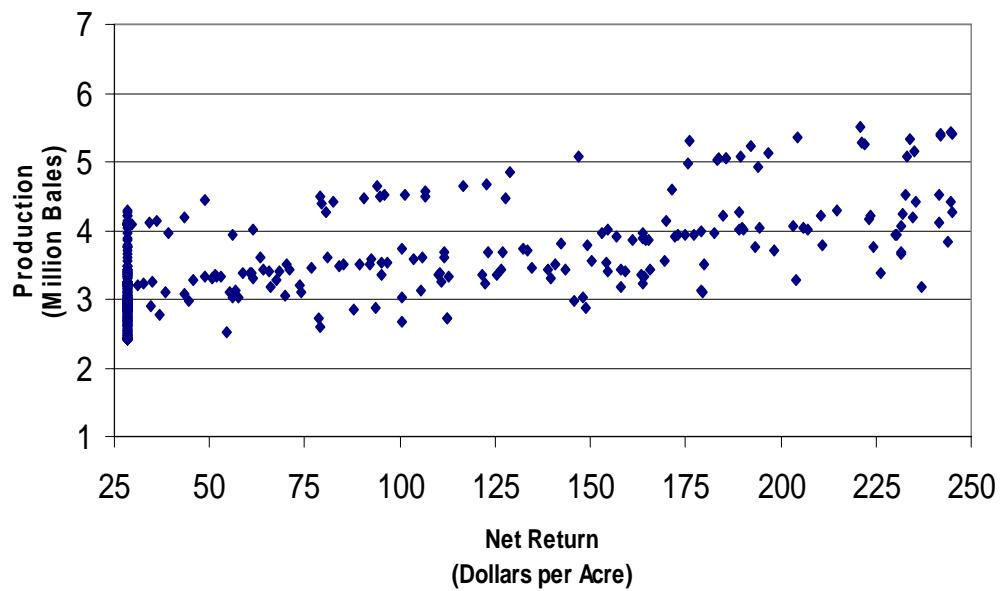


Fig. 2: Cotton Production vs. Net Return in the Southwest.

U.S. Production

The results for overall U.S. cotton production show a slight upward trend in the stochastic average of U.S. cotton production from 17.99 million bales in 2007/08 to 20.93 million bales in 2017/18 with an average of 19.60 million bales over the 10-year simulation period (Fig. 3). The stochastic analysis indicates an 80% chance that U.S. cotton production will fall between 14.48 million bales and 21.01 million bales in 2008/09. The average production over the 10-year projection period falls between 16.19 and 22.52 million bales with 80% probability.

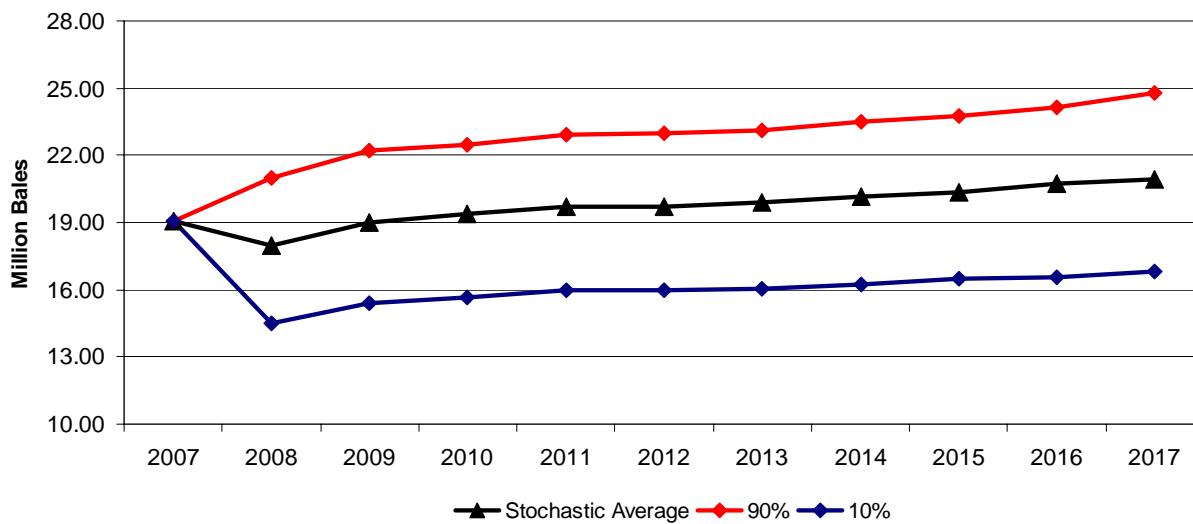


Fig. 3: U.S. Cotton Production

World Cotton Price

For the A-index, we present the stochastic means using the 500 random draws for each of the projected years (Fig. 4) and find a 6.73% decrease in 2008/09 relative to the 2007/08 period from 89.12 cents per pound to 83.11 cents per pound. This downward trend is projected to continue through the 2010/11 marketing year before reversing course with an upward trend from that

point forward, except for the 2012/13 marketing year. The simulated stochastic results for world price should be analyzed with caution because of the wide confidence interval stemming from the fact that prices are solved endogenously in the world fiber model. Based on the 10-year average, we found 10% chance that world price will fall below 13.13 cents per pound and 10% chance that it will fall above 149.98 cents per pound in 2008/09.

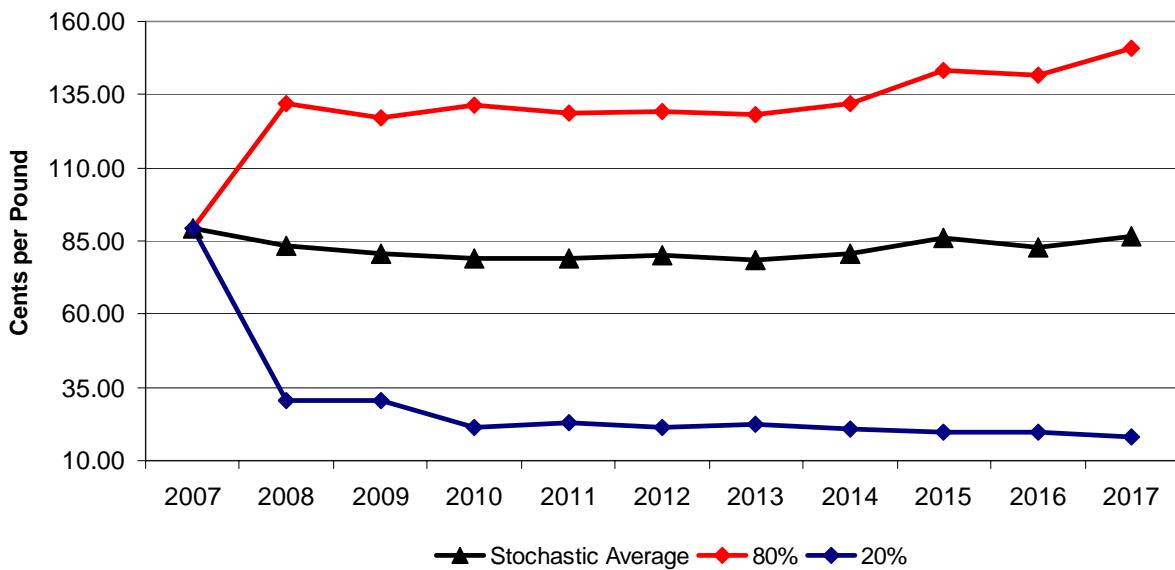


Fig. 4: World Cotton Price

U.S. Exports

Exports from the United States are estimated to account for about 39% of the world cotton trade in 2007/08. This percentage is projected to fall to 27% by 2017/18, which may be attributed to yield increase in competing countries such as India, China, West Africa and Other Africa as these countries adopt Bt cotton and/or better seed varieties and Brazil as acreage continues to increase as new areas are put into production. The projected stochastic means derived from the

500 draws for each projected years show a trend that mimics production and increases from 14.89 million bales in 2008/09 to 17.49 million bales in 2017/18 (Fig.5). The 10-year average is estimated at 16.10 million bales and the probabilistic outcome shows an 80% chance that U.S. exports in 2008/09 will fall between 12.23 and 17.36 million bales.

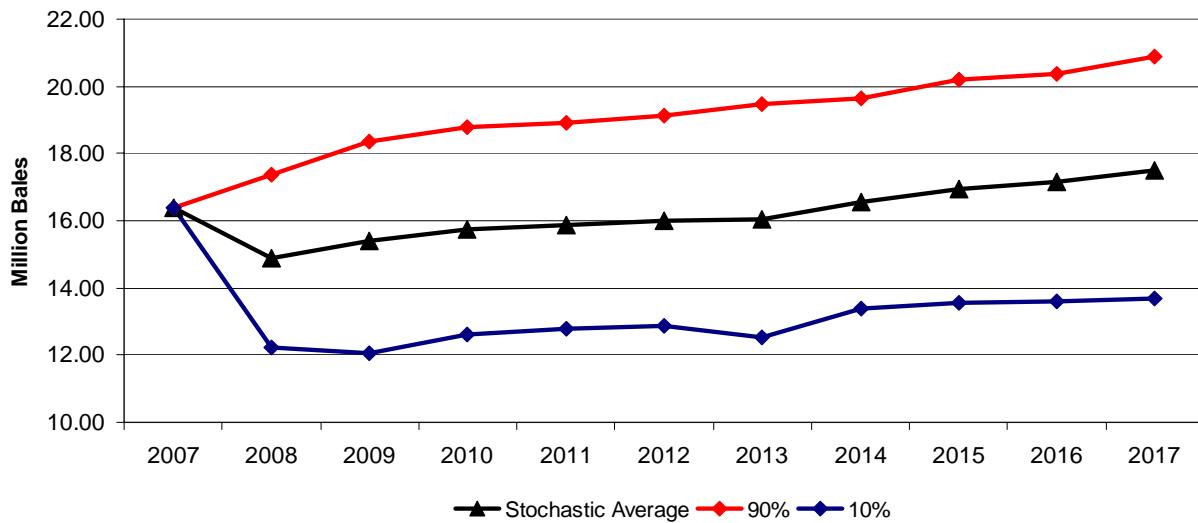


Fig. 5: U.S. Cotton Exports

Australia Exports

The projected stochastic means of Australia's exports show an upward trend, indicating recovery of cotton production after a period of decline (Fig. 6). Prolonged droughts have decreased Australian cotton production in recent years, resulting in Australia falling out of the top five world cotton exporters. Exports are expected to increase from 1.02 million bales in 2008/09 to 2.80 million bales in 2017/18, averaging 1.81 million bales over the 10-year period. There is a 90% chance that Australia's exports in 2008/09 will fall below 1.26 million bales and 10% chance that below 0.79 million bales.

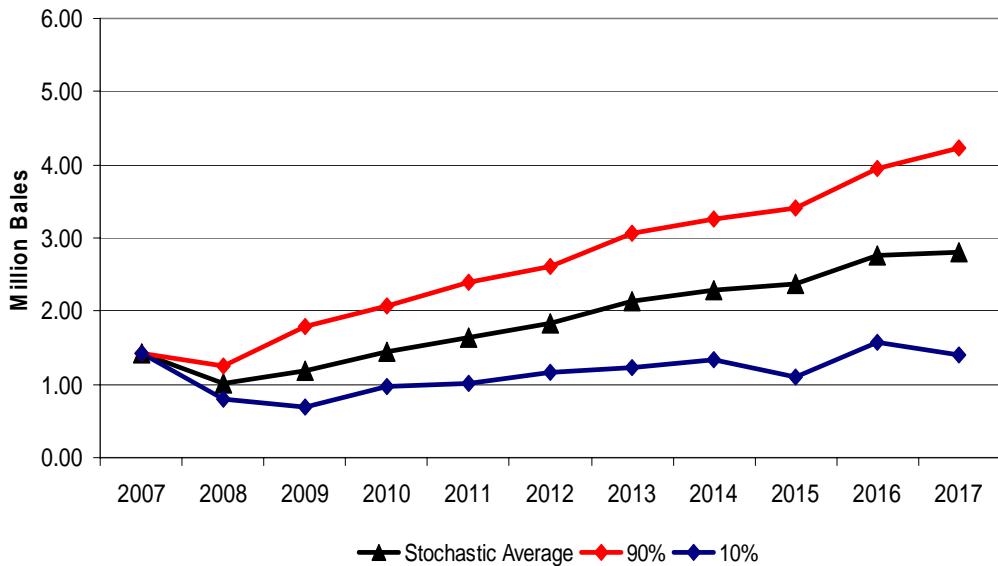


Fig. 6: Australia's Cotton Exports

Uzbekistan Exports

Uzbekistan is the world's third largest cotton exporter behind the United States and India since 2006/07. Cotton exports from Uzbekistan are projected to increase by 0.6 million bales in the next ten years. Under the stochastic analysis, Uzbek exports follow three paths over the simulation period: a period of increase from 4.11 million bales in 2008/09 to 4.35 million bales in 2009/10, followed by a period of decline from 4.35 million bales in 2009/10 to 4.19 million bales in 2012/13, and a period of increase from that point to the end of the simulation period (Fig. 7). The 10-year average was estimated at 4.35 million bales. The stochastic analysis indicate a 80% chance that Uzbekistan exports will fall between 2.72 and 5.20 million bales in 2008/09.

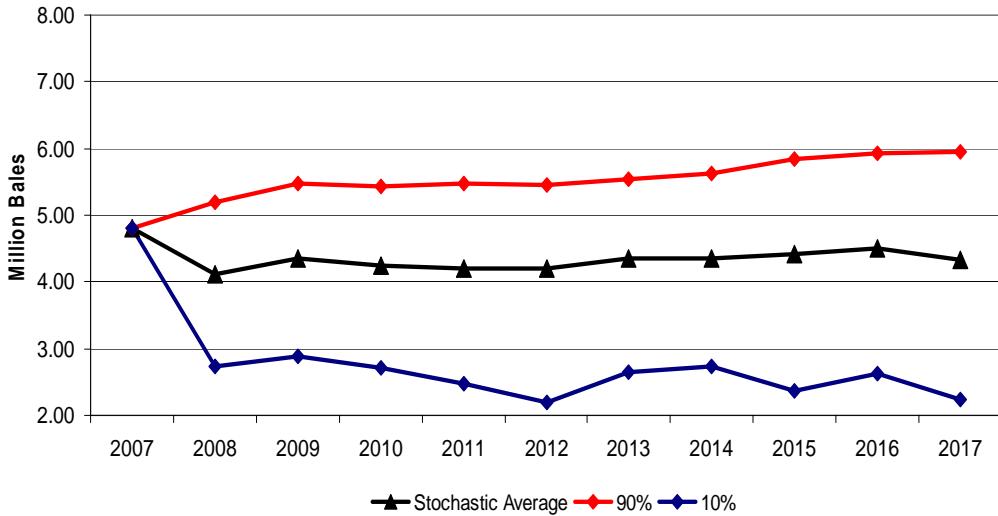


Fig. 7: Uzbekistan Cotton Exports

Brazil Exports

Brazil is expected to surpass Uzbekistan as the world second largest cotton exporter in 2009/10.

Although Brazilian cotton exports declined in 2006/07 because of exchange rate valuation, credit difficulties, and infrastructure limitations, we expect an increase in this simulation period as the economy rebounds and credit and infrastructure improve. The stochastic means of Brazil exports shows a period of rapid increase from 4.26 million bales in 2008/09 to 7.06 million bales in 2013/14 followed by a period of stabilization from that point forward (Fig. 8). The 10-year average exports volume was estimated at 6 million bales, 3.60% below the deterministic average. The stochastic analysis indicates an 80% chance that Brazil exports in 2008/09 will fall between 2.09 and 5.82 million bales.

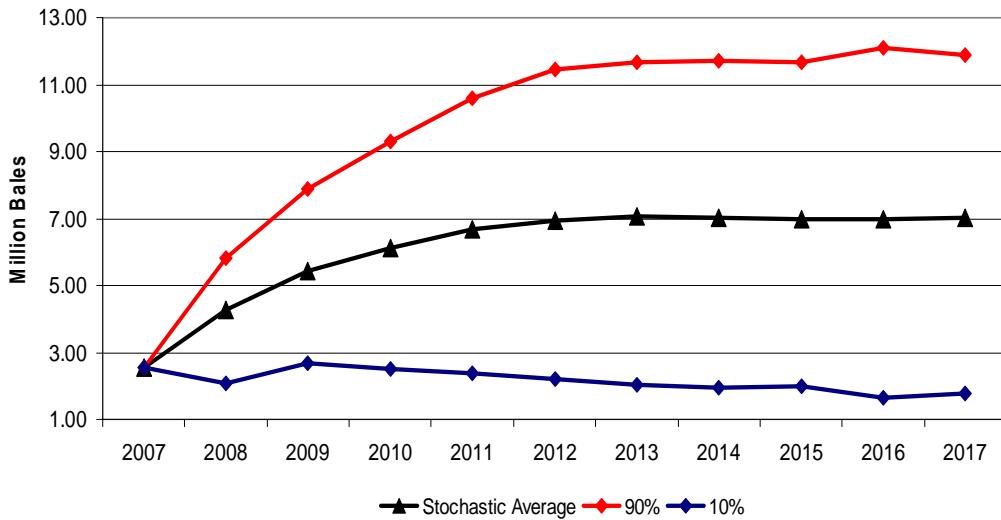


Fig. 8: Brazil Cotton Exports

West Africa Exports

West Africa ranks fourth in world cotton exports and comprises four countries Benin, Burkina Faso, Mali, and Chad. With a relatively small textile sector in these countries, a significant portion of cotton produced in West Africa is exported. The deterministic analysis projected a 3.2 million bale increase in production and 2.7 million bale increase in exports over the next 10 years. The stochastic analysis indicates an upward trend of exports over the simulated period. This illustrates a steady recovery of cotton sector in West Africa from a period of decline as a result of low international price (Fig. 9). The stochastic means are expected to pass from 2.54 million bales in 2008/09 to 5.23 million bales in 2017/18. The probabilistic outcomes show an 80% chance that West Africa exports in 2008/09 marketing year will fall between 2.04 and 3.03 million bales.

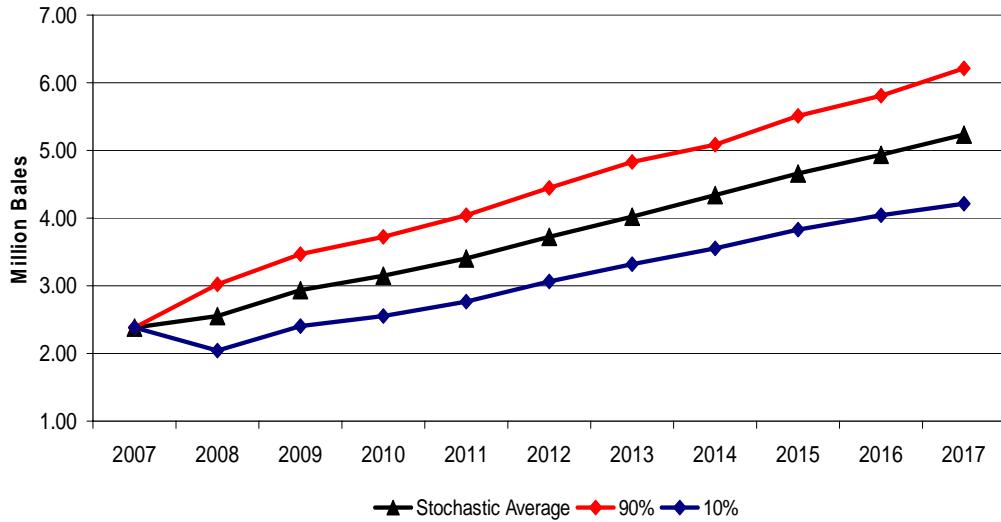


Fig. 9: West Africa Cotton Exports

China Imports

China is projected to remain the world largest cotton user; mill use is projected to increase from 55 million bales currently to over 68 million bales in 2017/18, a 24% increase. China is also the world's leading cotton producer and importer. The stochastic means of the projected years show a steady increase in China imports and less variability in the simulated outputs (Fig 10). Imports are, on average, expected to increase from 17.69 million bales in 2008/09 to 28.76 million bales in the 2017/18, averaging 22.40 million bales over the 10-year period. In 10% of the simulated outcomes that China imports fall below 16.89 million bales in 2008/09. Also, in 10% of the simulated outcomes that China imports exceed 18.46 million bales in 2008/09. While the stochastic means follow an upward trend, the dispersion of the random outcomes remains tight over the simulated period.

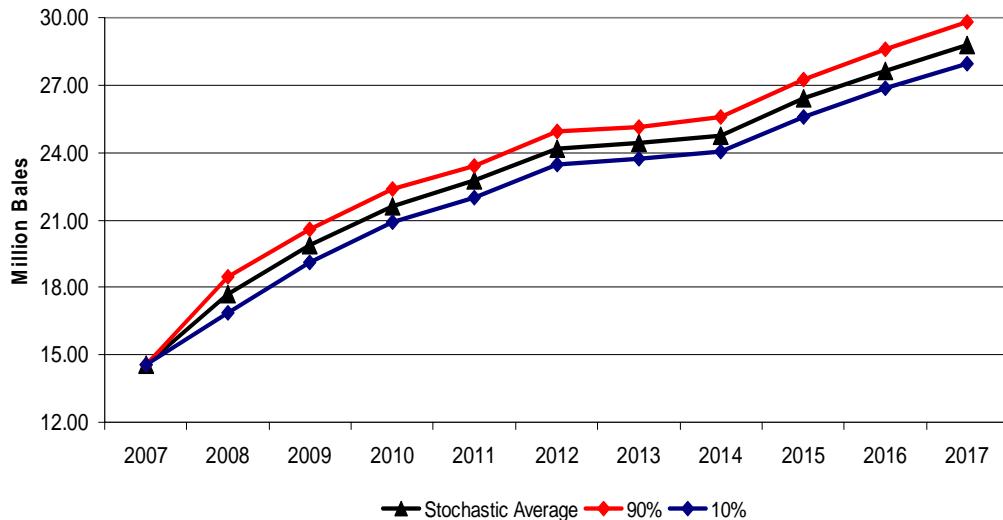


Fig. 10: China Imports

India Imports

India is the world second largest cotton user behind China; mill use is expected to increase by 36% over the next 10 years. India is also a major importer of long staple cotton. The stochastic average of India's imports over the projected years follows a steady increase though remaining relatively low from 0.4 million bales in 2008/09 to 2.89 million bales in 2017/18, averaging 1.34 million bales over the simulated period (Fig. 11). In addition, there is less variability in the simulated draws, which result in tighter confidence intervals of the stochastic means. The probabilistic outcome show an 80% chance that imports will fall between 0.37 and 0.45 million bales in 2008/09.

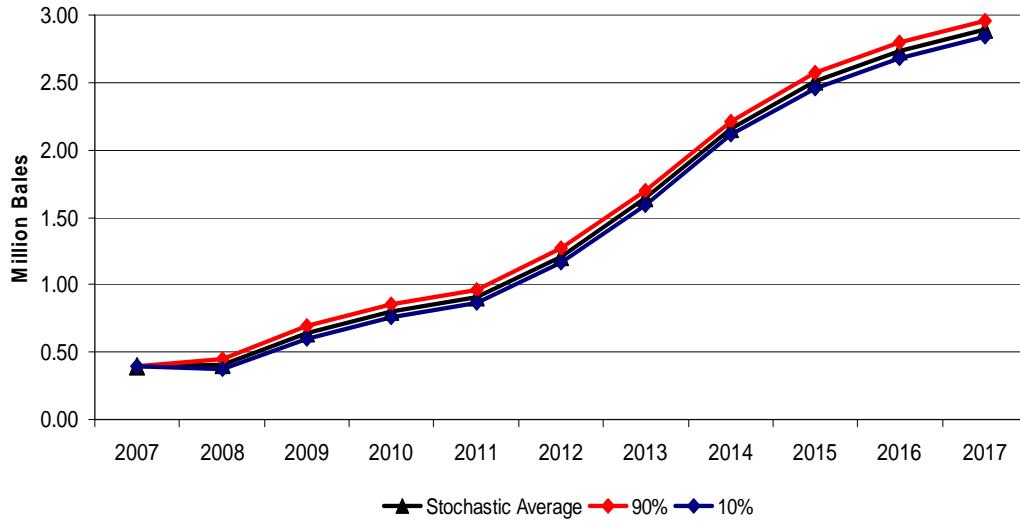


Fig. 11: India's Cotton Imports

Pakistan Imports

Pakistan's cotton use is expected to increase by more than 3 million bales over the next 10 years, from 12 million bales to 15.8 million bales. Although we project some gains in cotton production because of better varieties, Pakistan's cotton imports is expected to continue its upward trend for the next ten years. The stochastic means show a period of stable imports through 2012/13 and a period of upward trend from that point forward. Imports are expected to average 3.51 million bales in 2008/09 to 5.37 million bales in 2017/18, averaging 4.23 million bales over the 10-year simulation period (Fig. 12). The probabilistic outcome indicates an 80% chance that Pakistan imports fall between 2.30 and 4.55 million bales in 2008/09. There is 10% chance that imports in 2008/09 fall below 2.30 million bales and a 10% chance that imports fall above 4.55 million bales.

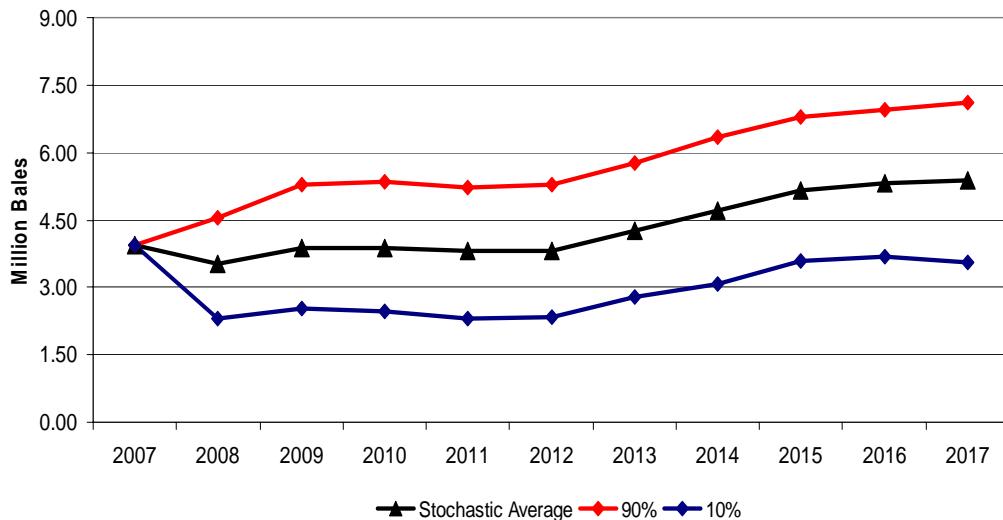


Fig. 12: Pakistan Cotton Imports

Other Asia Imports

We project cotton mill use by Other Asia to increase by 35% over the next 10 years, solidifying this region as the fourth largest cotton mill user in the world. The sustained mill use by textile industry indicates increased cotton importation. Our projected stochastic means indicate relatively stable imports for Other Asia between 2008/09 and 2012/13 and an upward trend from 2012/13 through the end of the simulated period (Fig. 13). Imports are expected to average 7.89 million bales in 2008/09 to 8.33 million bales in 2012/13 and to increase from its 2012/13 level to 10.53 million bales in 2017/18. The dynamism of Other Asia textile industry is expected to continue, averaging 8.72 million bales over the simulation period. The probabilistic outcome show an 80% chance that Other Asia imports in 2008/09 marketing year will fall between 7.02 and 9.13 million bales.

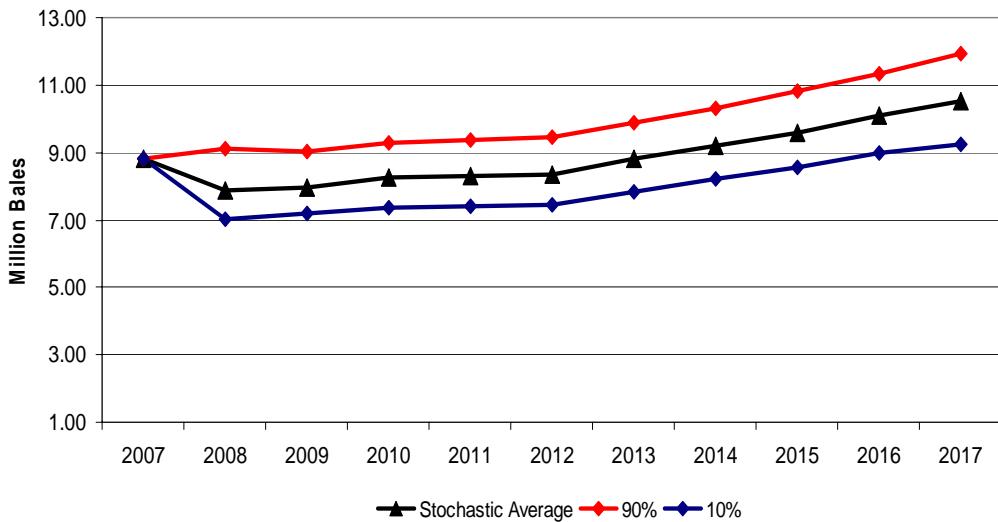


Fig. 13: Other Asia Cotton Imports

Turkey Imports

Turkish textile industry is expected to face a tougher competition from Asia over the next 10 years. Mill use is expected to grow by 6% over the next 10 years (421,000 bales) while cotton production is projected to grow at trend levels, hence leveling off raw cotton import demand. As a result, the average projected imports amount to 2.59 million bales over the simulated period. The stochastic analysis also indicates a high variability in Turkish projected imports. In 10% of the cases between 2008/09 and 2016/17 Turkey does not import. There is a 60% chance that imports will fall between 0.33 and 5.96 million bales in the 2008/09.

Conclusion

Overall, among the world major cotton traders, we found higher Imports variability for Pakistan and Turkey and higher exports variability for West Africa, Brazil, Uzbekistan, U.S.A, and Australia. The noted variability of exports and imports cannot be solely attributed to yield

variability. Based on the coefficient variations of the simulated random draws, countries that exhibit higher exports variability include those with lower yield variability (U.S.A and Australia) and those with higher yield variability (West Africa, Brazil, and Uzbekistan). Countries that exhibit higher imports variability (Turkey and Pakistan) show lower yield variability and countries with lower imports variability (China and India) also show lower yield variability in three of the four regions considered. It could be that other factors such as acreage are also contributing to export variability.

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Appendix: Stochastic Outputs of the World Cotton Market

U.S. Cotton Production (Million Bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	19.03	17.90	18.13	18.22	18.48	18.63	18.88	19.10	19.26	19.45	19.49	18.71
Stochastic Average	19.09	17.99	19.00	19.37	19.68	19.72	19.91	20.18	20.36	20.71	20.93	19.60
Difference	0.29%	0.51%	4.79%	6.31%	6.53%	5.89%	5.41%	5.63%	5.71%	6.47%	7.40%	4.77%
Standard Deviation	0.00	2.42	2.57	2.55	2.57	2.59	2.64	2.66	2.70	2.73	2.95	2.34
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Percentiles												
5%	19.09	13.76	14.57	14.96	15.14	15.24	15.10	15.52	16.02	16.02	15.70	15.54
10%	19.09	14.48	15.39	15.65	15.99	15.96	16.05	16.24	16.50	16.58	16.79	16.19
20%	19.09	15.78	16.67	16.87	17.32	17.39	17.42	17.76	17.89	18.10	18.14	17.43
30%	19.09	16.79	17.62	18.07	18.46	18.35	18.56	19.00	18.81	19.52	19.42	18.43
40%	19.09	17.44	18.44	18.90	19.19	19.25	19.37	19.68	19.70	20.24	20.18	19.13
50%	19.09	18.06	19.04	19.58	19.86	19.74	20.16	20.33	20.42	20.94	21.09	19.72
60%	19.09	18.66	19.69	20.20	20.44	20.59	20.80	20.94	21.14	21.63	21.80	20.32
70%	19.09	19.36	20.43	20.90	21.07	21.18	21.55	21.72	22.01	22.33	22.65	20.96
80%	19.09	20.14	21.17	21.76	21.97	22.03	22.33	22.46	22.81	22.92	23.54	21.67
90%	19.09	21.01	22.22	22.49	22.92	23.01	23.14	23.47	23.73	24.12	24.76	22.52
95%	19.09	22.03	23.16	23.29	23.84	23.81	23.97	24.12	24.68	24.87	25.49	23.29

U.S. Farm Price (Cents/lb.)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	57.34	60.65	58.27	58.00	58.04	57.77	57.67	57.76	57.39	56.04	55.10	57.89
Stochastic Average	66.42	67.77	61.96	58.92	58.49	57.99	57.86	59.20	62.91	61.43	63.45	61.30
Difference	15.83%	11.75%	6.33%	1.59%	0.78%	0.39%	0.31%	2.50%	9.62%	9.62%	15.14%	5.88%
Standard Deviation	0.00	37.09	35.24	36.79	35.40	35.64	36.13	37.22	40.56	41.21	44.00	33.53
Percentiles												
5%	66.42	3.62	3.12	3.60	3.19	1.95	5.03	2.52	2.14	2.91	1.88	9.45
10%	66.42	11.21	8.08	7.77	7.73	5.33	7.81	8.66	6.04	6.35	6.02	13.54
20%	66.42	27.89	25.63	19.33	19.42	20.85	17.65	17.33	17.01	17.74	15.38	24.93
30%	66.42	45.89	39.71	33.57	34.78	35.90	33.82	33.46	36.78	32.85	32.10	39.32
40%	66.42	59.62	54.10	47.83	51.79	49.51	48.59	48.42	52.03	45.93	46.03	52.42
50%	66.42	74.74	66.98	61.94	62.19	62.19	59.54	61.78	63.42	60.93	62.94	64.01
60%	66.42	84.43	77.54	71.75	71.17	70.48	69.64	71.87	78.08	73.68	75.36	73.51
70%	66.42	91.23	84.80	82.36	79.53	79.43	79.44	85.02	89.02	84.45	89.51	82.17
80%	66.42	102.21	91.83	93.66	89.82	88.66	90.58	93.75	100.99	96.47	105.40	91.44
90%	66.42	113.36	103.98	107.62	104.26	102.57	104.33	106.96	113.61	118.01	119.69	104.11
95%	66.42	123.16	115.20	119.75	111.25	113.02	117.42	117.64	128.28	131.72	135.88	114.39

World Cotton Price (Cents/lb.)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	73.43	78.67	78.50	77.65	76.46	76.07	75.86	75.97	75.97	75.97	75.97	76.46
Stochastic Average	89.12	83.11	80.94	79.12	79.27	80.14	78.47	80.88	85.92	82.89	86.82	81.98
Difference	21.36%	5.65%	3.10%	1.89%	3.67%	5.35%	3.44%	6.46%	13.09%	9.10%	14.27%	7.23%
Standard Deviation	0.00	50.11	50.97	53.69	51.44	53.62	53.01	55.89	59.89	61.66	65.97	49.03
Percentiles												
5%	89.12	4.01	3.13	3.84	3.48	2.21	4.97	2.84	2.10	2.99	2.28	11.87
10%	89.12	13.13	9.21	8.19	8.13	6.06	9.46	10.22	6.37	7.59	6.72	16.75
20%	89.12	30.46	30.48	21.23	23.07	21.20	22.27	20.98	19.78	19.82	18.02	29.84
30%	89.12	50.20	43.62	36.19	41.25	42.61	39.37	40.54	44.17	37.90	36.12	46.50
40%	89.12	68.95	64.93	57.39	63.08	62.57	57.53	61.26	64.54	54.69	55.96	64.41
50%	89.12	82.31	83.29	81.03	84.89	79.06	74.77	79.26	84.30	71.72	74.54	80.97
60%	89.12	99.20	97.95	95.35	95.83	96.81	93.39	94.58	102.23	94.26	102.08	95.87
70%	89.12	118.55	113.72	113.54	111.15	110.89	111.25	112.66	123.54	117.08	125.55	112.15
80%	89.12	131.76	126.94	131.38	128.78	129.37	127.99	131.79	143.54	141.70	151.02	128.23
90%	89.12	149.98	144.24	151.80	145.67	151.73	149.60	161.51	168.07	175.81	185.78	148.75
95%	89.12	160.44	163.47	167.98	163.63	165.88	163.75	175.83	181.90	192.28	199.24	162.43

U.S. Exports (Million Bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	16.00	14.98	14.73	14.72	14.66	14.89	15.02	15.45	15.45	15.45	15.45	15.13
Stochastic Average	16.37	14.89	15.42	15.76	15.87	16.01	16.04	16.54	16.94	17.17	17.49	16.10
Difference	2.34%	-0.57%	4.71%	7.08%	8.23%	7.54%	6.78%	7.08%	9.63%	11.10%	13.19%	6.39%
Standard Deviation	0.00	1.88	2.46	2.36	2.37	2.41	2.60	2.42	2.52	2.58	2.70	2.16
Percentiles												
5%	16.37	11.52	11.25	11.78	11.85	11.81	11.73	12.35	12.83	12.54	12.77	12.41
10%	16.37	12.23	12.08	12.63	12.81	12.87	12.52	13.40	13.58	13.60	13.69	13.21
20%	16.37	13.26	13.34	13.55	13.89	13.75	13.69	14.39	14.71	15.03	14.95	14.20
30%	16.37	13.91	14.14	14.51	14.71	14.77	14.54	15.27	15.52	15.83	15.98	14.96
40%	16.37	14.53	14.84	15.31	15.24	15.49	15.39	16.02	16.33	16.66	16.80	15.62
50%	16.37	15.13	15.46	15.95	15.81	16.15	16.07	16.71	17.00	17.35	17.75	16.20
60%	16.37	15.55	16.11	16.43	16.46	16.76	16.97	17.31	17.73	17.97	18.45	16.77
70%	16.37	15.99	16.83	17.07	17.15	17.31	17.68	18.02	18.35	18.68	19.31	17.35
80%	16.37	16.60	17.52	17.72	17.97	18.15	18.39	18.70	19.16	19.56	20.03	18.01
90%	16.37	17.36	18.37	18.77	18.91	19.11	19.49	19.64	20.21	20.39	20.88	18.86
95%	16.37	17.68	19.57	19.79	19.72	19.91	19.99	20.22	21.06	21.05	21.47	19.54

Australia Exports (Million Bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	1.40	1.04	1.18	1.43	1.66	1.88	2.07	2.27	2.46	2.65	2.78	1.80
Stochastic Average	1.43	1.02	1.18	1.45	1.64	1.84	2.13	2.29	2.38	2.77	2.80	1.81
Difference	2.46%	-2.27%	0.48%	1.13%	-1.29%	-1.89%	2.91%	0.79%	-3.29%	4.29%	0.45%	0.48%
Standard Deviation	0.00	0.40	0.60	0.64	0.85	1.02	0.97	1.17	1.49	1.53	1.97	0.87
Percentiles												
5%	1.43	0.37	0.32	0.50	0.56	0.26	0.47	0.57	0.00	0.44	0.00	0.49
10%	1.43	0.79	0.68	0.96	1.02	1.16	1.24	1.33	1.10	1.58	1.40	1.13
20%	1.43	0.98	0.90	1.16	1.30	1.54	1.67	1.90	1.98	2.23	2.27	1.51
30%	1.43	1.04	0.99	1.29	1.45	1.73	1.93	2.13	2.31	2.59	2.66	1.69
40%	1.43	1.08	1.11	1.40	1.60	1.86	2.09	2.29	2.52	2.80	2.91	1.82
50%	1.43	1.12	1.24	1.53	1.71	2.00	2.23	2.45	2.64	2.97	3.09	1.93
60%	1.43	1.15	1.34	1.62	1.83	2.11	2.38	2.58	2.82	3.16	3.33	2.04
70%	1.43	1.18	1.49	1.71	1.99	2.24	2.53	2.76	3.01	3.37	3.55	2.17
80%	1.43	1.21	1.63	1.90	2.19	2.42	2.74	2.95	3.19	3.60	3.83	2.33
90%	1.43	1.26	1.80	2.07	2.39	2.62	3.07	3.26	3.41	3.96	4.22	2.53
95%	1.43	1.31	1.92	2.19	2.58	2.93	3.34	3.57	3.77	4.33	4.62	2.74

Uzbekistan Exports (Million Bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	4.50	4.52	4.78	4.82	4.82	4.83	4.88	5.00	5.03	5.08	5.10	4.83
Stochastic Average	4.80	4.11	4.35	4.25	4.21	4.19	4.35	4.35	4.43	4.50	4.34	4.35
Difference	6.64%	-8.96%	-8.92%	-11.85%	-12.75%	-13.13%	-10.87%	-13.06%	-12.01%	-11.35%	-14.99%	-9.77%
Standard deviation	0.19	1.38	1.39	1.38	1.55	1.59	1.40	1.64	1.69	1.56	1.95	1.38
Percentiles												
5%	4.80	1.26	1.37	1.56	1.27	0.59	1.92	1.27	1.20	1.27	0.23	1.65
10%	4.80	2.72	2.88	2.71	2.47	2.19	2.65	2.73	2.36	2.63	2.23	2.81
20%	4.80	3.45	3.72	3.49	3.38	3.56	3.49	3.58	3.67	3.62	3.38	3.68
30%	4.80	4.00	4.21	3.94	4.05	4.07	4.07	4.15	4.22	4.18	4.07	4.17
40%	4.80	4.33	4.50	4.35	4.43	4.38	4.53	4.55	4.61	4.55	4.57	4.50
50%	4.80	4.53	4.76	4.62	4.68	4.69	4.75	4.80	4.90	4.87	4.89	4.74
60%	4.80	4.71	4.91	4.83	4.86	4.85	4.97	5.01	5.12	5.14	5.16	4.92
70%	4.80	4.87	5.11	5.02	5.06	5.05	5.16	5.18	5.31	5.36	5.41	5.09
80%	4.80	5.01	5.29	5.24	5.20	5.23	5.31	5.40	5.59	5.62	5.62	5.27
90%	4.80	5.20	5.48	5.44	5.47	5.45	5.55	5.63	5.83	5.94	5.96	5.48
95%	4.80	5.42	5.71	5.66	5.64	5.67	5.76	5.92	6.03	6.20	6.18	5.68

West Africa Exports (Million Bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	2.27	2.48	2.85	3.06	3.31	3.63	3.94	4.23	4.43	4.93	4.73	3.51
Stochastic Average	2.38	2.54	2.93	3.14	3.39	3.72	4.03	4.34	4.65	4.93	5.23	3.61
Difference	4.46%	2.51%	2.93%	2.65%	2.47%	2.45%	2.23%	2.56%	4.94%	0.09%	10.49%	2.61%
Standard deviation	0.00	0.38	0.41	0.46	0.49	0.55	0.60	0.62	0.65	0.70	0.75	0.48
Percentiles												
5%	2.38	1.94	2.27	2.42	2.58	2.86	3.08	3.36	3.61	3.81	3.98	2.83
10%	2.38	2.04	2.40	2.56	2.77	3.06	3.32	3.56	3.83	4.05	4.22	3.00
20%	2.38	2.18	2.55	2.74	2.95	3.24	3.55	3.81	4.08	4.33	4.56	3.18
30%	2.38	2.31	2.70	2.88	3.12	3.41	3.70	4.01	4.27	4.57	4.84	3.34
40%	2.38	2.43	2.82	2.99	3.27	3.55	3.83	4.15	4.47	4.72	5.02	3.46
50%	2.38	2.55	2.94	3.13	3.40	3.70	3.98	4.33	4.65	4.94	5.26	3.60
60%	2.38	2.66	3.05	3.25	3.54	3.85	4.14	4.49	4.82	5.15	5.40	3.73
70%	2.38	2.79	3.18	3.41	3.69	4.01	4.35	4.66	4.98	5.31	5.61	3.87
80%	2.38	2.90	3.31	3.57	3.81	4.20	4.54	4.85	5.17	5.49	5.87	4.02
90%	2.38	3.03	3.46	3.73	4.04	4.44	4.83	5.09	5.51	5.81	6.21	4.23
95%	2.38	3.16	3.57	3.87	4.16	4.57	5.09	5.34	5.79	6.04	6.48	4.40

Brazil Exports (Million Bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	2.50	4.30	5.53	6.29	6.90	7.22	7.40	7.38	7.38	7.45	7.55	6.23
Stochastic Average	2.57	4.26	5.43	6.13	6.68	6.95	7.06	7.01	6.98	6.96	7.01	6.00
Difference	2.71%	-1.00%	-1.80%	-2.57%	-3.12%	-3.72%	-4.50%	-4.99%	-5.44%	-6.53%	-7.17%	-3.70%
Standard deviation	0.00	1.34	2.10	2.67	3.22	3.54	3.76	3.88	3.84	4.13	4.08	2.85
Percentiles												
5%	2.57	1.62	1.82	1.18	1.21	1.01	0.52	0.32	0.34	-0.21	-0.01	1.04
10%	2.57	2.09	2.66	2.52	2.39	2.19	2.02	1.96	1.99	1.63	1.76	2.20
20%	2.57	3.26	3.45	4.03	3.80	3.74	4.04	3.94	4.01	3.43	3.67	3.63
30%	2.57	3.72	4.42	4.83	5.01	5.06	5.47	5.11	5.03	4.87	5.12	4.61
40%	2.57	4.05	5.05	5.60	6.08	6.24	6.38	6.17	6.21	6.21	6.10	5.46
50%	2.57	4.39	5.82	6.41	6.96	7.17	7.31	7.16	7.17	7.21	7.31	6.22
60%	2.57	4.81	6.20	7.06	7.84	8.22	8.27	8.18	8.16	8.18	8.27	6.95
70%	2.57	5.19	6.63	7.68	8.61	9.32	9.13	9.47	9.13	9.40	9.24	7.71
80%	2.57	5.44	7.39	8.45	9.43	10.11	10.35	10.46	10.16	10.49	10.33	8.49
90%	2.57	5.82	7.88	9.31	10.59	11.45	11.66	11.69	11.66	12.09	11.89	9.47
95%	2.57	6.04	8.41	10.20	11.50	12.23	12.86	12.71	12.70	13.33	13.36	10.25

China Imports (Million Bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	14.40	17.64	19.87	21.61	22.71	24.15	24.41	24.73	26.30	27.58	28.67	22.34
Stochastic Average	14.57	17.69	19.90	21.62	22.74	24.20	24.44	24.77	26.40	27.64	28.76	22.40
Difference	1.18%	0.27%	0.14%	0.07%	0.12%	0.17%	0.11%	0.20%	0.37%	0.22%	0.34%	0.25%
Standard deviation	0.00	0.57	0.57	0.56	0.52	0.54	0.53	0.56	0.60	0.63	0.67	0.51
Percentiles												
5%	14.57	16.79	19.04	20.84	21.98	23.41	23.70	23.99	25.55	26.83	27.90	21.67
10%	14.57	16.89	19.11	20.89	22.02	23.45	23.75	24.07	25.60	26.88	27.95	21.72
20%	14.57	17.09	19.34	21.02	22.17	23.60	23.88	24.18	25.73	27.00	28.06	21.86
30%	14.57	17.31	19.49	21.18	22.36	23.82	24.05	24.37	25.98	27.19	28.25	22.03
40%	14.57	17.53	19.72	21.40	22.58	24.02	24.23	24.58	26.18	27.36	28.45	22.22
50%	14.57	17.68	19.93	21.64	22.80	24.18	24.40	24.76	26.38	27.53	28.64	22.39
60%	14.57	17.88	20.09	21.79	22.91	24.36	24.59	24.91	26.56	27.76	28.92	22.54
70%	14.57	18.10	20.27	21.99	23.07	24.50	24.77	25.09	26.78	27.99	29.16	22.71
80%	14.57	18.25	20.41	22.17	23.25	24.69	24.93	25.28	26.98	28.24	29.43	22.88
90%	14.57	18.46	20.60	22.38	23.41	24.91	25.15	25.58	27.23	28.59	29.78	23.09
95%	14.57	18.58	20.82	22.55	23.60	25.06	25.29	25.73	27.37	28.75	29.91	23.23

India Imports (Million Bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	0.40	0.40	0.63	0.78	0.88	1.18	1.61	2.13	2.47	2.70	2.86	1.32
Stochastic Average	0.39	0.40	0.64	0.80	0.91	1.21	1.64	2.16	2.50	2.74	2.89	1.34
Difference	-1.57%	1.16%	2.25%	2.78%	2.97%	2.52%	1.93%	1.52%	1.34%	1.24%	1.27%	1.67%
Standard deviation	0.00	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.05	0.04
Percentiles												
5%	0.39	0.37	0.60	0.75	0.85	1.15	1.58	2.10	2.45	2.68	2.83	1.29
10%	0.39	0.37	0.60	0.75	0.86	1.16	1.59	2.11	2.45	2.68	2.84	1.30
20%	0.39	0.38	0.61	0.76	0.87	1.17	1.60	2.12	2.47	2.70	2.85	1.31
30%	0.39	0.38	0.61	0.77	0.88	1.18	1.61	2.13	2.48	2.71	2.86	1.32
40%	0.39	0.39	0.62	0.78	0.89	1.19	1.62	2.14	2.48	2.72	2.87	1.32
50%	0.39	0.39	0.63	0.79	0.90	1.20	1.63	2.15	2.49	2.73	2.88	1.33
60%	0.39	0.40	0.64	0.81	0.91	1.21	1.64	2.16	2.51	2.74	2.90	1.34
70%	0.39	0.41	0.65	0.82	0.92	1.22	1.66	2.17	2.52	2.76	2.91	1.35
80%	0.39	0.42	0.67	0.83	0.94	1.24	1.67	2.19	2.54	2.78	2.93	1.37
90%	0.39	0.45	0.70	0.85	0.96	1.27	1.70	2.21	2.57	2.80	2.96	1.39
95%	0.39	0.48	0.73	0.88	0.99	1.29	1.71	2.24	2.59	2.82	2.98	1.41

Pakistan Imports (Million bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	3.50	3.50	3.78	3.87	3.81	3.84	4.32	4.82	5.18	5.38	5.44	4.20
Stochastic Average	3.93	3.51	3.87	3.88	3.81	3.81	4.26	4.72	5.15	5.32	5.37	4.23
Difference	12.23%	0.32%	2.57%	0.51%	-0.02%	-0.82%	-1.46%	-2.20%	-0.60%	-1.08%	-1.32%	0.63%
Standard deviation	0.00	1.02	1.13	1.13	1.15	1.21	1.23	1.31	1.29	1.30	1.41	1.08
Percentiles												
5%	3.93	1.93	2.09	2.11	1.90	1.90	2.32	2.68	3.11	3.29	3.16	2.53
10%	3.93	2.30	2.52	2.46	2.32	2.32	2.77	3.07	3.58	3.69	3.57	2.90
20%	3.93	2.62	2.88	2.85	2.84	2.75	3.17	3.56	4.00	4.19	4.08	3.28
30%	3.93	2.88	3.17	3.22	3.15	3.13	3.54	4.00	4.34	4.61	4.60	3.60
40%	3.93	3.16	3.54	3.56	3.48	3.45	3.95	4.33	4.74	4.99	5.04	3.91
50%	3.93	3.49	3.98	3.98	3.81	3.90	4.32	4.71	5.20	5.32	5.40	4.26
60%	3.93	4.02	4.24	4.25	4.21	4.23	4.67	5.06	5.64	5.70	5.75	4.59
70%	3.93	4.25	4.46	4.57	4.54	4.51	4.97	5.46	5.92	6.13	6.10	4.87
80%	3.93	4.39	4.77	4.81	4.85	4.90	5.29	5.85	6.27	6.42	6.60	5.15
90%	3.93	4.55	5.28	5.35	5.21	5.28	5.77	6.36	6.78	6.96	7.10	5.55
95%	3.93	5.16	5.67	5.64	5.54	5.62	6.19	6.80	7.05	7.35	7.73	5.89

Other Asia Imports (Million Bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Deterministic Baseline	8.55	7.94	7.97	8.26	8.32	8.35	8.82	9.24	9.61	10.08	10.57	8.71
Stochastic Average	8.80	7.89	7.96	8.24	8.30	8.33	8.81	9.19	9.59	10.10	10.53	8.72
Difference	2.87%	-0.61%	-0.11%	-0.24%	-0.30%	-0.28%	-0.12%	-0.51%	-0.24%	0.21%	-0.37%	0.07%
Standard deviation	0.00	0.79	0.70	0.74	0.73	0.75	0.77	0.78	0.84	0.90	1.00	0.70
Percentiles												
5%	8.80	6.93	7.04	7.21	7.26	7.30	7.70	8.09	8.42	8.84	9.03	7.76
10%	8.80	7.02	7.18	7.35	7.42	7.46	7.85	8.24	8.58	8.98	9.23	7.89
20%	8.80	7.17	7.31	7.57	7.66	7.66	8.10	8.48	8.83	9.25	9.56	8.08
30%	8.80	7.33	7.45	7.70	7.82	7.81	8.30	8.67	9.01	9.47	9.85	8.24
40%	8.80	7.49	7.60	7.91	7.97	8.02	8.48	8.86	9.23	9.71	10.17	8.41
50%	8.80	7.68	7.83	8.13	8.13	8.24	8.70	9.07	9.44	10.01	10.43	8.60
60%	8.80	7.91	8.08	8.39	8.36	8.45	8.96	9.31	9.77	10.27	10.82	8.83
70%	8.80	8.21	8.28	8.73	8.75	8.75	9.31	9.68	10.03	10.68	11.17	9.12
80%	8.80	8.68	8.68	9.00	9.09	9.14	9.65	10.04	10.53	11.06	11.60	9.47
90%	8.80	9.13	9.03	9.29	9.39	9.43	9.89	10.29	10.80	11.36	11.94	9.74
95%	8.80	9.47	9.18	9.48	9.51	9.58	10.06	10.46	10.97	11.54	12.11	9.91

Turkey Imports (Million bales)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average	
Deterministic Baseline	3.82	4.12	4.21	4.16	4.15	4.11	4.06	4.13	4.05	4.01	4.00	3.82	4.12
Stochastic Average	2.92	2.47	2.33	2.34	2.33	2.27	2.42	2.67	2.66	2.98	3.15	2.92	2.47
Difference	-23.52%	-40.13%	-44.61%	-43.69%	-43.95%	-44.73%	-40.35%	-35.34%	-34.32%	-25.70%	-21.17%	-23.52%	-40.13%
Standard deviation	0.00	3.17	3.18	3.29	3.25	3.22	3.15	2.96	2.93	2.67	2.44	0.00	3.17
Percentiles													
5%	2.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	
10%	2.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	
20%	2.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.33	
30%	2.92	0.33	0.14	0.27	0.32	0.33	0.61	0.94	1.06	1.80	2.24	1.00	
40%	2.92	2.29	1.58	1.84	1.91	1.61	2.12	2.51	2.46	3.05	3.31	2.33	
50%	2.92	3.47	3.23	3.25	3.27	2.95	3.23	3.60	3.68	3.94	3.98	3.41	
60%	2.92	4.32	4.07	4.29	4.14	4.17	4.31	4.38	4.41	4.47	4.45	4.17	
70%	2.92	5.07	4.99	5.08	4.95	4.89	4.91	4.87	4.84	4.82	4.84	4.74	
80%	2.92	5.55	5.54	5.53	5.55	5.47	5.44	5.32	5.37	5.26	5.17	5.19	
90%	2.92	5.96	6.03	5.90	5.96	5.95	5.88	5.84	5.68	5.77	5.63	5.59	
95%	2.92	6.16	6.27	6.14	6.24	6.22	6.21	6.12	6.07	6.05	5.90	5.84	