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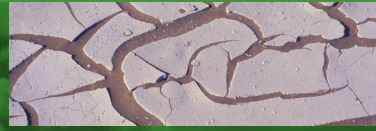
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# The 2014 US Farm Bill and its Effects on the World Market for Cotton



By Christian Lau, Simon Schropp, Daniel A. Sumner



International Centre for Trade  
and Sustainable Development

Issue Paper No. 58



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## CONTENTS

LIST OF TABLES AND FIGURES	iv
ABBREVIATIONS AND ACRONYMS	v
FOREWORD	vi
EXECUTIVE SUMMARY	vii
1. INTRODUCTION	2
1.1 Summary of the 2014 Farm Bill Programmes Relevant to Upland Cotton	3
1.2 Research Questions Addressed in this Paper	3
1.3 Summary of Findings	4
1.4 Overview of the Report	5
2. THE US COTTON SUBSIDY REGIME AND ITS INFLUENCE ON US COTTON PRODUCTION	6
2.1 Subsidy Programmes Under 2002 And 2008 Farm Bills	7
2.2 Subsidy Programmes under the 2014 Farm Bill	7
2.3 How US Cotton Subsidies Reduce Producers' Risk and Increase Revenue	10
3. CALCULATING THE EFFECTS OF THE COTTON SUBSIDIES UNDER THE 2014 FARM BILL	13
3.1 Model Intuition and Summary	13
3.2 Model Set-up	14
3.3 Expected Subsidy Disbursements from Subsidy Programmes	16
3.4 Model Solution in the Counterfactual Scenario	18
3.5 Calibration of the Model and Simulations	19
3.6 Results and Discussion	21
4. IMPLICATIONS OF OUR FINDINGS FOR TRADE DISPUTES AND TRADE NEGOTIATIONS, AS WELL AS DOMESTIC POLICY ANALYSIS	28
4.1 Potential WTO Challenge of the Trade Effects of US Cotton Subsidies	28
4.2 Implications of our Findings for the Doha Development Round Negotiations	29
4.3 Policy Changes that Would Limit the Market-distorting Effects of the Subsidies	30
REFERENCES	31
ENDNOTES	34

## LIST OF TABLES AND FIGURES

- |           |   |
|-----------|---|
| Table 1.  | Expected annual subsidies from US cotton programmes   |
| Table 2.  | US cotton acreage absent the subsidies                |
| Table 3.  | US exports of cotton absent the subsidies             |
| Table 4.  | Damage to RoW cotton producers from US subsidies      |
| Figure 1. | Expected annual subsidies from US cotton programmes   |
| Figure 2. | World price suppression caused by US cotton subsidies |
| Figure 3. | Yield per planted and harvest acre MY 1999-2014       |
| Figure 4. | Expected annual subsidies from US cotton programmes   |
| Figure 5. | Cotton subsidies relative to market revenues          |
| Figure 6. | World price suppression caused by US cotton subsidies |

## ABBREVIATIONS AND ACRONYMS

A&O	Administrative and operational
ACRE	Average crop revenue election
AoA	Agreement on Agriculture
AWP	Adjusted world price
CAT	Catastrophic coverage
CBO	Congressional Budget Office
CCP	Countercyclical payments
CGE	Computable general equilibrium
CIP	Crop insurance program
DP	Direct payment
EAA	Economic adjustment assistance
FAPRI	Food and Agricultural Policy Research Institute
ML	Marketing loan
MY	Marketing year
NCC	National Cotton Council
PLC	Price loss coverage
RMA	Risk Management Agency
RoW	Rest of the world
RP	Revenue Protection
SCM	Agreement on Subsidies and Countervailing Measures
SOB	Summary of business
STAX	Stacked Income Protection Plan
UK	United Kingdom
US	United States
USDA	United States Department of Agriculture



## FOREWORD

Cotton has been one of the most contentious issues in the Doha Round of multilateral trade negotiations at the World Trade Organization (WTO). Historically, the substantial subsidies provided by the United States (US) government to cotton producers were found to depress artificially world prices, undermining the viability of otherwise competitive but unsubsidised producers in the developing world. This led Brazil, a country affected by these subsidies, to file and win a series of disputes at the WTO against the US.

In October 2014, the two countries reached an agreement to settle their longstanding dispute on cotton. Under the terms of the agreement, Brazil gave up its rights to countermeasures against US trade or any further proceedings in this dispute for at least the duration of the Agricultural Act of 2014. For its part, the US agreed to pay a total of roughly USD 750 million into a fund maintained by the Brazilian Cotton Institute to benefit Brazilian cotton producers. The bilateral deal, however, left in place the US cotton subsidy regime regulated in the most recent Farm Bill, as well as its trade-distorting effects.

While WTO Members are currently debating whether an outcome on cotton might be a deliverable in view of the Tenth WTO Ministerial Conference in Nairobi in December 2015, this study aims to inform cotton-related discussions, and more generally the debate on agricultural subsidies, in the context of the Doha Development Round.

The following study seeks to provide policymakers and trade negotiators both in the US and other cotton-producing countries with an impartial, evidence-based assessment of the extent to which the subsidies provided by the US government under the Agricultural Act of 2014 affect the global market for cotton.

I hope that you find the paper a fruitful contribution to the debate and the quest for solutions in this area.



Ricardo Meléndez-Ortiz  
Chief Executive, ICTSD

## EXECUTIVE SUMMARY

Agricultural subsidies have long been a bone of contention in international trade relations and have repeatedly been the subject of trade disputes before the World Trade Organization (WTO). Arguably, the most prominent example is the *US - Upland Cotton* case between Brazil and the United States (US), which resulted in a series of dispute settlement proceedings, in which the WTO sided with Brazil. Ultimately, the dispute resulted in a mutually agreed solution under which the US paid a total of USD 750 million into a fund to benefit Brazilian cotton producers. This bilateral deal, however, left unchanged the new US cotton subsidy regime (enshrined in the 2014 US Farm Bill), which remains highly trade distorting.

This paper seeks to provide an objective, evidence-based assessment of the effects on the world market for cotton of the US cotton subsidies under the 2014 US Farm Bill. To that end, we introduce an economic simulation model designed to evaluate what would happen to world market prices for cotton if these subsidies were permanently removed. The model is an equilibrium displacement model applicable specifically to US cotton subsidies. The model could, however, be modified to assess the effects of subsidies for other crops. We report percentage deviations between an initial baseline equilibrium, in which all US cotton subsidies are in place, and an alternative counterfactual, in which all cotton subsidies are removed.

Our model is the first to assess comprehensively the effect of the US 2014 Farm Bill on world market prices for cotton. The parameters of the model are calibrated with reference to available market data, policy information from the US Government, and empirical evidence from relevant academic literature. Instead of relying on a speculative path of cotton prices over the period 2014-2018 (the envisaged lifetime of the 2014 Farm Bill), we present our simulation results for a wide range of plausible price configurations based on long-run historical and projected prices of cotton.

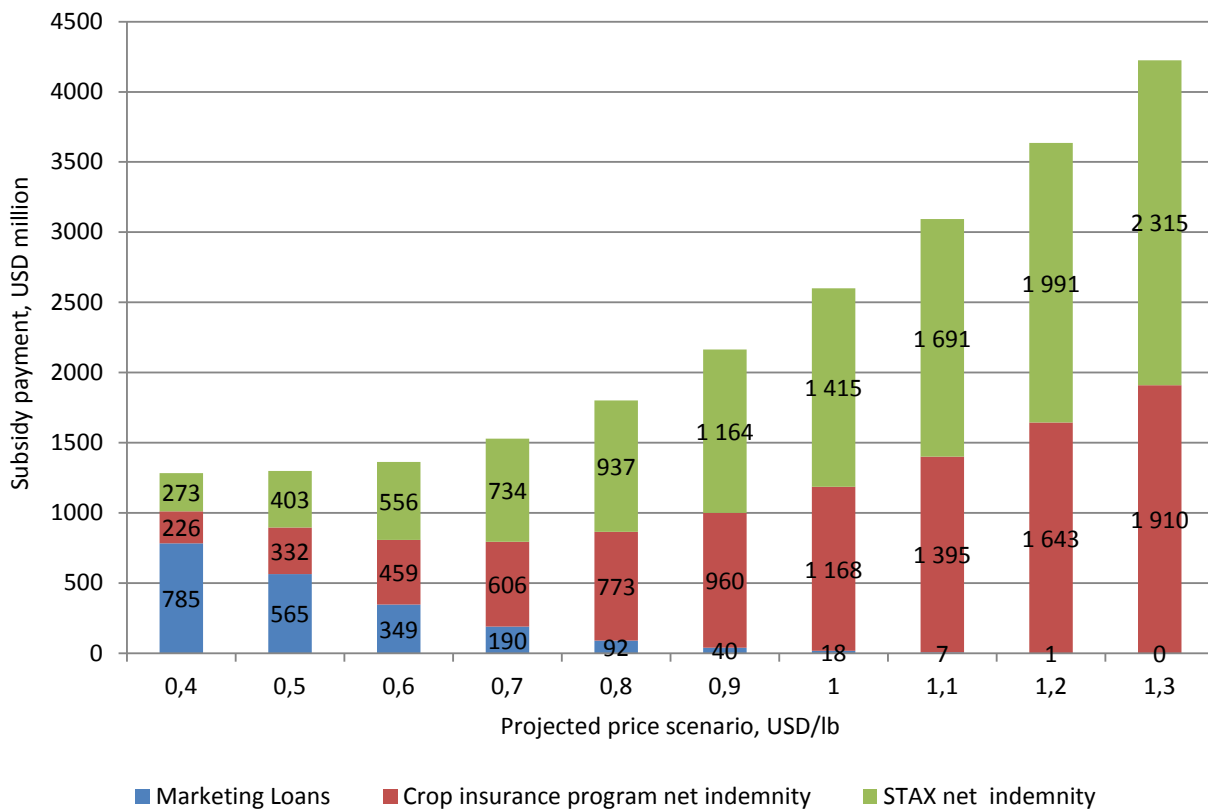
We find that, under a realistic scenario of a futures market price for cotton of USD 0.70/lb., US cotton producers would expect to receive more than USD 1.5 billion in subsidies annually. Putting these numbers in perspective, the value of the US subsidies at that price would amount to 41.5 per cent of the market value of US cotton production. At a market price of USD 0.70/lb. of cotton, US cotton subsidies have significant effects on the world market for cotton: we find that US cotton subsidy programmes inflate US cotton acreage by 2.1 million acres, boost US cotton exports by 3.0 million bales<sup>4</sup> of cotton a year, and suppress the world cotton price by 6.9 per cent. This degree of price-suppressing effects is comparable to that found by the WTO arbitrator in *US - Upland Cotton*, which was between 5 per cent and 9 per cent, depending on the year and price levels at issue.<sup>5</sup> Our finding translates into global monetary damages of nearly USD 3.3 billion annually, suffered by cotton-producing countries around the globe, most of them developing economies.

Under different - still plausible - market price scenarios, expected subsidy disbursements are even more dramatic: at an expected market price of USD 0.50/lb., a total of nearly USD 1.3 billion in subsidies would be expected annually by US cotton farmers. At high expected world prices of USD 1.30/lb., anticipated subsidy disbursements would total over USD 4.2 billion annually. Under these alternative price scenarios, the effects on the world market for cotton are also sizeable: at a fairly low price of USD 0.50/lb. of cotton, subsidy-fuelled excess production by US farmers is 2.8 million acres, creating additional exports of 4.0 million bales of cotton and a suppression of world prices of 9.3 per cent. This, in turn, causes monetary damages of USD 2.9 billion annually for cotton-producing countries worldwide. Even at high futures market prices of USD 1.3/lb.,

excess production is 1.9 million acres, creating additional exports of 2.7 million bales of cotton and a suppression of world prices by 6.3 per cent, causing damages to global cotton producers worth USD 6.4 billion annually. Thus, the current US cotton subsidy regime under the 2014 Farm Bill distorts markets substantially regardless of what prices are anticipated under the different market scenarios.

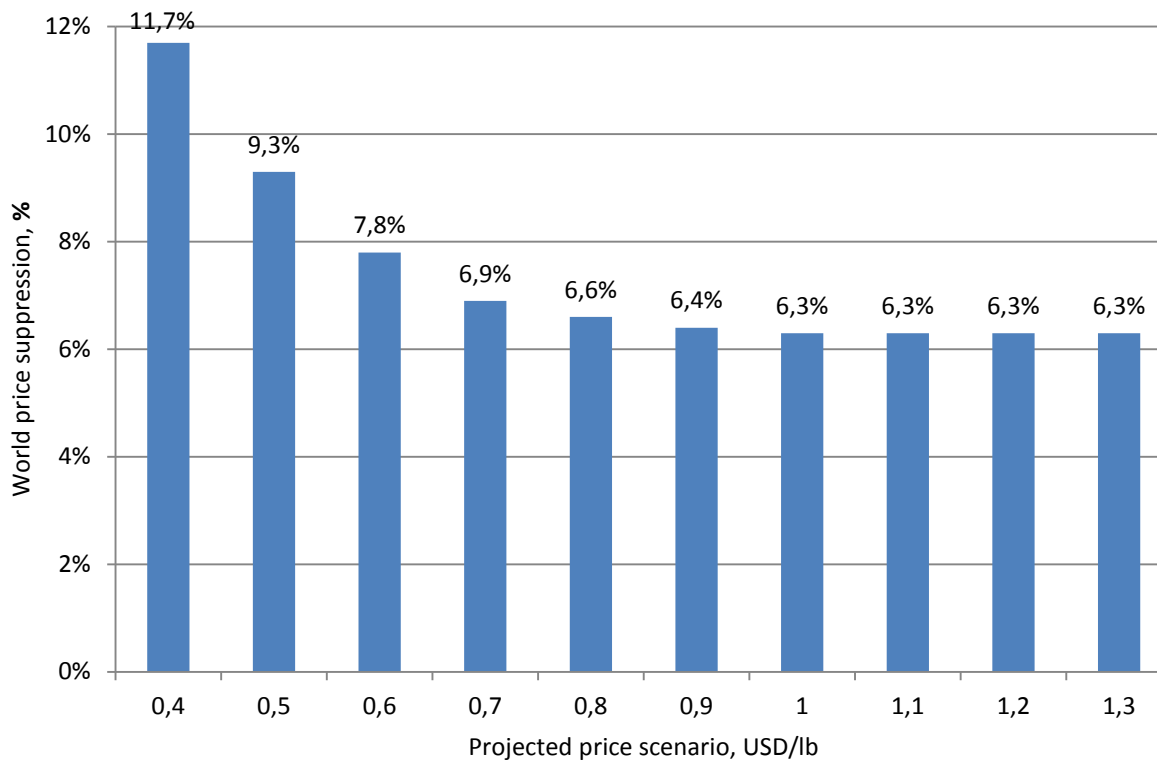
Figure A, below, provides an overview of expected annual subsidies from the available US subsidy programmes under various expected price levels. Figure B reports the world price suppression resulting from such subsidisation, again at various price levels.

**Figure 1. Expected annual subsidies from US cotton programmes**



*Note: Net indemnities for CIP and STAX are calculated as expected indemnity net of premiums paid by the insured farmers.*

Figure 2. World price suppression caused by US cotton subsidies



Based on the results of the economic model, we argue that the US cotton subsidy regime under the 2014 Farm Bill may continue to violate the US WTO commitment not to use subsidies to cause serious prejudice to the trade-related interests of other Members, under Articles 5(c) and 6.3 of the WTO Agreement on Subsidies and Countervailing Measures (SCM Agreement). In particular, following the precedent established in the *US - Upland Cotton dispute*, a new WTO panel looking into the effects of US cotton subsidies may well determine that the effects we found amount to ‘significant price suppression’ in the world market for cotton, under Article 6.3(c) of the SCM Agreement, or to result in displacement or impedance of cotton exports to particular third countries, under Article 6.3(b) of the SCM Agreement.

Our economic results may also motivate the ongoing trade negotiations in the context of the Doha Development Round negotiations. Trade negotiators may wish to take into account the recent changes in the US subsidy regime flowing from the 2014 Farm Bill - in particular its move from subsidies with more limited links to current production to highly subsidised insurance-based subsidies at very high coverage levels - when negotiating new subsidy disciplines and reduction commitments under the WTO Agreement on Agriculture (AoA).

Our economic analysis provides empirical evidence that may assist trade negotiators in their cotton-related discussions in the context of the Doha Development Round, as well as policymakers outside the US in deciding whether to challenge US cotton subsidies in WTO dispute settlement proceedings, should the cotton-related discussions in the Doha Development Round fail to achieve a satisfactory solution.

Our results may also be of use to US policymakers, helping them appreciate that the changes to the cotton subsidy programme in the 2014 Farm Bill leave the US still vulnerable to challenge. More important, our results may be useful for US policymakers and domestic constituencies who seek ways to reduce the trade-distortions caused by US subsidies for cotton and other farm commodities in an upcoming Farm Bill. Such steps may allow the US to regain its global leadership role in the drive toward more open agricultural trade with fewer and smaller trade distortions.

## 1. INTRODUCTION

In this paper we introduce an economic simulation model designed to quantify the market-distorting effects in international cotton markets of the US subsidies for cotton under the 2014 US Farm Bill.<sup>6</sup> We use this model to evaluate what would happen to the world market prices of cotton if these subsidies were removed. This model could also be modified to assess the effects of subsidies for other crops.

The fact that subsidies in support of agricultural commodities can have a damaging effect on producers and markets worldwide is widely accepted. In that context, the Membership of the WTO agreed on strictures on the use of subsidies in general, under the SCM Agreement, and, for agricultural goods specifically, under the AoA.

Agricultural subsidies have long been a bone of contention in international trade relations and have repeatedly been the subject of WTO disputes. Arguably, the most prominent example is the *US - Upland Cotton* case (WT/DS267) between Brazil and the US. At issue in that case was the US subsidisation of its domestic cotton sector. In 2002, Brazil brought a dispute to the WTO, challenging the trade-distorting nature of a host of US cotton subsidies, and in particular their significant price-suppressing effects on the world market for cotton.<sup>7</sup> Brazil prevailed before the WTO in five consecutive proceedings. In light of the US failure to implement fully the WTO's recommendations and rulings, a WTO arbitrator awarded Brazil retaliation rights worth roughly USD 150 million annually, commensurate with the degree of damage caused to Brazilian cotton-related interests. To avoid retaliation in the form of trade sanctions imposed by Brazil on US goods, services, and intellectual property rights, and to settle the dispute for at least the duration of the 2014 US Farm Bill, the US agreed to pay roughly USD 750 million into a fund maintained by the Brazilian Cotton Institute to benefit Brazilian cotton producers. While these US payments were the

basis for a mutually agreed solution that settled the dispute with Brazil, the resulting bilateral deal left in place the US cotton subsidies enshrined in the new 2014 Farm Bill, as well as their trade-distorting effects.<sup>8</sup>

African cotton-producing countries, who have equally been negatively affected by cotton subsidies worldwide, including those by the US,<sup>9</sup> have taken a different approach to challenging distortions in the world market for cotton. Benin, Burkina Faso, Chad, and Mali focused their energy on forming the so-called Cotton-4, a group of WTO Members that seeks to influence the Doha Development Round negotiations on agriculture, and cotton in particular. The Cotton-4 succeeded in emphasising the importance of cotton as an agricultural cash crop for subsistence farmers in their countries and elsewhere, and in drawing attention to the distortions in the markets for cotton caused by several WTO Members, including the US. The importance that the cotton issue gained is reflected in the creation of a separate WTO subcommittee on cotton<sup>10</sup> and the prominence the issue receives within the negotiating agenda of the Doha Development Round in general.

Against this background, our paper seeks to add substance to the discussions among trade negotiators and policymakers by providing an objective, evidence-based assessment of the effects on the world market for cotton of the US cotton subsidies provided under the recent 2014 US Farm Bill. It is hoped that this analysis will assist (i) trade negotiators in their cotton-related discussions in the context of the Doha Development Round; (ii) policymakers in the US, as they determine how to reform cotton subsidies in an upcoming Farm Bill; and (iii) policymakers outside the US in deciding whether to challenge US cotton subsidies in WTO dispute settlement, should the cotton-related discussions in the Doha Development Round fail to achieve a satisfactory solution.

### 1.1 Summary of the 2014 Farm Bill Programmes Relevant to Upland Cotton

The 2014 Farm Bill marks one of a long line of changes in the US approach to supporting its cotton producers, while maintaining a substantial government role. The two previous iterations of US farm policy, the 2002 and 2008 Farm Bills, were characterised by direct payments (DP) that were supplemented by price-contingent marketing loan (ML) subsidies and countercyclical payments (CCP), both of which provided price guarantees near or above expected market prices. Under the 2002 Farm Bill, US cotton exporters and domestic users also benefited from price-contingent Step 2 subsidies that paid them the difference between domestic and world market prices. The US discontinued Step 2 subsidies in August 2006, in response to the WTO recommendations and rulings in *US - Upland Cotton*.

A notable feature of DP and CCP disbursements was that they were partly paid without regard to current production or acreage, while still influencing production incentives. US policymakers abolished DP and CCP subsidies for cotton under the 2014 Farm Bill and introduced new insurance-based programmes. These new programmes provide payments against shortfalls from expected revenues even at prices well above those for which the earlier programme offered payments. The new programmes help US cotton producers manage high yields and price volatilities and continue production of cotton at times of high production costs.<sup>11</sup>

US cotton producers now benefit from insurance-based subsidies, the regime for which was strengthened significantly compared with previous iterations of the Farm Bill. The subsidised farm-level crop insurance program (CIP) continues to be at the heart of the US crop insurance system. Farm-level crop insurance, which is fully tied to production and price realisations, acts as a revenue assurance that mitigates even comparatively small shortfalls from expected revenue, including at times of high prices or yields. By providing indemnity payments when revenues fall short of expectations, subsidised crop insurance

policies raise expected returns and reduce the risks involved in farming cotton in the US. Insurance subsidies, thus, incentivize growing cotton even in market circumstances where crop failures are likely and price volatility is high.

The 2014 Farm Bill complements subsidised farm-level revenue insurance policies under CIP with a new heavily subsidised county-level insurance policy, Stacked Income Protection Plan (STAX).<sup>12</sup> The STAX is a cotton-specific subsidy that tops up CIP policies to obtain a coverage level of approximately 90 per cent of expected revenue.<sup>13</sup> Similar to crop insurance, and with high subsidy rates, STAX provides indemnity payments when revenue falls short of expectations, thereby increasing expected revenue and reducing further the risk involved in growing cotton.

The 2014 Farm Bill also maintains price-contingent ML subsidies for cotton, which were found to cause significant market distortions in five consecutive proceedings in the *US - Upland Cotton* dispute. These subsidies provide US cotton producers with a price floor for the entirety of their cotton production when prices fall below a government-determined minimum price. ML subsidies thus provide additional revenue at times of low prices, thereby reducing cotton producers' downside price risks and incentivizing US farmers to grow cotton.

Finally, the 2014 Farm Bill maintains a subsidy to US users of cotton in the form of an economic adjustment assistance (EAA) payment of USD 0.03/lb. of cotton used by US textile mills. Since virtually no cotton is imported into the US, the subsidy maintains a stable source of domestic demand for US cotton. As this subsidy is comparatively small, we have omitted it from our model.

### 1.2 Research Questions Addressed in this Paper

Each of the subsidies under the 2014 Farm Bill provides production incentives to US cotton farmers. In addition to an uncertain stream of market revenue from growing cotton, US



cotton producers are incentivised through the additional revenue provided by ML subsidies at times when prices are low and indemnity payments from heavily subsidised CIP and STAX insurance at times when prices or yields are lower than expected. Each of these subsidies serves to provide additional revenue at times when uncertain market revenues are lacking. Collectively, these subsidies have the effect of increasing US cotton production beyond what it would be otherwise.

In this paper, we seek to quantify the production incentives from these subsidies on the basis of the additional expected revenue they represent for US farmers producing cotton, and their risk-reducing impact on US cotton farmers. Specifically, we present the findings of an economic model that quantifies the additional US cotton production and exports that result from the production incentives provided by the US cotton subsidies, as compared to a scenario without the US cotton subsidies. In addition, we calculate the associated price-suppressing effects on the world market for cotton caused by the US subsidies, and assess the lost revenue for non-US cotton farmers.

### 1.3 Summary of Findings

We develop an economic model that addresses the magnitude of the impact that certain US cotton subsidies under the 2014 Farm Bill have on quantities supplied and exported by US cotton farmers, on the world market prices for cotton, and ultimately on the cotton-producing sectors worldwide.<sup>14</sup> Specifically, the model quantifies the effect on world market prices and quantities of cotton if US subsidies under the ML, CIP, and STAX had been announced to be withdrawn in time before the planting decision.<sup>15</sup>

In quantifying the economic impact of the price-suppressing effects of US cotton subsidies on the world cotton market, we rely on a simulation model developed by the authors. The model is a partial-equilibrium log-linear displacement model that calculates percentage changes from an initial baseline equilibrium in which all US cotton subsidies are in place. The

basic set up of the model is similar to the so-called Sumner model that Brazil submitted in the *US - Upland Cotton* dispute.<sup>16</sup> The Sumner model was largely accepted by the arbitrator in the same case, when charged with calculating the trade damage suffered by Brazil.<sup>17</sup>

The parameters of the model are calibrated with reference to available market data, policy information from the US Government, and empirical evidence from the relevant academic literature. Instead of relying on a speculative price path that cotton will follow over the period 2014-2018 (the envisaged lifetime of the 2014 Farm Bill), we present our simulation results for a wide range of plausible price configurations based on long-run historical and projected prices of cotton.

We find that, under a realistic scenario of a futures market price for cotton of USD 0.70/lb.,<sup>18</sup> US cotton producers would expect to receive over USD 1.5 billion of subsidies annually. In particular, at that futures market price level, farmers expect ML payments of USD 190 million, USD 734 million in STAX disbursements,<sup>19</sup> and USD 606 million in CIP disbursements annually. Putting these numbers in perspective, the value of these subsidies together amounts to 41.5 per cent of the market value of US cotton production.

Under more extreme - yet still plausible - futures market price scenarios, expected subsidy disbursements are even more dramatic: at a futures market price of USD 0.50/lb., a total of nearly USD 1.3 billion in subsidies would be expected by US cotton farmers annually (USD 565 million in ML, USD 403 million in STAX payments, and USD 332 million in CIP). Equally, at high expected world prices of USD 1.30/lb., anticipated subsidy disbursements would total more than USD 4.2 billion annually (USD 2.3 billion in STAX payments, and USD 1.9 billion in CIP).

Enhanced revenues for US farmers aside, the US subsidies cause significant effects on the world market for cotton: we find that at a futures market price of USD 0.70/lb. of cotton, all US cotton programmes together artificially inflate

US cotton acreage by 2.1 million acres, boost US cotton exports by 3.0 million bales of cotton a year, and suppress the world cotton price by 6.9 per cent. This degree of price-suppressing effects is comparable to that found by the WTO arbitrator in *US - Upland Cotton*, which was between 5 per cent and 9 per cent, depending on the year and price levels at issue.<sup>20</sup> Our finding translates into global monetary damages of nearly USD 3.3 billion annually, suffered by cotton-producing countries around the globe, most of them developing economies.

For more extreme price scenarios, the results are even more sobering: at a fairly low price of USD 0.50/lb. of cotton, subsidy-fuelled excess production by US farmers is 2.8 million acres, creating additional exports of 4.0 million bales of cotton, and a suppression of world prices by 9.3 per cent. This, in turn, causes monetary damages worth USD 2.9 billion annually for cotton-producing countries worldwide. Even at fairly high futures market prices of USD 1.3/lb., excess production is 1.9 million acres, creating additional exports of 2.7 million bales of cotton, and a suppression of world prices by 6.3 per cent, causing damages to global cotton producers worth USD 6.4 billion annually.

The results of our economic model may stimulate the policy discussion in various ways. As we demonstrate, the US cotton subsidy regime under the 2014 Farm Bill may continue to violate the US WTO commitment not to use subsidies to cause serious prejudice to the trade-related interests of other Members, under Articles 5(c) and 6.3 of the WTO SCM Agreement. In particular, following the precedent established in the *US - Upland Cotton* dispute, a new WTO panel looking into the effects of US cotton subsidies could determine that the effects we found amount to ‘significant price suppression’ in the world market for cotton, under Article 6.3(c) of the SCM Agreement or to result in displacement or impedance of cotton exports to particular third countries, under Article 6.3(b) of the SCM Agreement.

The change in the US subsidy regime - in particular its move from subsidies with limited links to production to highly subsidised

insurance-based subsidies at very high coverage levels - should also be taken into account when negotiating new subsidy disciplines and reduction commitments under the AoA in the context of the Doha Development Round.

To facilitate an assessment both under the SCM Agreement and the AoA, we identify a list of policy parameters that would make US cotton subsidies less trade distortive. These parameters may be used by policymakers and trade negotiators alike in assessing likely trade effects of agricultural subsidies.

#### 1.4 Overview of the Report

We begin our analysis, in Section 3, with a description of the basic contours of the US cotton subsidy regime under the previous 2002 and 2008 Farm Bills that Brazil successfully challenged in *US - Upland Cotton*. We then describe how the US subsidy landscape was significantly modified in the 2014 Farm Bill in an effort to take account of an evolving political agenda and economic environment for farming cotton in the US.

Section 4 constitutes the core of this paper. In that chapter, we set out in some detail the economic model used to quantify the effect on US cotton production and exports, as well as on world market prices for cotton, of the additional revenues and the reduced risks flowing from the US cotton subsidies.

Finally, in Section 5, we discuss the policy implications of our findings. We identify potential vulnerabilities of US cotton subsidies to challenges by WTO Members where cotton farmers continue to suffer from significantly suppressed world market prices for cotton, or displaced or impeded cotton exports, caused by US cotton subsidies. We also highlight the relevance of our findings for the ongoing Doha Development Round negotiations, where WTO Members may wish to look more closely into disciplines limiting the effect of trade-distorting insurance-based subsidies. To that end, we identify a number of changes that could make US cotton subsidies significantly less trade distorting.



## 2. THE US COTTON SUBSIDY REGIME AND ITS INFLUENCE ON US COTTON PRODUCTION

The US has a long history of providing large amounts of subsidies to its cotton producers.<sup>21</sup> US farm policy, including for cotton, is codified in periodic Farm Bills that each govern for a number of years the US agricultural subsidy regime, before expiring and being replaced by a new Farm Bill.

The cotton-related aspects of the three most recent Farm Bills - *i.e.*, the 2002, 2008, and 2014 Farm Bills - were all implicated in the *US - Upland Cotton* dispute at the WTO, in which Brazil challenged the effects of US cotton subsidies on the world market for cotton.

Under the 2002 and 2008 Farm Bills, US cotton subsidies consisted mostly of DP subsidies, supplemented by price-contingent ML and CCP subsidies that were triggered off price guarantees near or above expected market prices. CIP subsidies were also available, but used differently than today.<sup>22</sup> The resulting distortions of the world market for cotton led Brazil, in 2002, to challenge US cotton subsidies at the WTO.<sup>23</sup> The cotton-producing countries of Benin and Chad participated as third parties during these original proceedings to have their concerns heard.<sup>24</sup> A WTO panel sided with Brazil, and confirmed in September 2004 that a series of price-contingent US cotton subsidies under the then-applicable 2002 Farm Bill caused world market prices for cotton to be significantly suppressed, in violation of the US WTO commitments, a finding that the WTO Appellate Body upheld in March 2005.<sup>25</sup>

With the belated withdrawal of one of its price-contingent subsidies, the so-called Step 2 subsidy (which was also found to be a prohibited export and local content subsidy under applicable WTO subsidy rules), the US claimed to have complied fully with the WTO findings. Brazil disagreed, and returned to the WTO. In December 2007, a WTO Compliance Panel confirmed the US failure to comply fully with its WTO obligations, finding that the remaining price-contingent US cotton subsidies under the ML and CCP programmes continued to cause significant price suppression

in the world market for cotton.<sup>26</sup> On appeal, the WTO Appellate Body upheld that finding in June 2008.<sup>27</sup>

The continued failure of the US to comply with its WTO obligations led Brazil to seek WTO authorisation to suspend concessions or other obligations (commonly referred to as 'retaliation'). In August 2009, a WTO arbitrator quantified the trade damage to Brazil's cotton sector at USD 147.3 million annually, and the WTO Dispute Settlement Body subsequently authorised Brazil to take countermeasures in that amount.<sup>28</sup> Under the threat of Brazil exercising its retaliation rights in the form of trade sanctions against US goods, services, and intellectual property rights, the US and Brazil agreed a temporary solution to the dispute, under which the US committed to pay roughly USD 150 million a year into a Brazilian fund aimed at supporting the Brazilian cotton industry, pending implementation by the US of the WTO recommendations and rulings in the upcoming version of the Farm Bill.<sup>29</sup>

Changes in the political and market environment in the run-up to the 2014 Farm Bill, in particular US budget deficits and high commodity prices, made DP less palatable to US lawmakers. Moreover, changes in market circumstances made the existing subsidy system less effective in delivering sustained support to US cotton producers and led the US National Cotton Council (NCC) to advocate for a new direction for the cotton support regime, focusing on insurance-based subsidies, which the NCC considered would also cure the WTO violation. Ceding to these demands, the US Congress abolished DP and CCP subsidies for cotton. Congress replaced these subsidies with a new insurance-based programme under the 2014 Farm Bill - STAX. Along with the maintained crop insurance policies, these insurance-based subsidies stabilise overall market and subsidy revenue even at currently much higher prices, and help US cotton producers manage significantly increased yield and price volatility at times of significantly increased production costs.<sup>30</sup>

As the US Congress deliberated the contours of cotton support under what would become the 2014 Farm Bill, Brazil publicly expressed its concerns that the cotton subsidy regime under consideration would not satisfy US WTO obligations.<sup>31</sup> However, despite Brazil's critique and vehement opposition, the US Congress adopted the 2014 Farm Bill, including notably a number of contentious cotton subsidies.

The passage of the 2014 Farm Bill, therefore, failed to bring about the settlement of the dispute that the US and Brazil had envisaged, based on a US cotton subsidy regime that would be consistent with US WTO obligations. Indeed, it appears that even the US recognised the failure of the 2014 Farm Bill to achieve compliance. To avert yet another compliance proceeding initiated by Brazil at the WTO (and potentially another defeat), the US agreed, in October 2014, to pay a further USD 300 million into the aforementioned cotton fund. In return, Brazil agreed to settle the existing *US - Cotton dispute*, and to abstain, until the expiry of the 2014 Farm Bill, from launching a new WTO dispute over US cotton subsidies.<sup>32</sup>

## 2.1 Subsidy Programmes Under 2002 and 2008 Farm Bills

Under both the 2002 and 2008 Farm Bills, US cotton producers benefited from an essentially identical set of subsidies.

The principal subsidy under the 2002 and 2008 Farm Bills was the price-contingent marketing loan (ML) subsidy, which the WTO found to cause significant price suppression in the world market for cotton. Initially, the ML programme is a vehicle that allows cotton producers to take out a loan at the time of harvest to address their cash needs without having to sell their crop right away. More important, however, it is used to provide US cotton producers with a price floor. Specifically, price-contingent subsidy payments to US cotton farmers under the ML programme are available for the entirety of the US cotton harvest and amount to the full difference between the world market price for cotton, as adjusted by the USDA - the so-called adjusted world price (AWP) - and

the loan rate of USD 0.52/lb. of cotton whenever the AWP is below that loan rate.<sup>33</sup>

The second largest subsidy under the 2002 and 2008 Farm Bills, which the WTO also found to cause significant price suppression in the world market for cotton, were price-contingent CCPs, linked with DPs. US cotton producers received DP subsidies on the basis of 85 per cent of their cotton production in a historic base period. Payments amounted to USD 0.0667/lb. of cotton and were not price contingent. DP subsidies were supplemented by price-contingent CCP disbursements whenever the US national average farm price for cotton fell below the target price (USD 0.7125/lb.) minus the DP rate (USD 0.0667) - *i.e.*, USD 0.6573/lb. The payment rate increased as the US national average farm price fell below this level, up to the ML rate of USD 0.52/lb., and payments were again made on 85 per cent of a farm's cotton production in a historic base period. Given price levels since 2002, significant CCP subsidies have been disbursed in most years. However, as cotton prices increased in recent years, fewer CCP subsidies were made to US cotton producers.<sup>34</sup>

Moreover, the US provided crop insurance subsidies, at that time predominantly in the form of yield insurance at low coverage levels, as well as Step 2 subsidies to exporters and domestic users of cotton. The WTO panel and Appellate Body found the latter to constitute prohibited subsidies that also contributed to significant price suppression in the world market for cotton.

## 2.2 Subsidy Programmes under the 2014 Farm Bill<sup>35</sup>

### 2.2.1 Marketing loan subsidies

Under the 2014 Farm Bill, the ML programme was retained essentially unchanged.<sup>36</sup> Only one modification to the loan rate was implemented to allow the loan rate to fluctuate between USD 0.52/lb. and USD 0.45/lb., based on the average AWP over the previous two years.<sup>37</sup> Given current price projections, however, it is not expected that the loan rate would fall below USD 0.52/lb. on a sustained basis.

The ML programme, thus, continues to provide US cotton farmers with a price floor for the entirety of the actual production on a farm, and with no effective limitation on the amount of benefits they can receive under the ML programme. The Appellate Body explained that the ML programme's risk reduction impacts production decisions, because, even where "farmers had expected higher [market] prices in making their planting decisions, they were also aware that if actual prices were ultimately lower, they would be 'insulated' by government support."<sup>38</sup>

The protection afforded by the ML subsidy is currently important to US cotton producers because of the heightened price volatility in recent years, as further discussed below. Indeed, while just a year ago, in May 2014, the adjusted world price was at USD 0.71/lb., in April 2015, it stood at USD 0.50/lb. and in May 2015, at USD 0.52/lb.<sup>39</sup> That is, the ML subsidy currently provides real protection and payments to US cotton producers.

### 2.2.2 Crop Insurance Program

The CIP provides US cotton producers with an opportunity to insure against shortfalls in yields or revenue suffered for either specific crops or entire farm income. The programme is structured as a public-private partnership between the USDA - more precisely, the Risk Management Agency (RMA) - and 16 approved private insurance companies that sell and service the insurance policies.<sup>40</sup> Independent insurance agents are paid sales commissions by the companies.

Although CIP policies themselves are provided by private insurance companies, the US heavily subsidises every element of CIP. While the details are complex, our focus here is on introducing the most salient features of CIP and the involvement of the US Government in supporting the programme:<sup>41</sup>

- The US pays private insurance companies to cover their administrative and operating (A&O) expenses for CIP, thereby significantly reducing the insurance companies' cost of running the programme, and hence the premiums charged to US cotton producers

by the insurance companies. Depending on the type of insurance policy involved, these payments constitute between 12 per cent and 21.9 per cent of the premium for the policy,<sup>42</sup> and in marketing year (MY) 2014 amounted to USD 136 million related to cotton insurance policies alone.<sup>43</sup>

- The US Government also assumes a large portion of the so reduced insurance premiums, in the form of premium subsidies. Depending on the type of insurance policy and coverage level chosen, the US Government pays between 38 per cent and 80 per cent of the insurance premiums,<sup>44</sup> amounting to USD 473 million in MY 2014 for cotton insurance policies alone.<sup>45</sup>
- In addition, the US Government provides a complex reinsurance mechanism to the insurance companies that allows them to offload much of the risk insured, further reducing their capital costs for the programmes.<sup>46</sup>
- Finally, the US collects and provides to the insurance companies data necessary for the operation of CIP and finances the development of new crop insurance policies.<sup>47</sup>

Thus, the US Government is involved in every aspect of CIP and ensures, through its financial and administrative participation, that CIP policies are provided to US cotton producers at a fraction of their true economic cost. As we explain in greater detail in describing our economic model, this results in US cotton producers holding the reasonable expectation that, when they enrol in CIP, they will receive indemnity payments well in excess of the premiums they pay for the insurance policy.<sup>48</sup>

The CIP provides US cotton producers with effective farm-level insurance against revenues or yields falling below expected levels. Subsidised CIP policies for cotton are available as revenue and yield insurance, with coverage options at the farm or county level. At the time of planting, a producer growing an insurable crop, including cotton, purchases an insurance policy, selects a level of revenue or yield coverage, and pays

a portion of the premium, which increases as the level of coverage rises (as mentioned above, the remainder of the premium is covered by the US Government). Whenever the actual harvest revenue/yield falls under the insured level, the crop insurance kicks in and pays an indemnity according to the selected policy. An additional perceived benefit of CIP is the timely payment. Farmers are typically reimbursed 30 days after claims are submitted.<sup>49</sup>

At the time of the original proceedings of *US - Upland Cotton*, in 2002, most CIP policies covered only farm-level yield risks at comparatively low coverage levels. Today, that situation has changed dramatically.<sup>50</sup> Over time, increases in premium subsidies and increased yield and price volatility have led US farmers to opt for revenue, rather than yield, insurance policies, and to increase steadily their coverage levels: today, roughly 95 per cent of US cotton acreage is covered by subsidised CIP policies, of which 80 per cent constitute farm-level revenue insurance.<sup>51</sup> The vast majority of these policies insure 70 per cent or 75 per cent of expected revenues (expected prices times expected farm-level yields).<sup>52</sup> US cotton producers appear to have determined that this is their optimal level of protection, given that premiums increase with coverage levels and the share of premiums paid by the US Government decreases with increases in coverage levels.

For farm-level revenue insurance, 'expected prices' are determined by reference to the February price of the December cotton futures contract,<sup>53</sup> and 'expected yields' are based on the individual farm's production history.<sup>54</sup> The cotton producer then selects a coverage level between 50 per cent and 85 per cent.<sup>55</sup> Indemnities are paid if actual revenues, calculated as 'actual prices' (based on the December futures contract at harvest time) times actual farm-level yields, fall below the selected percentage coverage level of expected revenues, calculated as either (i) 'expected prices' times expected farm yields, or (ii), if higher, 'actual prices' times expected farm yield.<sup>56</sup> The latter means that insured revenues increase when actual prices increase, providing a further kicker that increases protection against

low yields if harvest-time prices are higher than expected.

### 2.2.3 *Stacked Income Protection Plan (STAX) and transition assistance*

STAX is a cotton-specific subsidy that supplements the revenue protection afforded by CIP to boost protection to roughly 90 per cent of expected revenues, eliminating nearly the entire downside risks of farming cotton in the US.<sup>57</sup> As noted in Section 3.2.2, above, US cotton producers appear to hold the view that very high CIP coverage levels, at 75 per cent or higher, are too expensive. The 2014 Farm Bill addressed this with the introduction of STAX,<sup>58</sup> which provides county-level revenue protection for relatively small revenue shortfalls of between 10 per cent and 30 per cent of expected revenue, i.e., when revenue falls into the range of 70 per cent to 90 per cent of expected revenue.<sup>59</sup>

The STAX is made available to US cotton producers through private insurance companies, much like other CIP policies, but in contrast to CIP, the US Government pays 80 per cent of premiums at these very high coverage levels.<sup>60</sup> STAX thus complements and supplements CIP policies, as its coverage level starts where the farm-level CIP policy ends, with no overlap in coverage levels.

'Expected revenues' are determined on the basis of 'expected prices' (determined by reference to the February price of the December cotton futures contract)<sup>61</sup> times 'expected yields' (based on the county's production history).<sup>62</sup> A cotton producer may select any coverage level between 70 per cent and 90 per cent of expected revenues. Indemnities are paid if actual revenues, calculated as 'actual prices' (based on the December futures contract at harvest time) times actual county-level yields, fall below the selected percentage coverage level of expected revenues, calculated as either (i) 'expected prices' times expected county yields, or (ii), if higher, 'actual prices' times expected county yield.<sup>63</sup> Again, the latter means that insured revenues increase when actual prices increase, providing a further kicker that increases protection against low yields if harvest-time prices are higher than expected.



To tailor the protection afforded by a STAX policy to a cotton producer's specific yield situation, STAX provides for US cotton producers to choose a multiplier that allows producers to scale indemnity payments. Specifically, producers can scale the amount of indemnity payments to reflect higher expected farm-level yields relative to the average expected county yield by selecting a higher protection factor, farmers can scale their expected indemnity payments, with correspondingly higher premiums payable and premium subsidies. While this may be useful where their own expected yields are above the county's average, every farmer can select a high protection factor.<sup>64</sup>

### 2.3 How US Cotton Subsidies Reduce Producers' Risk and Increase Revenue

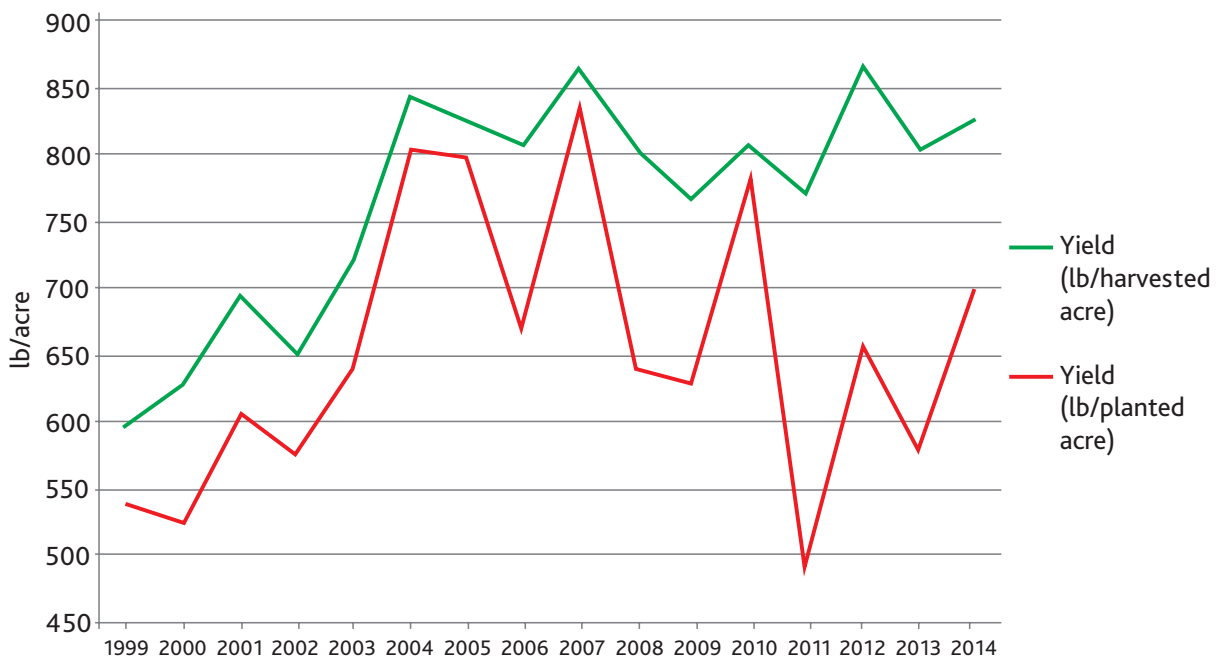
In the previous sections, we have emphasised the impact of US cotton subsidies under the 2014 Farm Bill on the risks faced by US cotton producers from an uncertain stream of market revenue that results from growing cotton. The extent of the production incentives from the US subsidies - through both additional revenue and reduced downside price and revenue risk - becomes evident when considering the risky market environment in which US farmers continue to grow large amounts of cotton year after year.

Under normal circumstances, the natural response by economic actors to a dramatic increase in (i) production costs, (ii) yield volatility, and (iii) market price volatility - factors that have significantly affected US cotton production over the last decade - is to reduce production, unless something else increases revenues and ensures that these revenues flow with an enhanced level of predictability and reliability. The subsidies under the 2014 Farm Bill are designed to do precisely that, thereby incentivising US cotton producers to continue

growing cotton. As the NCC put it, US cotton producers "have to have access to crop insurance ... to survive."<sup>65</sup>

On the cost side, the expenditures necessary to produce US cotton have increased dramatically in recent years. On average, production costs in the US were roughly USD 488 per planted acre in MY 1999. Compare this number with production costs of USD 813 per planted acre in MY 2015, as projected by the USDA.<sup>66</sup> This means an increase of 66 per cent over a period of 16 years. In the absence of subsidies and under normal market conditions, continuing cotton production, therefore, requires stable and significantly increased revenues, either through increases in yields or increases in prices, or both. While yields and prices have indeed increased over the same period, both yields and prices have also experienced unprecedented volatility in recent years, thereby dramatically increasing the business risks of growing cotton. These market conditions would normally make farmers wary of continuing to grow cotton. However, with the availability of ML subsidies and subsidised CIP/STAX insurance, US cotton farmers overwhelmingly stay in the business of growing cotton.

On the yield side, yields per harvested acre have increased, as shown in the graph below.<sup>67</sup> However, this increase in yields has been accompanied by a sharp increase in yield volatility, mainly because large portions of US cotton acreage are abandoned every year. As the NCC observed, "portions of the US Cotton Belt [have] faced extreme weather conditions" leading to "the percentage of planted acres that were un-harvested reach[ing] an all-time high."<sup>68</sup> As a consequence, and as shown in the following graph, yields per planted acre have fallen in recent years, not increased, and are thus unable to compensate for increased costs.

Figure 3. Yield per planted and harvest acre MY 1999-2014<sup>69</sup>

A historical comparison of crop abandonment highlights the yield volatility. During the MY 1999-2002 period, which was the reference period in the original proceedings in *US - Upland Cotton*, an average of 12 per cent of US acreage planted to cotton was abandoned annually - suggesting a total crop failure due to adverse weather conditions in one out of nine years.<sup>70</sup> Similarly, during MY 2003-2006, US cotton producers abandoned, on average, 9 per cent of planted acreage,<sup>71</sup> meaning that, on average, producers experienced a total crop failure in one out of 11 years. During the more recent period, MY 2011-2013, however, the average abandonment rate increased to an average of 29 per cent,<sup>72</sup> suggesting a crop failure in one out of three years. Worse still, in the Southwest cotton producing region of the US - which includes Texas, the largest cotton producing US state<sup>73</sup> - the average abandonment rate during those three years was roughly 50 per cent,<sup>74</sup> meaning that cotton producers experience a total crop failure every other year.

High yield volatility, at times of significantly increased production costs, highlights the central role of the subsidised CIP and STAX insurance in keeping US cotton producers in the business of growing cotton, and keeping US cotton production at high levels. In large

parts of the US cotton belt, it is the revenue stabilisation afforded by highly subsidised insurance policies that enables many US cotton farmers to continue growing cotton, despite the risks involved. Without such subsidisation, US cotton farmers would likely switch to more predictable and drought-resistant crops, or cease farming on some marginal land altogether.

On the price side, market prices for cotton have also become increasingly volatile, thus further undermining the viability of growing cotton. As the NCC put it, “market prices experienced greater turbulence” in recent years, resulting in “unprecedented [price] volatility.”<sup>75</sup> The increased price volatility leads to increased risks for cotton farmers that the market value of the cotton actually produced will be less than expected at the time the planting decision was made.<sup>76</sup> Indeed, the huge Chinese cotton stock, and China’s decisions on when to sell large portions of it, at present, constitutes significant downside risks for cotton prices.<sup>77</sup>

Similar to increased yield volatility, greater price volatility threatens the economic viability of cotton production at today’s elevated production costs. Indeed, the greater the price volatility, the more likely it is that the value of

the crop produced may be insufficient to cover costs. These risks further highlight the role of ML subsidies in providing coverage against low prices and heavily subsidised CIP and STAX insurance, covering up to 90 per cent of their expected revenue, in allowing US cotton producers to continue producing cotton.

Intuitively, it is therefore clear that the price floor provided by the ML subsidy, along with heavily subsidised US revenue insurance that assures cotton producers receipt of roughly 90 per cent of expected revenue (under CIP and STAX policies), significantly affect US cotton production.

### 3. CALCULATING THE EFFECTS OF THE COTTON SUBSIDIES UNDER THE 2014 FARM BILL

#### 3.1 Model Intuition and Summary

We develop an economic model that addresses the magnitude of the impact that certain US cotton subsidies under the 2014 Farm Bill have on quantities supplied and exported by US cotton farmers and, thus on the world market prices for cotton and ultimately on cotton-producing sectors worldwide. Specifically, the model quantifies the effect on world market prices and quantities if US subsidies under the ML, CIP, and STAX had been announced to be withdrawn in time before the planting decision.<sup>78</sup>

In quantifying the economic effects in the world cotton market, we rely on a simulation model developed by the authors. The model is a partial-equilibrium log-linear displacement model that calculates percentage changes from an initial baseline equilibrium in which all US cotton subsidies are in place.<sup>79</sup> The basic set-up of the model is similar to the so-called Sumner model that Brazil submitted in the *US - Upland Cotton* dispute.<sup>80</sup> The Sumner model was largely accepted by the arbitrator in the same case, when charged with calculating the trade damage suffered by Brazil.<sup>81</sup>

Our model considers two regions, the US and the rest of the world (RoW). The world market for cotton is assumed to be in initial equilibrium, at which the world market price for cotton clears the world market for that commodity.<sup>82</sup> We then apply a standard counterfactual exercise in which we assess how much lower US production and exports, and, consequently, how much higher world market prices for cotton, would be following a permanent and complete withdrawal of US ML, CIP, and STAX subsidies for cotton.<sup>83</sup>

Technically, a one-time fully anticipated policy shock of permanently removing the subsidies at issue is introduced, and the system moves to a new equilibrium with new world market prices and new supply and demand quantities.

This informs us about the percentage change in world market prices, cotton production and exports in the US and in the RoW, relative to actual market data, that would result from the permanent withdrawal of the US cotton subsidies at issue. From this, we derive the revenue loss sustained by producers worldwide through the impact of suppressed world market prices on actual production (price effects), as well as on production that would have occurred in the absence of cotton ML, CIP, and STAX subsidies (volume effects).

A central feature of our model is the development of a proper benchmark scenario. To that end, we project the subsidies that farmers would reasonably expect to receive from the various cotton programmes under the 2014 Farm Bill at a number of realistic futures market price scenarios. We then simulate how production decisions by US cotton producers would differ as a result of an elimination of expected subsidy revenues, i.e., based on only expected market revenues.<sup>84</sup> Since price and yield information at harvest time are unknown to producers at the time of planting, we make reasonable assumptions about cotton producers' expectations of distributions of prices, yields, and, consequently, revenues at the time of harvesting (including, importantly, revenues from subsidy disbursements).<sup>85</sup>

The parameters of the model are calibrated with reference to available market data, policy information from the US Government, and empirical evidence from relevant academic literature. Instead of relying on a speculative price path that cotton will follow over the period 2014-2018 (the envisaged lifetime of the 2014 Farm Bill), we present our simulation results for a wide range of plausible price configurations based on long-run historical and projected prices of cotton.

We note that ours is not the first attempt to quantify the harmful impact of US agricultural subsidies on producers worldwide.<sup>86</sup> The



literature on the implications for developing countries of potential agricultural policy reform is large and varied. A key resource is the set of analyses assembled by the World Bank on a host of important issues that arise in the WTO context.<sup>87</sup> The authors in that edited volume deal with issues of tariff cuts, nontariff barriers, export subsidies, and domestic support. Modelling tools range from careful descriptions of policies to computable general equilibrium (CGE) modelling. Dynamic implications for the development process are often left out of these studies, which means they tend to underestimate gains to openness in terms of developing institutions conducive to economic growth.

On the specific issue of cotton, precursors to the current work look at earlier variants of US policy,<sup>88</sup> and include detailed evaluation of impacts of US subsidies on West Africa and an overview of implications for major developing country exporters of cotton.<sup>89</sup> Baffes (2011) usefully reviews cotton policy, especially in the context of African institutions.<sup>90</sup> Jales (2010) considered the potential effects of a WTO deal on cotton subsidies on importing and exporting countries.<sup>91</sup> De Gorter (2012) has examined cotton policy in the US in the context of the WTO *US - Upland Cotton* dispute.<sup>92</sup> Zulauf and Orden (2012) consider risk-based programmes, while Babcock and Paulson (2012) discuss commodity programmes.<sup>93</sup> Smith (2014) assesses trade policies proposed for the 2014 US Farm Bill and discusses implications for trade policy and development.<sup>94</sup> All of this work was done prior to the passage and implementation of the new 2014 Farm Bill.

Below, we introduce the general set-up of our model (Section 4.2), explain our approach to constructing the benchmark scenario by calculating expected subsidy disbursements to US farmers (Section 4.3), and provide the model solution in the counterfactual (Section 4.4). We then explain how we calibrate the model using the most reliable data and model parameters available (Section 4.5). Readers who are not interested in the technical details of the model are referred to the final subsection, Section 4.6,

which discusses the results from our simulation exercise.

### 3.2 Model Set-up

We derive the key equations using a partial equilibrium displacement approach that is widely used for the economic analysis of tax, subsidy, and trade policies, including agricultural subsidies.<sup>95</sup> Accounting for the supply and demand conditions in the markets of interest, the model allows analysts to easily quantify the impacts of policies on market outcomes.<sup>96</sup> Key equations are specified in logarithmic differential form.<sup>97</sup> They represent the structural equations of supply and demand for the commodity cotton in the US (subscript  $u$ ) and in the RoW (subscript  $r$ ). In particular, the four equations, (1a)-(1d) capture the global cotton supply and cotton demand conditions, and equation (1e) is the market clearing condition for the world cotton market.<sup>98</sup> Specifically, we have:

$$(1a) \quad d\ln S_u = \varepsilon_u * d\ln R_u,$$

$$(1b) \quad d\ln D_u = \eta_u \cdot d\ln P,$$

$$(1c) \quad d\ln S_r = \varepsilon_r * d\ln P,$$

$$(1d) \quad d\ln D_r = \eta_r \cdot d\ln P,$$

$$(1e) \quad S_u + S_r = D_u + D_r,$$

where the term  $d\ln S_i$  stands for the percentage (or proportional) change in the quantity supplied in region  $i \in [u; r]$ ;  $d\ln D_i$  stands for the percentage change in the quantity demanded in region  $i \in [u; r]$ ; and  $d\ln P$  represents the percentage change in the world market price for cotton. The variable  $R_u$  represents the effective per-unit revenue received by producers in the US, a term that notably includes the US subsidies at issue. The parameters  $\varepsilon_i$  are the per-unit revenue elasticities of supply in the US and the RoW, respectively. The parameters  $\eta_i$  are the price elasticities of demand for cotton in the US and the RoW.

Equations (1a) and (1c) make clear that the incentives faced by US cotton producers and US cotton users are not purely dependent on

market price signals, but also fundamentally determined by the level of US cotton subsidies described above. On the supply side, the variable  $R_u$  equals market price per unit,  $P$ , plus effective per-unit revenue received from government subsidies, denoted by  $G$ . For US producers, effective revenue per unit can therefore be written as:

$$(2) R_u = P + G .$$

The variable  $G$  thereby is not simply the per-unit revenue from government subsidies to US cotton farmers; rather, it also reflects the degree to which these subsidies (i) provide an incentive for production relative to the incentive created by market prices, and (ii) reduce the risks faced by the participants and financial service firms that provide production financing. This is captured in the concept of the coupling factor,  $\gamma$ , and the risk mitigation multiplier,  $\rho$ .

The concepts of production incentive relative to market revenue and risk mitigation are introduced into the model by defining:

$$(3) G = \gamma * \rho * g ,$$

where  $g$  is the per-unit government support from all subsidies,  $\gamma$  is the overall coupling factor, the weighted average of all production incentives yielded by all subsidies, and  $\rho$  is the overall risk mitigation factor (explained in detail below). Thus, the variable  $G$  measures subsidies in market-price equivalent terms.

Some revenue from government subsidies is not fully linked to production and, hence, might not provide as strong an incentive to produce more cotton as does revenue from the market. In other cases, per-unit revenue from government subsidies can have as strong a production effect as market revenue.<sup>99</sup> The notion of different production incentives of different subsidies is represented by a policy parameter  $\gamma \in [0; 1]$  - the overall coupling factor. This parameter measures the extent to which the payment from a specific programme provides additional incentives for the programme participants to expand current production relative to an

increase in the market price, leaving aside the risk-mitigating impact of the programme, discussed next.

The risk mitigation multiplier  $\rho$  measures the degree to which a subsidy programme provides additional incentives for participants to expand production, because the payment scheme of the programme reduces the risks faced by cotton producers and financial service firms that provide operational financing. Introduction of this common-sense parameter in this way represents an innovation relative to previous applications. Note that  $\rho \geq 1$ . For example, the ML programme protects participants from risks that prices will fall below the programme-set prices, while CIP and STAX shield participants from risks that crop revenues fall below some pre-specified portion of revenues expected at the time of planting. These programmes are not just defined to supplement market revenue; they explicitly offset shortfalls in market income. With lower exposure to risks for the subsidised crop, US cotton farmers anticipate more steady flows of profits and are thus likely to produce more than would be the case otherwise. This may be due to producer risk aversion or to credit market linkages that allow for better access to credit for crops with risk protections.<sup>100</sup>

While the existence of risk mitigation is undisputed, and the literature on the potential impact of risk mitigation on production has made several important contributions, it has not yet been fully incorporated in the policy simulation literature.<sup>101</sup> Indeed, while much of the literature on demand for insurance assumes heavy subsidisation, the analysis of its impact on supply in the US is underdeveloped.<sup>102</sup>

Expressed in logarithmic algebra, Equation (3) becomes:

$$(4) d\ln G = d\ln \gamma + d\ln \rho + d\ln g$$

1. The expression  $d\ln G$  is thus the percentage change in the effective government subsidy mix (measured as a price-subsidy equivalent).<sup>103</sup>

### 3.3 Expected Subsidy Disbursements from Subsidy Programmes

With that basic set-up in mind, we can now construct the baseline scenario, or ‘actual,’ by incorporating individual subsidy programmes under the 2014 Farm Bill into the model. We start by breaking down the total expected subsidies,  $G$ , programme by programme. Equation (3) really is shorthand for:

$$(5) G = y_{ml} \cdot \rho_{ml} \cdot g_{ml} + y_{cip} \cdot \rho_{cip} \cdot g_{cip} + y_{stax} \cdot \rho_{stax} \cdot g_{stax},$$

where  $g_{ml}$ ,  $g_{cip}$ , and  $g_{stax}$  are expected per-unit payments that US cotton producers receive from the ML, CIP, and STAX programmes;  $y_{ml}$ ,  $y_{cip}$ , and  $y_{stax}$  denote the coupling factors of the three programmes; and,  $\rho_{ml}$ ,  $\rho_{cip}$ , and  $\rho_{stax}$  are the risk mitigation factors of the three programmes.

Recall that the larger the coupling factor, the more closely the programme payment is tied to current acreage and the more it therefore incentivises cotton producers to expand planting. Because the payments from all three programmes are based on the acreage at the time of planting, and hence fully tied with current production (and current prices), we consider the programme payments are entirely coupled with current production. That is, we reasonably assign  $y_{ml} = y_{cip} = y_{stax} = 1$ .<sup>104</sup>

Next, recall that the risk mitigation factor measures the risk mitigation benefits embedded in the payment scheme of a cotton programme relative to marked revenues. The risk mitigation factor is always greater than one, because all three programmes make payments, in the form of loans or indemnities, to cotton producers when downside risks materialise.<sup>105</sup> Lacking any specific information about farmer’s valuation of risk mitigation or, in fact, about their actual behaviour under the 2014 Farm Bill, we conservatively assign  $\rho_{ml} = 1.1$  as the risk mitigation factor from the pay-outs under the ML programme, because the programme shields cotton producers from risks of extremely low prices.<sup>106</sup> Equally

conservatively, we assign  $\rho_{cip} = 1.2$  as the risk mitigation factor for net indemnities under CIP, because most cotton producers elect the revenue (rather than the yield) protection products,<sup>107</sup> which protect the insured from both low-price risks and low-yield risks at the individual farm level. Similarly, we assign  $\rho_{stax} = 1.2$  as the risk mitigation factor for net indemnities under STAX, because STAX also locks in high revenue expectations.

#### 3.3.1 Marketing loan subsidies

The ML programme provides a subsidy payment when commodity prices are low. Regarding cotton, producers receive a per-pound payment whenever the AWP falls short of the loan rate. The loan rate can fluctuate between USD 0.45/lb. and USD 0.52/lb. under the 2014 Farm Bill, but given the loan rate formula and current market price projections, the loan rate is likely to stay at USD 0.52/lb. The following specification captures the incentives embedded in the ML programme. Specifically, the per-acre payment from the ML programme,  $g_{ml}$ , is given by:

$$(6) g_{ml} = \begin{cases} (l - p_a) \cdot y, & \text{if } l > p_a \\ 0 & \text{otherwise} \end{cases},$$

where  $l = \text{USD } 0.52/\text{lb}$  denotes the loan rate,  $p_a$  denotes the AWP,<sup>108</sup> and  $y$  represents the actual yield per acre. In essence, the ML programme effectively provides a price floor, shielding cotton producers in the US from low prices.<sup>109</sup>

#### 3.3.2 Crop insurance programmes

US farmers’ participation in the crop insurance programmes has increased substantially over the past decade and is now virtually ubiquitous: as of MY 2014, roughly 95 per cent of US cotton acres have been registered for crop insurance products.<sup>110</sup> The most popular buy-up policy is called Revenue Protection (RP), which does not include the Harvest Price Exclusion Option.<sup>111</sup> We use this policy to represent CIP in general.<sup>112</sup> In particular, we specify the indemnity scheme from CIP,  $I_{cip}$ , as:

$$(7a) I_{cip} = \begin{cases} (y_p^c \cdot \max\{p, p_p\} \cdot cov - y \cdot p), & \text{if } y_p^c \cdot \max\{p, p_p\} \cdot cov > y \cdot p \\ 0 & \text{otherwise} \end{cases}$$

where  $y_p$  is the projected yield for the insured cotton farmer,  $p$  is the futures price at harvest time (the calculation basis for CIP disbursements),  $p_p$  is the futures price at planting time,  $cov$  is the coverage level elected by the insured farmer, and  $y$  is the actual yield per acre at harvest time.

We assume that the insurance premiums are fully subsidised by the US Government. This is a reasonable assumption to make, if we consider the four complementary support channels through which the Government subsidises crop insurance products: first, crop insurance products are sold to cotton farmers at federally subsidised premium rates. Specifically, at a 70 per cent coverage level, the RMA subsidises 65.2 per cent of listed premiums of RP products.<sup>113</sup> Second, and in addition, the RMA reimburses the A&O costs borne by private insurance companies offering CIP, which amounts to 18.5 per cent of the listed premiums.<sup>114</sup> Third, the US Government also provides reinsurance to the insurance companies, thus further reducing their capital costs for the programme.<sup>115</sup> Fourth, the US collects and makes available to the insurance companies all data necessary for the operation of CIP and finances the development of new crop insurance policies.<sup>116</sup> The reduction of insurance company costs with subsidy and arbitrage among insurance suppliers drives down the ‘actuarially fair’ premium, which is the base for the premium summary. In sum, there is little doubt that crop insurance for cotton (and most other crops) would not exist in the absence of the US Government’s intervention. Taken together, it thus seems appropriate to assume that US Government contributions account for 100 per cent of expected disbursements, even though premium subsidies nominally fall short of 100 per cent. US cotton farmers can expect the following net subsidies from CIP:

$$(7b) g_{cip} = E\{I_{cip}\} - (1 - \pi_{cip})E\{I_{cip}\} = \pi_{cip} E\{I_{cip}\},$$

where  $E\{I_{cip}\}$  is the farmer’s expected indemnity from his CIP contract, and  $\pi_{cip} = 1$  reflects the assumption of full subsidisation of CIP.

### 3.3.3 STAX

As discussed in Section 3.2.3 above, STAX is a cotton-specific insurance product covering shortfalls, when actual revenue are between 70 per cent and 90 per cent of expected revenues.<sup>117</sup> Despite the fact that only 80 per cent of the listed premiums for STAX are officially subsidised,<sup>118</sup> we believe it is reasonable to consider that the US Government fully subsidises the programme. As with CIP,<sup>119</sup> STAX would not exist but for the interest and influence by the US Government. This is equivalent to saying that the US Government covers 100 per cent of expected disbursements with its provision of STAX.<sup>120</sup>

Relying on the same logic as spelled out in equations (7a and 7b), we specify the indemnity scheme of STAX,  $I_{stax}$ , and capture the net subsidy from STAX,  $g_{stax}$ .

$$(8a) I_{stax} = \begin{cases} (y_p^c \cdot \max\{p, p_p\} \cdot (90\% - cov) \cdot 120\% - y \cdot p), & \text{if } y_p^c \cdot \max\{p, p_p\} \cdot 90\% > y \cdot p \\ 0 & \text{otherwise} \end{cases}$$

$$(8b) g_{stax} = E\{I_{stax}\} - (1 - \pi_{stax})E\{I_{stax}\} = \pi_{stax} E\{I_{stax}\},$$

where  $E\{I_{stax}\}$  is the farmer’s expected indemnity from his STAX contract, and  $y_p^c$  and  $y^c$  are the projected and actual yields at the county level, respectively. As above,  $p$  is the futures market price at harvest time (the basis for STAX disbursements),  $p_p$  and is the futures market price at planting time.<sup>121</sup> The factor 90 per cent is the guarantee level of STAX,  $cov$  denotes the coverage level selected by the insured farmer for his or her individual CIP policy, 120 per cent is the multiplier option in STAX,<sup>122</sup> and  $\pi_{stax} = 1$  reflects the notion that farmer premiums are fully subsidised in STAX.

The CIP and STAX interact through the coverage level ( $cov$ ) elected by the insured cotton farmer.<sup>123</sup> With a higher CIP coverage level, the insured farmer can expect higher payments from CIP, but less from STAX. The optimal coverage for each cotton producer thereby depends on the correlation between her individual yield and the county-level yield, which is private information. Lacking this information, and



for simplicity, we reasonably assume that the coverage level selected by an average cotton producer in CIP is 70 per cent, which leaves 20 per cent shallow-loss coverage by STAX.<sup>124</sup> This assumption understates effects, because farmers may adjust their CIP coverage levels upward if their correlation with the county yield is low, allowing them to maximise the joint payoff in a way that increased the production incentives created by both subsidies.

### 3.4 Model Solution in the Counterfactual Scenario

As discussed, we consider a counterfactual scenario in which all US cotton programmes are expected to be and are eliminated permanently, and income from subsidy shrinks to zero. As per equations (1a) and (2), the removal of all US cotton programmes ( $d\ln R_u < 0$ ) would reduce the incentives for US farmers to plant cotton. As a result, we expect fewer cotton acres in the US, a lower US production and cotton export volume, a higher world price of cotton, and increased quantity supplied by the RoW to satisfy worldwide quantity demanded. This intuition is derived within our framework by the model solutions, as presented below.

Logarithmic manipulation of the supply equation (2) yields:

$$(9) \quad d\ln R_u = 1/(1+B)*d\ln P + B/(1+B)*d\ln G ,$$

where  $B = G/P$  is the ratio of subsidy revenue as a function of market revenue.

Total differentiation with respect to equation (1e) yields an expression for the change in world cotton production after a policy shock:

$$(10) \quad \phi_u d\ln S_u + \phi_r d\ln S_r = \varphi_u d\ln D_u + \varphi_r d\ln D_r ,$$

where  $\phi_u$  denotes the share of US cotton production in the world total, and  $\phi_r = 1 - \phi_u$  is the RoW-share in cotton production. Equally,  $\phi_u$  denotes the share of US usage of cotton in the world total and is the RoW-share of cotton usage.

The counterfactual scenario - removal of all US cotton subsidies at issue - corresponds to the following exogenous shock:

$$(11) \quad d\ln G = -100\% ,$$

which means that all subsidies,  $g_{ml}$ ,  $g_{cip}$ , and  $g_{stax}$  are permanently removed.

Solving equation (10) for  $d\ln P$  yields:

$$(12) \quad d\ln P = (\phi_u \varepsilon_u (1-B)) / (\phi_u \varepsilon_u B + \phi_r \varepsilon_r - \varphi_u \eta_u - \varphi_r \eta_r) ,$$

where  $B = 1/(1+B)$ . Since  $B$  is positive and  $B$  is positive, but strictly smaller than 1, the right side of equation (12) is unambiguously positive: the withdrawal of the producer subsidies pushes the equilibrium price up. Therefore, in the counterfactual scenario in which all US cotton programmes are removed, the market price of cotton increases.

A removal of subsidies will also affect US production. This can be seen by integrating equations (9) and (11) into equation (1a):

$$(13) \quad d\ln S_u - \varepsilon_u (B*d\ln P - (1-B)) .$$

Replacing the expression for  $d\ln P$  in equation (12) yields:

$$d\ln S_u = \phi_u \varepsilon_u (1-B) ((-\phi_r \varepsilon_r + \varphi_u \eta_u + \varphi_r \eta_r) / (\phi_u \varepsilon_u B + \phi_r \varepsilon_r - \varphi_u \eta_u - \varphi_r \eta_r)) .$$

Note that  $d\ln S_u$  takes the negative sign, since  $B$  is positive, but strictly smaller than 1 and,  $\phi_u$ ,  $\varepsilon_u$ ,  $\phi_r$ ,  $\varepsilon_r$ ,  $\varphi_u$ ,  $\varphi_r$  are positive, and  $\eta_u$  and  $\eta_r$  are negative. Intuitively, the elimination of subsidies discourages US farmers from planting cotton.

Regarding the impact of a removal of subsidies on exports we compute the difference between US production and domestic demand. Specifically, we have:

$$(14) \quad d\ln(S_u - D_u) = (S_u / ((S_u - D_u))) d\ln S_u - (D_u / ((S_u - D_u))) d\ln D_u = ((1/\omega) \varepsilon_u B + (1-1/\omega) \eta_u) d\ln P - (1/\omega) \varepsilon_u (1-B) ,$$

where  $\omega = (S_u - D_u) / S_u$  is the share of US export ( $S_u - D_u$ ) in US production ( $S_u$ ). Without going

into the mathematical details, we simply note that equation (14) is negative. Thus, the overall change in US export is negative in the counterfactual scenario in which all US cotton programmes are removed.

The world price suppression due to US subsidy programmes (equation 12) harms cotton producers worldwide. Specifically, the artificially low world prices have two distinct negative consequences for cotton farmers outside the US: ‘price effects,’ i.e., income losses on actual cotton production, owing to suppressed world market prices; and ‘volume effects,’ i.e., cotton production foregone by otherwise competitive farmers in the RoW, owing to suppressed world market prices. We can thus express the revenue loss suffered by the global producers as:

$$(15) \text{ Damage} = d\ln P \cdot P \cdot S_r + (1 + d\ln P) \cdot P \cdot \varepsilon_r \cdot d\ln P \cdot S_r,^{125}$$

where  $S_r$  is current RoW production of cotton,  $P$  is the actual world price (A-Index<sup>126</sup>), and  $\varepsilon_r$  represents the supply elasticity for cotton in the RoW. We derive a measurement of damage on the basis of total revenue effects to be consistent with the WTO framework, where the rules anticipate countermeasures affecting an equivalent amount of total value of trade flows. Deriving consumer and producer surplus and other economic welfare measure are less relevant in this trade policy context. For the same reason, we do not derive effects on others in the supply chain for cotton, such as textile users or suppliers of competitive raw materials, processing labour or others affected.

### 3.5 Calibration of the Model and Simulations

To implement the model, we now need two key ingredients: (i) the appropriate model parameters, and (ii) the level of expected subsidy disbursements, the removal of which constitutes the ‘policy shock’ that drives the counterfactual,<sup>127</sup> holding constant the other facts that affect the market.

#### 3.5.1 Model calibration - parameter values and data sources

The quantification of the price effect calls for the proper assignment of parameters in the economic model in light of the counterfactual analysed, involving a large, anticipated and permanent shock in US subsidy policy for one US commodity only. The parameters can be classified into three categories: (i) supply and demand elasticities  $\varepsilon_u$ ;  $\varepsilon_r$ ;  $\eta_u$ ; and  $\eta_r$ ; (ii) US production and consumption shares  $\phi_u$  and  $\phi_r$ ; and (iii) total world production  $S_r$  and world prices to determine the damage suffered by cotton producers worldwide.

With respect to supply and demand elasticities for cotton, we assign  $\varepsilon_u=0.8$  as the supply elasticity for cotton in the US. This parameter assignment is consistent with the empirical evidence in Poonyth et al. (2004), and was supported by the arbitrator in the *US - Upland Cotton* dispute in light of the counterfactual at issue.<sup>128</sup> Next, we use  $\varepsilon_r=0.2$  as the supply elasticity for cotton in the RoW, which was the value used by the arbitrator in *US - Upland Cotton*.<sup>129</sup> The magnitude aligns with the finding in Shepherd (2006) that the world elasticity of supply for cotton is 0.18. Finally, we assign  $\eta_u=\eta_r=-0.2$ , that is, the demand elasticity for cotton is -0.2 in the US and the rest of the world. These are again the values selected by the arbitrator in *US - Upland Cotton*.<sup>130</sup>

For US production and consumption shares, we use the production and consumption data projected in the USDA’s Cotton and Wool Outlook for the MY 2014-2015.<sup>131</sup> Based on the Outlook, US cotton production and milling use account for 13 per cent and 3 per cent of the world total respectively. US imports of cotton were negligible during the same marketing year.<sup>132</sup>

With respect to world production and prices, we use the world production and consumption data projected in the USDA’s Cotton and Wool

Outlook for MY 2014-2015.<sup>133</sup> Cotton world price data (A-Index) is available from the NCC.<sup>134</sup>

For price scenarios other than the base scenario of USD 0.70, we adjust quantities supplied by the US and the rest of the world using the supply elasticities discussed above. That is, we have taken into account that, in the scenarios with higher prices, quantities supplied in both the US and the RoW will be higher. Equally, our analysis takes into account that, in the scenarios with lower prices, quantities supplied in both the US and the RoW will be lower.

### *3.5.2 The simulation procedure to determine expected subsidy disbursements*

The model parameter  $\beta$ , the ratio of government subsidies tied to current production over market revenues, is the central element driving the model. As shown in equations (2), (9), and (13), parameter  $\beta$  determines the size of  $d\ln R_u$  (the change in effective revenue per unit received by US cotton farmers when expected subsidy disbursements go down to zero), and therewith of  $d\ln S_u$ , that is the change in US cotton production as a response to a permanent removal of the cotton-related subsidies.

At the time of planting, no cotton farmer can know exactly the level of subsidies or farm-gate prices - the farm manager must make reasonable assumptions. As will be discussed in detail below, we assume that all stakeholders in the cotton market (including cotton farmers and insurance lenders) use the prices of futures contracts at the planting time to forecast the harvest prices.<sup>135</sup> Moreover, cotton producers realistically use the production history of their own fields and of their counties to project actual yields at harvest time.

By the same token, 'actual' future prices and harvests are currently unknown in the context of our simulations. We use a simple simulation procedure to determine future yields and prices, and thereby the subsidy disbursement projections, and ultimately the planting decisions by US cotton growers.

With respect to price levels and variability, US cotton producers make their planting decisions not based on actual market price and subsidy disbursement levels, but on expected prices and disbursements. Subsidy disbursements and prices are joined at the hip, because cotton prices partially determine the level of subsidy disbursements (see equations (6) - (8b)).

Our model projects US Government subsidies that US cotton producers expect to receive from US cotton programmes under the 2014 Farm Bill.<sup>136</sup> Because the prices and yields of cotton at harvest time are unknown to producers and users at the time of planting, we need to make realistic assumptions about how US producers form their expectations about harvest prices and actual yields, because these expectations will drive farmers' decision-making at the time of planting.

Instead of picking one arbitrary long-term price projection for the cotton market, we consider ten plausible expected price levels in the long run.<sup>137</sup> Each price level is defined by February prices of December cotton futures traded at the New York Cotton Exchange. In particular, the ten projected prices range from USD 0.40/lb. to USD 1.30/lb. in 10 cent increments.<sup>138</sup> The comparison of simulated effects across ten price levels allows us to draw policy implications for high-price and low-price scenarios.

The futures market price at harvest time deviates from the futures market price at planting time as the crop year unfolds. We assume that the harvest-time price follows a log-normal distribution with the mean at the projected price at planting,<sup>139</sup> and the standard deviation calibrated to prices of futures as recorded over the past decade.<sup>140, 141</sup>

With respect to yield levels and variability, cotton farmers make planting decisions based not only on price projections that they cannot influence, but also on expected yields from their own fields. Because farm-level yield data are unavailable on a national scale, we use the county-level yield data to approximate

the yields at individual farms. This is the best available information and since farm-level and county-level yields are typically highly correlated. Specifically, we take the realistic assumption that, for an average farm, the projected yield coincides with the projected yield in the residing county. In fact individual farm yields are more variable than county yields even if highly correlated. We know, for example, that crop insurance indemnities are often large in counties even where the county average yield would trigger little or no payment. We describe the scaling factor to convert from county yield to farm yield below.

We further assume that farmers expect yields to be based on the Olympic average (with maximum and minimum observations dropped) of yields over the past five years.<sup>142</sup> We use county-specific yield data from the National Agricultural Statistics Service of the USDA over the period 1995-2014.<sup>143</sup>

Expected and harvested yields are seldom the same. Cotton yield is notoriously volatile. We begin with the variability of actual county-level yield, which is the basis of payments for STAX. For each US county with cotton production history, we first compute the difference between the actual yield and the yield projected by a linear-trend model, and then calculate the standard deviation of the residual series.<sup>144</sup> We assume that the actual county-level yield follows a log-normal distribution with the mean at the projected county yield and the standard deviation as calculated above.<sup>145</sup>

In contrast to STAX, CIP disbursements are calculated based on farm-level yield. Since yield variability of an average farm is typically higher than county-level yield variability and

yields are hence more variable at individual farms than in the entire county, we assume that the standard deviation of farm-level yield is 20 per cent higher than the standard deviation of the yield in the respective county.<sup>146</sup> As we do for STAX and the county-level yield, we assume the actual yield at the farm level follows a log-normal distribution with the mean at the projected county-level yield and the standard deviation as above mentioned.<sup>147</sup>

As for simulating farmers' revenue expectations, based on realistic assumptions of price and yields, as well as variability at the time of harvest, we can now quantify the level of expected subsidy disbursements, and thus the ratios of government subsidies over production incentives, or  $\beta$ , at each price level.

To that end, we randomly draw 100 harvest prices from the log-normal price distribution and 100 county-level yields from the respective log-normal yield distributions, yielding 10,000 unique price/yield combinations defining that year's cotton harvest.<sup>148</sup> In each scenario, we evaluate subsidy disbursements from all US cotton programmes at issue, as characterised by equations (6)-(8). At the time of planting, the anticipated subsidy level from each cotton programme is the average subsidy across all 10,000 scenarios. The overall anticipated subsidies and the average market revenues<sup>149</sup> from these 10,000 draws allow us to specify the key parameter  $\beta$  that is crucial to quantify the price suppression effect (see equation (12)).

### 3.6 Results and Discussion

We present the anticipated annual subsidies by programme for all price levels in Table 1 and Figure 4.

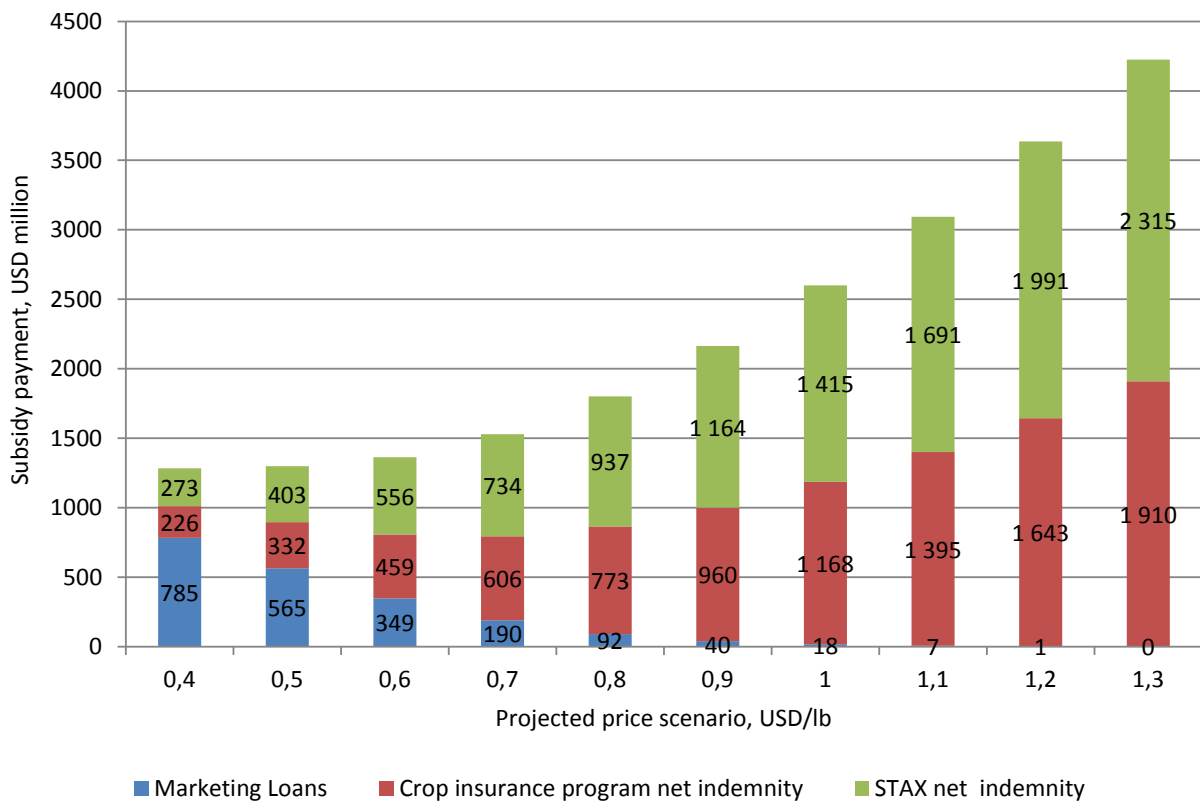


Table 1. Expected annual subsidies from US cotton programmes

Price scenario	Projected price, USD/lb.	ML payment, USD million	CIP net indemnity, USD million	STAX net indemnity, USD million	Total subsidies, USD million
1	0.40	785 (863)	226 (271)	273 (328)	1,283 (1,462)
2	0.50	565 (622)	332 (399)	403 (483)	1,300 (1,504)
3	0.60	349 (384)	459 (551)	556 (668)	1,364 (1,602)
4	0.70	190 (209)	606 (727)	734 (881)	1,531 (1,818)
5	0.80	92 (102)	773 (928)	937 (1,124)	1,802 (2,154)
6	0.90	40 (45)	960 (1,152)	1,164 (1,397)	2,165 (2,593)
7	1.00	18 (20)	1,168 (1,401)	1,415 (1,698)	2,601 (3,119)
8	1.10	7 (8)	1,395 (1,674)	1,691 (2,029)	3,093 (3,711)
9	1.20	1 (1)	1,643 (1,971)	1,991 (2,389)	3,634 (4,361)
10	1.30	0 (0)	1,910 (2,292)	2,315 (2,778)	4,226 (5,071)

Note: Net indemnities for CIP and STAX are calculated as expected indemnity net of premiums paid by the insured farmers. The figures in parentheses represent the risk-adjusted value of the expected subsidy disbursements, using the risk mitigation multiplier,  $p$  (see Section 4.685, below).

Figure 4. Expected annual subsidies from US cotton programmes

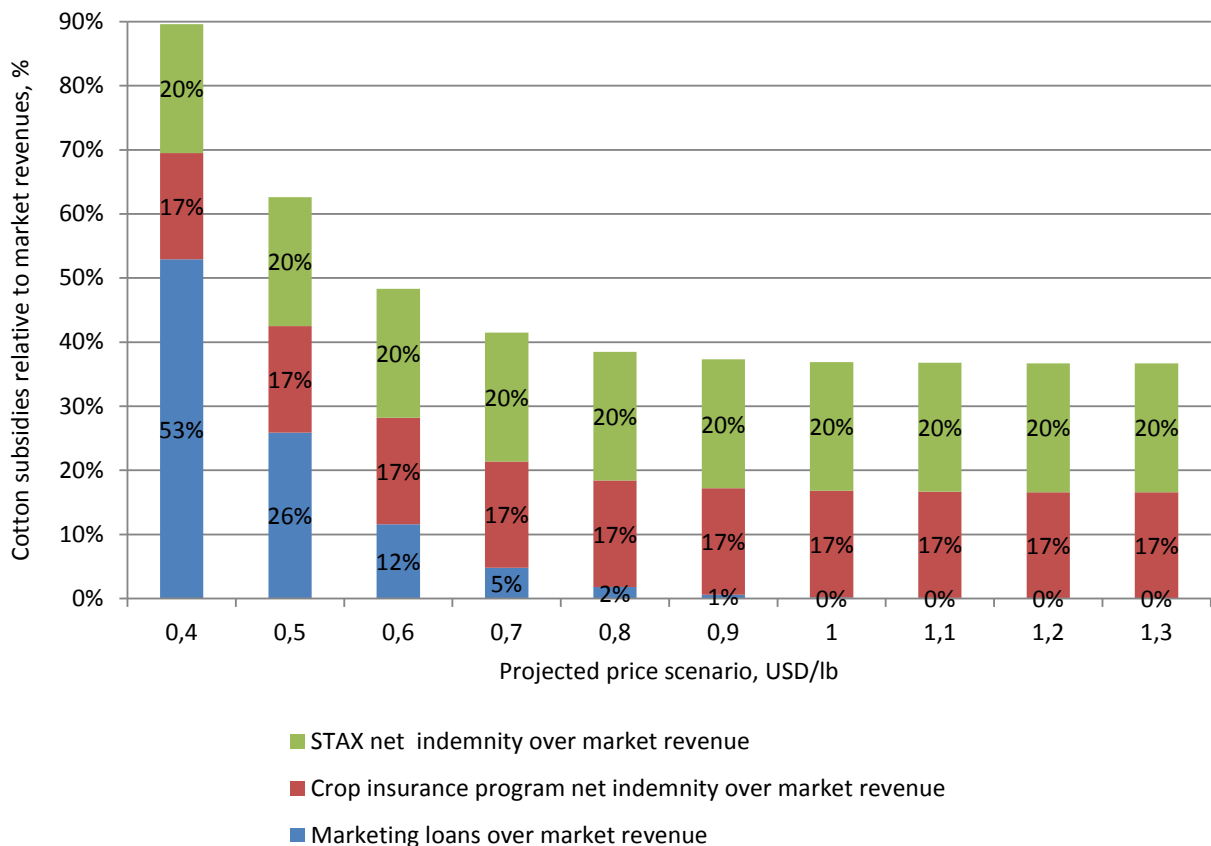


Tables 1 and 2 suggest that the ML programme triggers considerable subsidy disbursements for US cotton producers when the expected cotton futures price approaches or falls below the targeted loan rate of USD 0.52/lb. The net indemnity from CIP increases with the expected price level, because higher expected prices at the time of planting help cotton producers lock in higher guaranteed revenues through CIP. In addition, at higher expected price levels, US cotton acreage will be larger, so the area covered by crop insurance increases, causing higher subsidy disbursements. For the same reasons, the net indemnity payments from STAX also increase with the expected cotton prices. Note that the net indemnity payments from STAX are higher than for CIP at any given price level, because STAX premiums are more generously subsidised and because STAX is triggered more often, at a revenue shortfall of 10 per cent, whereas CIP requires a revenue shortfall of 30 per cent.

Take the scenario featuring a projected futures price of USD 0.70/lb.: there, the payment expected from the ML programme is estimated at USD 190 million annually. These expected payments result from the possibility that realised prices may well be low enough for ML subsidies to be paid at certain price/yield combinations. The expected net indemnity payments triggered by CIP and STAX are USD 606 million and USD 734 million a year, respectively.<sup>150</sup> Taken altogether, US cotton farmers expect to receive in excess of USD 1.5 billion a year.

To put the degree of the production incentive of the cotton subsidies into perspective, Figure 5 and Table 2.4 report the ratios of the value of the risk-adjusted expected cotton programme payments to expected market revenues. We also present the ratios of all subsidies over the market revenues. These ratios shed light on the extent to which US cotton programmes alter the production incentives in the US.

Figure 5. Cotton subsidies relative to market revenues



Note: Total subsidies sum up payments from the ML, CIP, and STAX, each weighted by the respective coupling factor and risk mitigation factor as defined in equation (5).

As Figure 5 shows, ML payments significantly enhance the US production incentives when the cotton price is low. Both CIP and STAX contribute considerably to the overall incentives of growing cotton in the US, irrespective of the actual price level. With the price of cotton futures at USD 0.70/lb., the anticipated payments from the ML, CIP, and STAX are 4.8 per cent, 16.6 per cent, and 20.1 per cent of the expected market values of US cotton production, respectively, yielding a total ratio of 41.5 per cent of subsidies to market revenue. The level of support of the US cotton programmes at issue becomes even

more pronounced as expected farm prices for cotton are extremely low. At a - not unrealistically low - price of USD 0.40/lb., the ratio of subsidies to market revenue is 89.6 per cent. At higher expected prices, of USD 0.80/lb. or higher, the subsidy ratio is still at over 35 per cent of market revenue.

Tables 2 and 3 report the excessive US production and export caused by the US cotton programmes, according to equations (13 and 14). Specifically, we present the subsidy-maintained cotton acreage in the Table 2 and subsidy-maintained cotton export in Table 3.

Table 2. US cotton acreage absent the subsidies

Price scenario	Projected price, USD/lb	Absent the US subsidies	
		Acreage reduced by	Acreage reduced by
1	0.40	32.9%	3.6 million acres
2	0.50	26.2%	2.8 million acres
3	0.60	21.9%	2.4 million acres
4	0.70	19.5%	2.1 million acres
5	0.80	18.5%	2.0 million acres
6	0.90	18.0%	2.0 million acres
7	1.00	17.9%	1.9 million acres
8	1.10	17.8%	1.9 million acres
9	1.20	17.8%	1.9 million acres
10	1.30	17.8%	1.9 million acres

Note: the percentage change in acreage is calculated according to equation (13); the absolute acres are calculated with the percentages and the projected US planted acreage of upland cotton in MY 2014/15, or 10.8 million acres

Table 3. US exports of cotton absent the subsidies

Price scenario	Projected price, USD/lb	Absent the US subsidies	
		Export reduced by	Export reduced by <sup>151</sup>
1	0.40	49.1%	5.0 million bales
2	0.50	39.1%	4.0 million bales
3	0.60	32.6%	3.3 million bales
4	0.70	29.1%	3.0 million bales
5	0.80	27.5%	2.8 million bales
6	0.90	26.9%	2.7 million bales
7	1.00	26.7%	2.7 million bales
8	1.10	26.6%	2.7 million bales
9	1.20	26.5%	2.7 million bales
10	1.30	26.5%	2.7 million bales

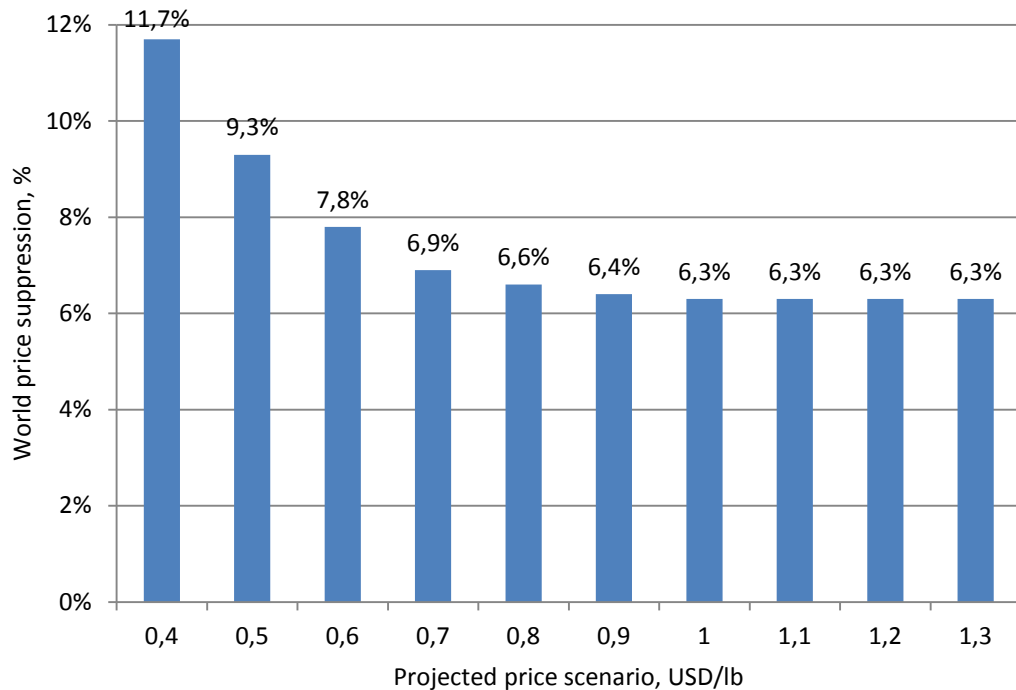
Note: the percentage changes in US export is calculated according to equation (14); the absolute volume is calculated with the percentage, and the projected US net export of upland cotton in MY 2014/15, or 10.2 million bales.

Table 2 shows the degree to which US cotton programmes induce US farmers to dedicate agricultural land to cotton production. In particular, with the price of cotton futures at USD 0.70/lb., the anticipated subsidies from the programmes are responsible for 2.1 million acres, or 19.5 per cent, of acreage planted to cotton by US farmers. Table 3 shows that US cotton programmes lead to excessive exports of US cotton to the RoW. With the cotton price at USD 0.70/lb., the US cotton programmes contribute 29 per cent of total exports of US cotton, or 3 million bales a year.

Tables 2 and 3 also reveal the perverse incentives that US cotton subsidies provide to US farmers in times of relatively high prices: even when prices are high, at or around USD 1.30/lb., US cotton subsidies result in 1.9 million acres of cotton land, and exports of 2.7 million bales, that would not exist, but for the US subsidies.

Figure 6 demonstrates the changes in the world price of cotton under the counterfactual scenario in which all US programmes are eliminated. The simulated results represent the price-suppressing effect that the cotton programmes under the 2014 Farm Bill have on the world cotton market today.

Figure 6. World price suppression caused by US cotton subsidies

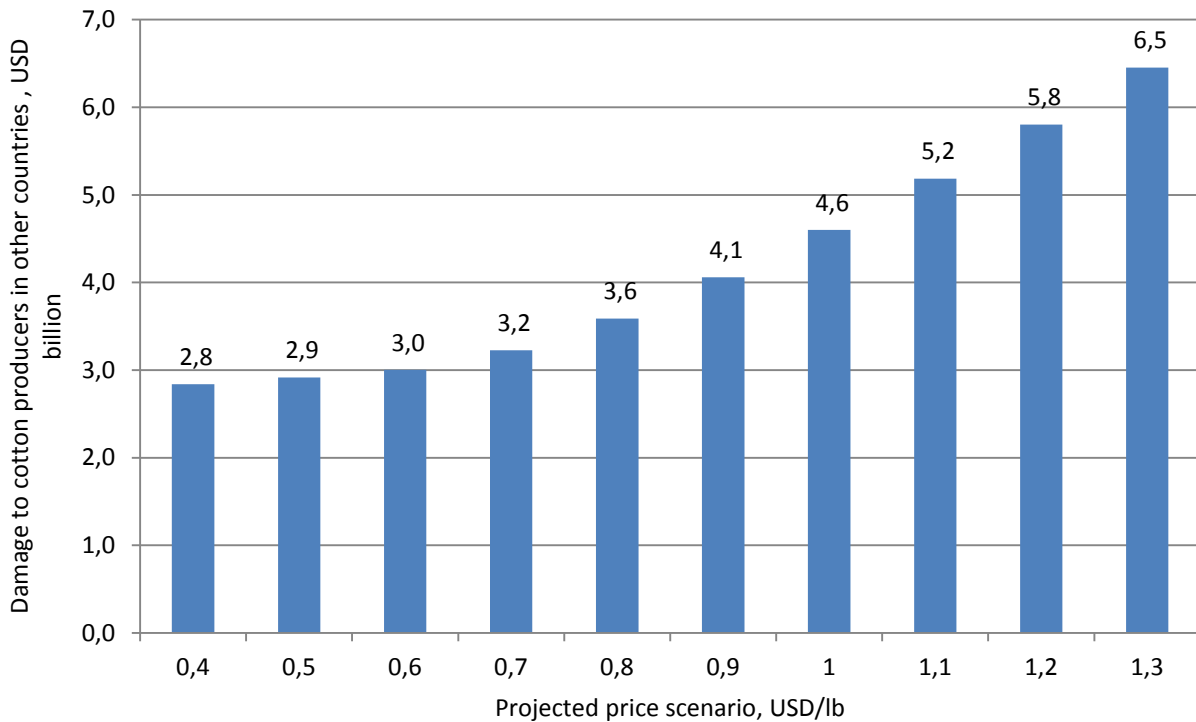


Note: The price-suppressing effects are calculated according to equation (12).

Figure 6 suggests that the US cotton programmes suppress the world price of cotton more when the cotton price is low. At a price of cotton futures at USD 0.70/lb., the world price would be 6.9 per cent higher without US cotton programmes; at an expected price at USD 0.40, the price suppression is a full 11.7 per cent.

Table 4, finally calculates the benefit to cotton producers outside the US from a permanent removal of US cotton programmes, or, in other words, the current annual damage suffered by non-US cotton farmers around the world.

Table 7. Damage to RoW cotton producers from US subsidies



Note: the percentage change in acreage is calculated according to equation (15)

These figures demonstrate the degree of trade damage caused by the US subsidies on the world market for cotton. At futures market prices of USD 0.70/lb., non-US cotton producers lose nearly USD 3.3 billion in cotton-related

revenues per year. At low prices of USD 0.40/lb., these losses are about USD 2.8 billion, and at high prices of around USD 1.30/lb., non-US cotton producers lose USD 6.5 billion in revenues.

#### 4. IMPLICATIONS OF OUR FINDINGS FOR TRADE DISPUTES AND TRADE NEGOTIATIONS, AS WELL AS DOMESTIC POLICY ANALYSIS

The results of our simulation have a number of important policy implications. They raise the possibility that one or several cotton-producing countries adversely affected by the US cotton subsidies under the 2014 Farm Bill could successfully challenge their trade-distorting effects at the World Trade Organization, following the precedent of Brazil in *US - Upland Cotton* (Section 5.1). Our finding that the majority of the trade-distorting effects results from insurance-based subsidies also suggests the urgent need to reconsider important elements of the existing negotiating framework on domestic support in the context of the Doha Development Round. To ensure that any results of the negotiations provide meaningful disciplines on trade-distorting domestic support measures actually granted today - rather than the measures of the past that dominated negotiations in 2008, leading to the most recent negotiating text - this result ought to be considered (Section 5.2). To that end, we identify a number of changes that could make US cotton subsidies significantly less trade distorting (Section 5.3).

##### 4.1 Potential WTO Challenge of the Trade Effects of US Cotton Subsidies

As demonstrated by Brazil's successful challenge of US cotton subsidies in the *US - Upland Cotton* dispute, the WTO SCM Agreement is the primary vehicle for challenging any market distortions resulting from agricultural subsidies, such as those granted by the US to its cotton producers.

The results of our model reveal the significant trade-distorting effects of the US cotton subsidies. Where a Member provides to its producers subsidies that are large and have a positive impact on production and exports, and where the subsidising Member accounts for a significant share of world production and exports of the product in question, that Member may expect to face claims in WTO dispute settlement under the SCM Agreement. Indeed, as previously mentioned, in an effort to avoid a further SCM

Agreement challenge by Brazil of the US cotton subsidies under the 2014 Farm Bill, the US agreed to pay a further USD 300 million as compensation for the damage likely caused by US cotton subsidies to the Brazilian cotton sector.

Yet, Brazilian cotton farmers are far from the only market participants harmed by the market distortions caused by US cotton subsidies. As reported in Table 4, above, the worldwide damages range from USD 2.8 billion to USD 6.4 billion, depending on the price scenario. The shares of the trade damage incurred by individual countries are likely roughly proportional to their shares in world cotton production. For example, in MY 2013, China, India, and Uzbekistan accounted for 26 per cent, 25 per cent, and 3 per cent of world cotton production, respectively. Benin and Chad, which participated as third parties in the original proceedings in *US - Upland Cotton*, account for 0.5 per cent and 0.1 per cent, while their Cotton-4 partners Burkina Faso and Mali account for 1 per cent and 0.8 per cent of world cotton production, respectively.<sup>152</sup> In monetary terms, the largest cotton producing countries would naturally be the ones with the largest trade damage. However, given the much larger relative importance of cotton to the economies of the Cotton-4, they would appear to be hit hardest in terms of the share of the damage in their gross domestic product.

We recall that Article 5 of the SCM Agreement provides that “[n]o Member should cause, through the use of subsidies ..., adverse effects to the interests of other Members, i.e.: (c) serious prejudice to the interests of another Member”. The SCM Agreement further defines serious prejudice as arising where one or several market distortions enumerated in Article 6.3 exists, including where subsidies (i) cause significant price suppression in a particular market (Article 6.3(c)) or (ii) cause the complaining Member's exports of a competing products to be displaced or impeded in a third country market (Article 6.3(b)).

While each WTO dispute has its own challenges and complications, including those on matters already litigated, bringing a WTO case in which several different subsidies are challenged has become easier since the original WTO Panel proceedings in *US - Upland Cotton*. While the panel in that dispute felt entitled to decline including DP subsidies and largely yield-based crop insurance in its serious prejudice findings, WTO case law since has emphasized that a panel must assess the effects of all challenged subsidies collectively, and that only subsidies that make no contribution to the serious prejudice may be omitted from a verdict of WTO inconsistency.<sup>153</sup> Any WTO panel reviewing a new subsidy challenge will, therefore, now have to consider the combined effects of all of the challenged subsidies, including those with a large impact on production, exports, and prices, as well as those that may only contribute small effects.

In line with recent findings by the WTO Appellate Body, our model thus quantifies the collective effects of all of the subsidies under the 2014 Farm Bill that US cotton production benefits from. Our analysis has also taken into account the specifics of today's context, most notably the current 2014 Farm Bill subsidies and the US share of world cotton production and exports. In terms of the quantum of price effects, our results are in line with those determined by the WTO arbitrator in *US - Upland Cotton*, which found that US MLs and CCPs under the 2002 Farm Bill caused price-suppressing effects of between 5 per cent and 9 per cent, depending on the year and price levels at issue.<sup>154</sup> This compares with our finding of price effects amounting to between 6.3 per cent and 11.7 per cent, suggesting that our results could establish the basis for a successful claim that the US cotton subsidies continue to cause significant price suppression in the world market for cotton, within the meaning of Articles 5(c) and 6.3(c) of the SCM Agreement.

Moreover, we identify export-enhancing effects of the US cotton subsidies, resulting in additional US exports of between 2.7

and 5 million bales (amounting to between 26.5 per cent and nearly 50 per cent of US exports), depending on the price scenario. For a particular cotton-exporting country, this could support an argument that its exports to a particular third country market are 'displaced or impeded,' within the meaning of Articles 5(c) and 6.3(b) of the SCM Agreement. Specifically, where a Member focuses much of its exports to a small number of export markets, in which the US also holds a significant market share, this claim could be a viable addition to a claim of suppressed prices in the world market, as pursued in *US - Upland Cotton*.

We caution, however, that any adverse effects dispute will be factually and legally complex, requiring a very good understanding of the dynamics of the market at issue and the many ways in which the subsidising Member's subsidies interact to affect the relevant market at issue. In particular, any Member challenging the effects of agricultural subsidies may wish to complement an economic model with in-depth analyses of the products and markets at issue, the effects of the subsidies in terms of their impact on subsidized producers' ability to cover short- and long-term costs of production as well as the particular business risks and challenges faced by the subsidized producers. Moreover, any complainant must ensure a close integration of its legal and economic teams to ensure that the legal arguments and their economic support are consistent and complementary, to present the best possible basis for a challenge.

#### 4.2 Implications of our Findings for the Doha Development Round Negotiations

In addition to the SCM Agreement disciplines on the use of subsidies,<sup>155</sup> the AoA imposes Member-specific limits on the use of trade-distorting domestic support and export subsidies.<sup>156</sup> These so-called reduction commitments are currently being renegotiated in the context of the Doha Development Round with a view towards tightening them. As Glauber and Westhoff point out, already under existing disciplines, there is a significant risk that US budgetary outlays will exceed the US reduction commitments for



trade-distorting amber box domestic support for agriculture,<sup>157</sup> suggesting that the current rules are of some relevance to limit trade distortions caused by US farm subsidies.

However, the current rules do not yet take into account the specific developments in US farm policy, in particular the significant policy shift toward insurance-based subsidies. Moreover, the current negotiations do not consider improving existing disciplines to take account of this policy shift. Instead, in developing the domestic support chapter of the most recent negotiating text - the 2008 Draft Modalities in Agriculture<sup>158</sup> - WTO negotiators focused their attention on putting limitations on overall trade-distorting domestic support, and the definition of a new 'blue box' to accommodate, principally, the US CCP programme.

While subsidies covered by any revised blue box may be pertinent for some crops,<sup>159</sup> the US subsidy regime for cotton and other important agricultural commodities has clearly moved away from price-contingent, target price-based programmes, such as the CCP, and toward insurance-based subsidies, such as CIP and STAX. As our analysis shows, insurance-based subsidies may have significant trade effects when provided on highly subsidized terms to cover large portions of the downside risks of farming. Notably, these trade effects accrue also in a high-price market environment. And since it is their impact on US farmers' decisions to grow cotton, based on (i) expected market revenue; (ii) expected subsidy revenue; and (iii) the revenue protection afforded by the subsidies, these effects occur irrespective of whether there are significant actual indemnity payments in a given year. The distortion results from the fact that these subsidies enable producers to grow a high-risk crop that otherwise would not be an economically viable production decision.

Current negotiations are thus behind the curve, trailing the actual regulatory developments in subsidisation. Insurance-based subsidies have received very little attention in the

Doha Development Round discussions thus far. To remain relevant, and to avoid the need for Members to address the harmful effects of insurance-based subsidies through trade disputes rather than in the multilateral negotiation forum, the Doha Development Round agricultural negotiations should, therefore, consider how to discipline further the use of such insurance-based subsidies. Indeed, as the US is pushing for major developing countries to consider undertaking further commitments on domestic support, Members may wish to seek further disciplines on the use of insurance-based subsidies.

#### **4.3 Policy Changes that Would Limit the Market-distorting Effects of the Subsidies**

We conclude by identifying a list of policy parameters that would make US cotton subsidies less trade distortive. These parameters may be used by policymakers and trade negotiators alike in assessing likely trade effects of agricultural subsidies.

In the context of insurance-based or price-contingent subsidies, the following - less than comprehensive - reforms would reduce distortions: (i) much lower premium subsidies and much lower coverage levels; (ii) limitations on the percentage of acreage or production that can be covered by the subsidized insurance or the price guarantee; (iii) insurance at the whole-farm level, rather than crop-specific level; (iv) where variable payment triggers (revenue, prices or yields) are used, they should be set at the national, state, or county level, rather than farm-specific triggers; (v) where fixed price or yield triggers are used for payments, they should be set substantially below current market price and yield expectations; and, (vi) any subsidy programme overlap that results in double compensation for the same loss should be eliminated. Significantly stronger reductions in distortions (from the same level of expenditure) would flow from a set of subsidies that is not price contingent and is not insurance based and that, per dollar of subsidy payment, provides smaller incentives to produce.

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## ENDNOTES

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- 4 We use 480 lb. bales of cotton as the unit in this paper, because the US Department of Agriculture (USDA) provides most cotton-related data on this basis, and it was used as the basis of the arguments and findings in *US - Upland Cotton*. We note that a metric ton amounts to 2,204 lb. of cotton, such that one bale translates to 0.2178 metric tons.
- 5 Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*, p. 119.
- 6 Technically, the Agricultural Act of 2014 (H.R. 2642; Public Law 113-79).
- 7 The dispute also involved US agricultural export credit guarantee programmes, which we are not discussing in this paper.
- 8 Schnepf (2014).
- 9 Alston, et al. (n.d.) available at <http://www.oxfamamerica.org/static/media/files/paying-the-price.pdf> (last visited 14 July 2015). Sumner 2005).
- 10 See [https://www.wto.org/english/news\\_e/archive\\_e/cott\\_arc\\_e.htm](https://www.wto.org/english/news_e/archive_e/cott_arc_e.htm) (last visited 14 July 2015).
- 11 See Section 4.3, above.
- 12 Until the STAX is fully implemented, a percentage of former DPs is available in the form of transition assistance payments.
- 13 Under the 2014 Farm Bill cotton is no longer eligible to the newly introduced Agricultural Risk Coverage and alternative Price Loss Coverage and Supplemental Coverage Option subsidies that are available to the other traditionally subsidized US crops, such as corn, soybeans, wheat, and rice.
- 14 On the application of economic models and tools of analysis to agricultural policy instruments, market contexts, and policy concerns, see, e.g., Sumner, et al. (2010).
- 15 In other words, our exercise quantifies the short-term effects that a (i) large, (ii) anticipated, (iii) permanent shock in (iv) one US commodity has on the world market for cotton, (v) holding all the other potential parameters constant. Point (v) implies that we assume that subsidy programmes for other crops under the 2014 Farm Bill remain in place. As the arbitrator in *US - Upland Cotton* noted, this is the proper counterfactual to examine pursuant a WTO challenge of US cotton subsidies only. See Decision of the Arbitrator, *US - Upland Cotton (Articles 22.6 and 7.10)*, para. 4.147.

As discussed in Section 2.1, above, for the purposes of this model, we do not consider the effects of the EAA on the US and world markets for cotton. This is likely to lead to an underestimation of the real effects of the US cotton subsidy regime.

- 16 See Panel Report, *US - Upland Cotton*, Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*. The model specifications presented below are slightly different than in the Sumner model, because a different set of WTO-inconsistent subsidies are at issue under the 2014 Farm Bill than were disputed in the *US - Upland Cotton* case. In addition, the Sumner model related to the world market for cotton as it existed in the marketing year 2005.
- 17 See Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*.
- 18 According to the USDA at the time of writing, the world price (A-Index; see footnote 127, below) for upland cotton was in excess of USD 0.75/lb. of cotton. See <http://usda.mannlib.cornell.edu/usda/fas/cotton-market//2010s/2015/cotton-market-05-12-2015.pdf> (last visited 14 July 2015).
- 19 We emphasize that our results are generally consistent with the Congressional Budget Office (CBO) projected expenditure of about USD 300 million per year for STAX premium subsidies at price levels similar to our base scenario of USD 0.70/lb. See <https://www.cbo.gov/sites/default/files/cbofiles/attachments/44202-2015-03-USDA.pdf> (last visited 5 August 2015). In contrast to the figure reported by the CBO - which relates to premium subsidies only - our figure for expected disbursements reflects indemnity payments based on (i) US Government premium subsidies; (ii) cotton producers' premium payments; (iii) US Government payments of administrative and overhead costs that artificially reduce premium amounts; and (iv) losses covered by the US Government. In this respect, we note that cotton crop insurance policies often have loss ratios that exceed 1, which means there will be significant US Government contributions through the reinsurance scheme, not reflected in the CBO data. See Sections 3.2.2 and 3.2.3, below.
- 20 Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*, p. 119.
- 21 See, e.g., Sumner, et al. (2010).
- 22 Under the 2002 and 2008 Farm Bills, most CIP policies covered only farm-level *yield* risks at comparatively low coverage levels. Usage of CIP subsidies has dramatically changed over time. Over the years, increases in premium subsidies and increased yield and price volatility have led US farmers to opt for revenue, rather than yield, insurance policies and to steadily increase their coverage levels. See Section 3.2.2., above.
- 23 For a brief history of Brazil's WTO challenge of US cotton subsidies, see [https://www.wto.org/english/tratop\\_e/dispu\\_e/cases\\_e/ds267\\_e.htm](https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds267_e.htm) (last visited 14 July 2015).
- 24 WTO Member Chad also participated as a third party in the subsequent compliance proceedings.
- 25 Panel Report, *US - Upland Cotton*, WT/DS267/R; Appellate Body Report, *US - Upland Cotton*, WT/DS267/AB.
- 26 WTO Panel Report, *US - Upland Cotton (Article 21.5 - Brazil)*, WT/DS267/RW.
- 27 Appellate Body Report, *US - Upland Cotton (Article 21.5 - Brazil)*, WT/DS267/AB/RW.
- 28 Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6 - US)*, WT/DS267/ARB/2. In separate proceedings, Brazil also secured additional retaliation rights relating to the US



- export credit guarantees at issue in the dispute. See Decision of the Arbitrator, *US - Upland Cotton (Article 4.11 and 22.6 - US)*, WT/DS267/ARB/1.
- 29 Memorandum of Understanding between the United States and Brazil Regarding a Fund for Technical Assistance and Capacity Building with Respect to the *Cotton Dispute* (WT/DS267) in the World Trade Organization, Section II. The document is available at <http://www.state.gov/documents/organization/143669.pdf> (last visited 14 July 2015).
- 30 See Townsend (n.d.) available at <http://www.choicesmagazine.org/choices-magazine/submitted-articles/the-2014-us-farm-bill-and-cotton-proof-that-the-wto-matters> (last visited 14 July 2015). See also Section 4.3 below.
- 31 See, e.g., *Inside U.S. Trade*, “Brazil Blasts NCC Farm Bill Proposal, Says it Could Violate WTO Rules,” February 6, 2012; *The Guardian*, (2012) available at <http://www.theguardian.com/global-development/2012/jul/19/us-cotton-subsidies-farm-bill-brazil> (last visited 14 July 2015).
- 32 WT/DS267/46, Sections I, VI, and X. Notably, this most recent payment is on top of approximately USD 450 million, paid by the US into the same Brazilian cotton fund over the period of 2010-2013 in exchange for Brazil refraining from imposing WTO-authorized retaliatory measures on the US following the 2009 WTO authorisation to retaliate over the cotton subsidies under the 2008 Farm Bill. See footnote 30, above, and accompanying text.
- 33 ML subsidy payments may take several different forms. Cotton producers that do not take out a ML for their cotton crop may apply for a loan deficiency payment in the amount of the difference between the AWP and the loan rate. Otherwise, they may opt to repay the loan taken out at the lower AWP, rather than the loan rate plus interest, or may opt to forfeit their crop as collateral to the US Government and retain the loan proceeds.
- 34 While the 2008 Farm Bill allowed US cotton producers to select alternatively a programme called the average crop revenue election program (ACRE), virtually no cotton producers made use of this option.
- 35 As noted, the 2014 Farm Bill also provides for EAA to domestic users of cotton. See Agricultural Act of 2014, section 1207(c). As currently authorized, the programme provides for subsidy payments of USD 0.03/lb. for the use of cotton, conditional on the subsidy funds being used to “to acquire, construct, install, modernize, develop, convert, or expand land, plant, buildings, equipment, facilities, or machinery.” This subsidy increases domestic demand for US cotton and ensures a stable market for a portion of US cotton production, because there are virtually no cotton imports into the US. This alleviates some of the market risks US cotton producers face. Nonetheless, as this subsidy is comparatively small, we have omitted it from our model.
- 36 Agricultural Act of 2014, sections 1201-1205.
- 37 Agricultural Act of 2014, section 1202(a)(6).
- 38 Appellate Body Report, *US - Upland Cotton*, para. 445.
- 39 USDA, Cotton and Wool Outlook, 12 June 2015, p. 10, available at <http://www.ers.usda.gov/media/1853305/cws15f.pdf> (last visited 14 July 2015).
- 40 The private insurers are under no obligation to offer coverage in all areas and for all crops selected by the USDA. As discussed below in more detail, however, in practice insurance companies have every incentive to sign as many policies as possible.

- 41 For a more detailed overview of CIP, see, for example, Shields (2013) available at <http://www.nationalaglawcenter.org/assets/crs/R40532.pdf>; Chite (2008) available at <http://www.fas.org/sgp/crs/misc/RL34207.pdf> (last visited 14 July 2015).
- 42 US Risk Management Agency: 2015 Standard Reinsurance Agreement, Section III(a)(2), available at <http://www.rma.usda.gov/pubs/ra/sraarchives/15sra.pdf> (last visited 14 July 2015).
- 43 Calculated based on information on (i) rates and (ii) insurance usage data from the US Risk Management Agency: (i) 2015 Standard Reinsurance Agreement, Section III(a)(2) , available at <http://www.rma.usda.gov/pubs/ra/sraarchives/15sra.pdf> (last visited 14 July 2015); and (ii) US Risk Management Agency: Summary of Business, Report Generator, available at <http://prodwebnlb.rma.usda.gov/apps/SummaryofBusiness/ReportGenerator> (last visited 14 July 2015).
- 44 Federal Crop Insurance Act, 7 U.S.C. 1508b(d)(1) and (e); and Iowa State University, Extension and Outreach, Current Crop Insurance Policies, available at <http://www.extension.iastate.edu/agdm/crops/html/a1-48.html> (last visited 14 July 2015). For basic catastrophic coverage (CAT), which is virtually not used by US cotton producers, the US Government even pays 100 per cent of the premium. Data on the number of acres under CAT is available from the US Risk Management Agency: Summary of Business, Report Generator, available at <http://prodwebnlb.rma.usda.gov/apps/SummaryofBusiness/ReportGenerator> (last visited 14 July 2015).
- 45 Calculated based on data available from the Management Agency: Summary of Business, Report Generator, available at <http://prodwebnlb.rma.usda.gov/apps/SummaryofBusiness/ReportGenerator> (last visited 14 July 2015). The Federal Crop Insurance Corporation is a government-owned entity that has financial responsibility for operation of CIP.
- 46 Federal Crop Insurance Act, 7 U.S.C. 1508(k); US Risk Management Agency: 2015 Standard Reinsurance Agreement, available at <http://www.rma.usda.gov/pubs/ra/sraarchives/15sra.pdf> (last visited 14 July 2015).
- 47 Federal Crop Insurance Act, 7 U.S.C. 1522.
- 48 In Section 4 below, we quantify the expected net indemnity payments to US cotton producers.
- 49 Shields (2013, p. 3) available at <http://www.nationalaglawcenter.org/assets/crs/R40532.pdf> (last visited 14 July 2015).
- 50 Glauber (2012); Smith and Glauber (2012).
- 51 Calculations based on data from US Risk Management Agency: Summary of Business, Report Generator, available at <http://prodwebnlb.rma.usda.gov/apps/SummaryofBusiness/ReportGenerator> (last visited 14 July 2015); and USDA, Cotton and Wool Outlook, 12 June 2015, p. 6, available at <http://www.ers.usda.gov/media/1853305/cws15f.pdf> (last visited 14 July 2015).
- 52 Calculations based on data from US Risk Management Agency: Summary of Business, Report Generator, available at <http://prodwebnlb.rma.usda.gov/apps/SummaryofBusiness/ReportGenerator> (last visited 14 July 2015).
- 53 US Risk Management Agency: Commodity Exchange Price Provisions (15-CEPP), 2015 and Succeeding Crop Years (Cotton (0021)), Section II, p. 1-2, available at <http://www.rma.usda.gov/policies/2015/15ceppcotton.pdf> (last visited 14 July 2015).
- 54 US Risk Management Agency: Common Crop Insurance Policy (11-BR), p. 1-2, available at <http://www.rma.usda.gov/policies/2011/11-br.pdf> (last visited 14 July 2015).

- 55 US Risk Management Agency: Policies, available at <http://www.rma.usda.gov/policies/> (last visited 14 July 2015).
- 56 US Risk Management Agency: Policies, available at <http://www.rma.usda.gov/policies/> (last visited 14 July 2015).
- 57 Until STAX is fully implemented, the 2014 Farm Bill also provides for transition assistance payments, as a percentage of DP, had these been continued. See Agricultural Act of 2014, section 1119. For the purpose of our analysis, we assume that STAX has been fully implemented.
- 58 Agricultural Act of 2014, section 11017.
- 59 De Gorter (2012) provided an initial assessment of STAX for ICTSD.
- 60 Agricultural Act of 2014, section 11017.
- 61 Agricultural Act of 2014, section 11017(b)(4)(A). US Risk Management Agency: Commodity Exchange Price Provisions (15-CEPP), 2015 and Succeeding Crop Years (Cotton (0021)), Section II, p. 1-2, available at <http://www.rma.usda.gov/policies/2015/15ceppcotton.pdf> (last visited 14 July 2015).
- 62 Agricultural Act of 2014, section 11017(b)(4)(B).
- 63 Stacked Income Protection Plan (15-STAX-0021), Section 1, p. 1, Section 8(b), p. 3, available at <http://www.rma.usda.gov/policies/2015/15staxpolicy> (last visited 14 July 2015).
- 64 Stacked Income Protection Plan (15-STAX-0021), Section 5(a), p. 2, available at <http://www.rma.usda.gov/policies/2015/15staxpolicy> (last visited 14 July 2015).
- 65 NCC press release (2012) available at <http://www.cotton.org/news/releases/2012/coleysen.cfm> (last visited 14 July 2015).
- 66 USDA, Economic Research Service: Commodity Costs and Returns, available at: <http://www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx> (last visited 14 July 2015).
- 67 USDA, Economic Research Service: Cotton and Wool Yearbook 2014, Tables 2, 4 and 5, available at: <http://www.ers.usda.gov/data-products/cotton,-wool,-and-textile-data/cotton-and-wool-yearbook.aspx> (last visited 14 July 2015).
- 68 Testimony of Chuck Coley (2012, p. 2.)
- 69 USDA, Economic Research Service: Cotton and Wool Yearbook 2014, Table 2, available at: <http://www.ers.usda.gov/data-products/cotton,-wool,-and-textile-data/cotton-and-wool-yearbook.aspx>; and USDA, Cotton and Wool Outlook, 12 June 2015, p. 10, available at <http://www.ers.usda.gov/media/1853305/cws15f.pdf> (last visited 14 July 2015).
- 70 USDA, Economic Research Service: Cotton and Wool Yearbook 2014, Table 2, available at: <http://www.ers.usda.gov/data-products/cotton,-wool,-and-textile-data/cotton-and-wool-yearbook.aspx> (last visited 14 July 2015).
- 71 USDA, Economic Research Service: Cotton and Wool Yearbook 2014, Table 2, available at: <http://www.ers.usda.gov/data-products/cotton,-wool,-and-textile-data/cotton-and-wool-yearbook.aspx> (last visited 14 July 2015).
- 72 USDA, Economic Research Service: Cotton and Wool Yearbook 2014, Table 2, available at: <http://www.ers.usda.gov/data-products/cotton,-wool,-and-textile-data/cotton-and-wool-yearbook.aspx> (last visited 14 July 2015).

- 73 USDA, Economic Research Service: Cotton and Wool Outlook, 13 June 2014, p. 2, available at <http://www.ers.usda.gov/media/1478837/cws14f.pdf> (last visited 14 July 2015). The states listed are: Kansas, Oklahoma, and Texas.
- 74 USDA, Economic Research Service, Cotton and Wool Outlook, 13 June 2014, p. 2, available at <http://www.ers.usda.gov/media/1478837/cws14f.pdf> (last visited 14 July 2015).
- 75 Testimony of Chuck Coley 14 March 2012, p. 2); Testimony of Chuck Coley (16 May 2012, p. 2).
- 76 Moreover, prices for the December cotton futures contract at the time of planting, in February, almost doubled from USD 0.7236/lb. in February 2010 to USD 1.228/lb. in February 2011, then dropping to USD 0.9335/lb. in MY 2012, and as low as USD 0.6446/lb. in February 2015. See National Cotton Council, Monthly Prices, available at: <https://www.cotton.org/econ/prices/monthly.cfm> (last visited 14 July 2015).
- 77 For example, recent intra-season price volatility is illustrated by the fact that prices for the nearby-December cotton futures contract were at USD 0.8188 in May 2014, and six months later, in November 2014, had dropped more than 20 cents, or more than a quarter, to USD 0.6114. See National Cotton Council, Monthly Prices, available at: <https://www.cotton.org/econ/prices/monthly.cfm> (last visited 14 July 2015).
- 78 In other words, our exercise quantifies the effects that a (i) large, (ii) anticipated, (iii) permanent shock in (iv) one US commodity has on the world market for cotton, (v) holding all the other potential parameters constant. Point (v) implies that we assume that subsidy programmes for other crops under the 2014 Farm Bill remain in place. As the arbitrator in *US - Upland Cotton* noted, this is the proper counterfactual to examine pursuant to a WTO challenge of US cotton subsidies only. See Decision of the Arbitrator, *US - Upland Cotton (Articles 22.6 and 7.10)*, para. 4.147.
- As discussed in footnote 36, above, for the purposes of this model, we do not consider the effects of the EAA on the US and world markets for cotton. This is likely to lead to an underestimation of the real effects of the US cotton subsidy regime.
- 79 The model does not solve for absolute quantities or absolute price levels, but assesses relative effects in the form of percentage deviations from the baseline equilibrium.
- 80 See Panel Report, *US - Upland Cotton*, Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*. The model specifications presented below are slightly different than in the Sumner model, because a different set of WTO-inconsistent subsidies are at issues under the 2014 Farm Bill than were disputed in the *US - Upland Cotton* case. In addition, the Sumner model related to the world market for cotton as it existed in MY 2005.
- 81 See Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*.
- 82 A normal level of stockholding, including carry-over stocks, is implicitly considered in the model
- 83 More precisely, we compare the production decisions of US cotton farmers under an ‘actual,’ or benchmark, scenario, in which US producers receive the battery of cotton subsidies foreseen under the 2014 Farm Bill, with a ‘counterfactual,’ in which the cotton subsidies are permanently removed.
- 84 We note that our analysis takes into account that, in the scenarios with higher prices, quantities supplied in both the US and the RoW will be higher. Equally, our analysis takes into account

that, in the scenarios with lower prices, quantities supplied in both the US and the RoW will be lower. See Section 4.5.1, below.

- 85 In particular, we follow a standard practice, like the arbitrator in the *US - Upland Cotton* case, and use cotton futures prices at the time of cotton planting in February as representative of farmers' expected harvest prices and the production history of farmers' own counties as representative of their reasonable expectations of future yields.
- 86 We note that US Government agencies, such as the CBO (see footnote 20, above), only calculate budgetary outlays of US agricultural subsidies and not the harmful impact on the economy as a whole.
- 87 Sumner (2005).
- 88 See, e.g. Sumner (2005).
- 89 Alston, et al. (n.d.) available at <http://www.oxfamamerica.org/static/media/files/paying-the-price.pdf> (last visited 14 July 2015); Sumner, (2005).
- 90 Baffes. (2011).
- 91 Jales (2010).
- 92 de Gorter ((2012.
- 93 Zulauf and Orden (2012); Babcock and Paulson (2012).
- 94 Smith (2014).
- 95 See Gardner (1990) for a detailed exhibition of the equilibrium displacement model. Our model is a further development of the approach detailed in: Sumner (2005) available at <http://www.cato.org/publications/trade-policy-analysis/boxed-conflicts-between-us-farm-policies-wto-obligations> (last visited 14 July 2015).
- 96 For example, Alston and James (2002) used the model to assess the welfare effects of agricultural policies. Zepeda, et al. (2000) used the model to evaluate the effects of DP on agricultural trade. Rickard and Sumner (2011) use simulations to model the impact of EU subsidies on tomato production.
- 97 For an introduction in equilibrium displacement models and the log linear variant in particular, see Gardner (1990).
- 98 Note that we assume endogenous equilibrium adjustments in storage.
- 99 A coupling factor of zero means that the programme payment is equivalent to a lump-sum transfer with no link to production, and it therefore has no effect on commodity supply. In contrast, a coupling factor of one implies that the programme payment is directly tied to current production just as market revenue, and is therefore equivalent to market price incentives.
- 100 The credit market linkage of risk mitigating policies has been an important area of recent research on crop insurance in developing countries. See Carter (1988); Carter, et al. (2010 available at [http://scholar.harvard.edu/files/jwillis/files/kmd\\_paper\\_20141117.pdf](http://scholar.harvard.edu/files/jwillis/files/kmd_paper_20141117.pdf) (last visited 14 July 2015).
- 101 Moschini and Hennessy (2001).



- 102 See, e.g., Wu (1999); Goodwin, et al. (2004); Goodwin and Smith (2013).
- 103 As equation (4) indicates, a percentage reduction in  $G$  may be achieved by reducing or eliminating the level of support,  $d_{\text{In}g}$ , or by changing the nature of the subsidies,  $d_{\text{In}y}$  or  $d_{\text{In}p}$ .
- 104 Concerning the coupling factor for ML, the parameter choice of one was undisputed in the *US - Upland Cotton* dispute (note that neither CIP nor STAX were at issue in the *Cotton* arbitration). See Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*, para. 4.164 and Annex 2.
- 105 Cotton is a riskier crop than other field crops. Hence, US cotton farmers face credit constraints. Any protection against financial downside makes cotton growers more secure borrowers in the eyes of lenders.
- 106 In other words, a payment of USD 10 in adverse market conditions is worth USD 11 in normal market conditions. We assign a smaller risk mitigation factor to ML payments than to CIP and STAX (see below), since farmers are only covered against extremely low prices, but still bear the risk of low yields.
- 107 See Section 3.2.2 above, and data provided by RMA, available at <http://www.rma.usda.gov/data/sob/scc/index.html> (last visited 14 July 2015).
- 108 According to USDA, the AWP in May 2015 is USD 0.52. See <http://www.fsa.usda.gov/FSA/epasReports?area=home&subject=ecpa&topic=fta-uc> (last visited 14 July 2015). Historically, the AWP has been 15 per cent (or USD 0.101/lb.) lower than harvest prices, as measured by October futures for a December crop. See (i) U.S. Baseline Briefing Book: Projections for Agricultural and Biofuel Markets (March 2015) FAPRI-MU Report #01-15), Microsoft Excel tables with historical data, available at [http://www.fapri.missouri.edu/wp-content/uploads/2015/03/FAPRI-MU\\_2015\\_baseline\\_tables.xlsx](http://www.fapri.missouri.edu/wp-content/uploads/2015/03/FAPRI-MU_2015_baseline_tables.xlsx) (last visited 14 July 2015) and (ii) NCC, Monthly Prices, available at: <https://www.cotton.org/econ/prices/monthly.cfm> (last visited 14 July 2015).
- 109 We reasonably assume a participation rate of 100 per cent, since programme participation is free and there are no effective payment limitations.
- 110 As of marketing year 2014, 10.3 million acres, out of 10.8 million acres in total cotton acreage, are registered under crop insurance. See US Risk Management Agency: Summary of Business, Report Generator, available at <http://prodwebnlb.rma.usda.gov/apps/SummaryofBusiness/ReportGenerator> (last visited 14 July 2015); and USDA, Cotton and Wool Outlook, 12 June 2015, p. 6, available at <http://www.ers.usda.gov/media/1853305/cws15f.pdf> (last visited 14 July 2015). We assume a 100 per cent participation rate. Producers have access to information about the likelihood of indemnities on each farm. The resulting adverse selection means that producers may increase expected returns in the long run when participation is less than 100 per cent in each year. Knowing they can avoid premium payments in a given year when the program has only a low chance of payoff above the premium causes producers to value the program even more highly. So, even with participation averaging below 100 per cent the effect of the program on expected revenue, risk reduction and production is larger than if participation were 100 per cent every year, because premium payments cannot be avoided.
- 111 RP policies without Harvest Price Exclusion insure an average of historical cotton revenues against losses from low yields, low prices, low quality, or any combination of these events. The farmer selects the amount of average yield he or she wishes to insure - from 50 per cent to 75 per cent (in some areas to 85 per cent) in 5 per cent increments. The amount of insurance protection is based on the greater of the projected price or the harvest price (both determined by futures contracts). If the harvested plus any appraised production, multiplied



by the harvest price is less than the amount of insurance protection, the producer is paid an indemnity based on the difference. As of crop year 2014, acreage covered by RP accounted for 80 per cent of all insured cotton acreage. Liability under RP accounts for 83 per cent of total liabilities under all cotton insurance products. Cotton insurance data is available at [http://www3.rma.usda.gov/apps/sob/current\\_week/crop2014.pdf](http://www3.rma.usda.gov/apps/sob/current_week/crop2014.pdf) (last visited 14 July 2015). We note that RP without harvest-price protection is available, and carries lower premiums. However, producers the vast majority of policies include the harvest-price option. Our model is able to include the farmers' option of no harvest-price protection. We note that the results do not change materially using the assumption of no harvest price option.

- 112 Practically, an insured farmer chooses the type of policy that maximizes the expected payments. Therefore, we are likely to underestimate the amount of subsidies by assuming that all participants use the same insurance product.
- 113 Total subsidies and total premium for the cotton RP products are available from the Summary of Business Report, Federal Crop Insurance Corporation. [http://www3.rma.usda.gov/apps/sob/current\\_week/crop2014.pdf](http://www3.rma.usda.gov/apps/sob/current_week/crop2014.pdf) (last visited 14 July 2015).
- 114 See the 2015 Standard Reinsurance Agreement from the USDA at <http://www.rma.usda.gov/pubs/ra/sraarchives/15sra.pdf> (last visited 14 July 2015).
- 115 Federal Crop Insurance Act, 7 USC. 1508(k); US Risk Management Agency: 2015 Standard Reinsurance Agreement.
- 116 Federal Crop Insurance Act, 7 U.S.C. 1522.
- 117 Indemnities from CIP and STAX thereby cannot overlap. This means that a cotton farmer cannot claim the same revenue losses under both CIP and STAX. See Agricultural Act of 2014, section 11017.
- 118 Agricultural Act of 2014, section 11017.
- 119 The same support under CIP is provided for STAX, namely (i) premium subsidy; (ii) A&O support; (iii) reinsurance; and (iv) provision of relevant data by the RMA. See Section 3.2.2 for the justification. Specifically, insurance companies receive reimbursements to cover the A&O costs of STAX, which amount to 12 per cent of the listed premiums of area-wide insurance products (see the 2015 Standard Reinsurance Agreement from the USDA at <http://www.rma.usda.gov/pubs/ra/sraarchives/15sra.pdf>) (last visited 14 July 2015).
- 120 We assume that the participation rate of US farmers to the STAX programme is 100 per cent. This assumption is reasonable, given the generous premium subsidies of the programme. The Food and Agricultural Policy Research Institute (FAPRI), in its forecasts, also assumes almost full participation. See US Baseline Briefing Book: Projections for Agricultural and Biofuel Markets (March 2014) FAPRI-MU Report #02-14) p. 10, available at [http://www.fapri.missouri.edu/wp-content/uploads/2014/12/FAPRI\\_MU\\_Report\\_02\\_14.pdf](http://www.fapri.missouri.edu/wp-content/uploads/2014/12/FAPRI_MU_Report_02_14.pdf) (last visited 14 July 2015). Preliminary reports from the RMA indicate low participation in the STAX in 2015, the first year for which it is available. We maintain our 100 per cent participation assumptions, because (i) producers are still learning about the programme, (ii) producers have some residual frustration about the elimination of other subsidy programmes for cotton, (iii) there is speculation that STAX premiums were initially set too high, and will be reduced in subsequent years, and (iv) many producers had good growing conditions in the spring of 2015 and thus anticipated that, even with a very large premium subsidy, the benefit from the STAX was not sufficient for participation in 2015. This last effect reflects adverse selection and, as noted in footnote 111, above, means the long-run benefit of the programme is even larger. That is, knowing they can

avoid premium payments in a given year when the programme has only a low chance of payoff above the premium causes producers to value the programme even more highly.

- 121 Like CIP, the legal basis for calculating STAX disbursements are not expected and realized farm-gate prices, but futures prices at planting and harvesting, i.e., the February futures for December delivery and the October futures for December delivery, respectively. See Federal Crop Insurance Act, 7 U.S.C. 1508b(b)(4)(A).
- 122 The multiplier allows producers to scale indemnity payments. Specifically, producers can scale upwards when their own expected yields are above the county's average, and downward when their own yield is below the county average, with corresponding effects on the premium payable. See Stacked Income Protection Plan (15-STAX-0021), Section 5(a), p. 2, available at <http://www.rma.usda.gov/policies/2015/15staxpolicy> (last visited 14 July 2015). We assume that all participants select the 120 per cent payment multiplier, because this maximizes the net gain from the STAX for US cotton farmers, as additional costs will be borne over-proportionally by the US Government.
- 123 See footnote 118, above.
- 124 As of crop year 2014, the liabilities of cotton RP insurance under 65-75 per cent coverage accounts for 76 per cent of total liabilities of cotton RP insurance. The data is available from the summary of business (SOB data) of the RMA-USDA at <http://prodwebnlb.rma.usda.gov/apps/SummaryofBusiness/ReportGenerator/Results?CY=2014&CM=0021&IP=02&ORD=CY,CM,IP,CVL&CC=S> (last visited 14 July 2015).
- 125 Mathematically,  $(d\ln P \cdot P \cdot S_r)$  are the price effects, and  $S_r \cdot d\ln S_r \cdot (1 + d\ln P) \cdot P$ , which can equally be expressed as  $(1 + d\ln P) \cdot P \cdot \varepsilon_r \cdot d\ln P \cdot S_r$ , is an expression for the volume effects, whereby  $(1 + d\ln P) \cdot P$  represents the higher counterfactual world market price, and  $\varepsilon_r \cdot d\ln P$  the change in world supply, according to equation (1c).
- 126 The cotton 'A-Index' is a composite of an average of the five lowest price quotes from a selection of the principal cottons traded in the world market obtained by Cotlook, a private organisation based in the United Kingdom (UK). For an explanation of the A-Index, see Panel Report, *US - Upland Cotton*, paras 7.1264-1274 and 7.1311-7.1313 and Panel Report, *US - Upland Cotton (Article 21.5 - US)*, para. 10.44. Since there is a historical relationship between domestic futures prices and the A-Index, we use futures market prices as the starting point, and then determine their relationship to world prices based on historical precedent. Historically, the A-Index has been roughly 8 per cent (or USD 0.084/lb.) above the US harvest price, as measured by futures for a December crop. See National Cotton Council, *Monthly Prices*, available at: <https://www.cotton.org/econ/prices/monthly.cfm> (last visited 14 July 2015).
- 127 More specifically, the expected subsidy disbursements determine the ratio of government subsidies tied to current production over market revenues,  $\beta$ .
- 128 Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*, para. 4.163. See also the arbitrator's discussion *ibid.*, paras. 4.160-4.162. The arbitrator accepted this parameter value given the particular counterfactual scenario at issue: a policy shock in the form of a permanent, previously announced, withdrawal of US cotton subsidies, while subsidies for other crops would remain intact. This counterfactual provides incentives for US cotton farmers to switch to alternative crops, thus justifying a relatively elastic supply response.
- 129 Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*, para. 4.163. See also the arbitrator's discussion *ibid.*, paras. 4.160-4.162. The arbitrator was convinced by Brazil's arguments that the supply reaction by the non-US cotton producers (which notably includes

a number of developing countries) as a response to the unique counterfactual at issue - a permanent removal of US cotton subsidies - was smaller, slower, more indirect, and in the opposite direction from that faced by US producers.

- 130 Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*, para. 4.163. The arbitrator was convinced by Brazil's arguments that cotton demand is mainly determined by end consumers and that their demand is relatively inelastic with respect to changes in cotton prices for reasons of consumer preferences and the small share that raw cotton has in the final price of textiles. The relative irresponsiveness of cotton usage to cotton prices is also well documented in the literature Goreux (2003); Fadiga et al. (2006).
- 131 <http://usda.mannlib.cornell.edu/usda/current/CWS/CWS-06-12-2015.pdf>, Tables 1 and 2, accessed on 14 July 2015.
- 132 US import of cotton is about 0.01 million bales a year, while the US export of cotton is over 10 million bales annually. Data source: <http://usda.mannlib.cornell.edu/usda/current/CWS/CWS-06-12-2015.pdf>, Table 2 accessed on 14 July 2015, T.
- 133 <http://usda.mannlib.cornell.edu/usda/current/CWS/CWS-06-12-2015.pdf>, Table 2, accessed on 14 July 2015.
- 134 See <http://www.cotton.org/econ/prices/monthly.cfm>.
- 135 The arbitrator in *US - Upland Cotton* agreed with this assessment. See Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*, para. 4.189.
- 136 As mentioned above, we assume that all US cotton producers participate in the ML, CIP, and STAX.
- 137 According to the USDA, the MY 2015 average farm price received by US producers is projected to range from 50 to 70 cents per pound, with the midpoint of 60 cents. See <http://usda.mannlib.cornell.edu/usda/fas/cotton-market//2010s/2015/cotton-market-05-12-2015.pdf> (last visited 14 July 2015). For interested readers, both the Food and Agricultural Policy Research Institute at the University of Missouri and the Office of Chief Economist at the USDA provide cotton price projections into the future. See <http://www.fapri.missouri.edu/> and <http://www.usda.gov/oce/commodity/wasde/>.
- 138 Futures price levels are then modified according to footnotes 109, 122, and 127, above, to predict future farm-gate prices, the AWP, and the A-Index for each price scenario.
- 139 In other words, we assume that February futures are a good predictor of October Futures prices. While this is a reasonable assumption, other relationships between these futures prices are conceivable. More research will be needed on this issue.
- 140 We opt for a log-normal distribution for three reasons. First, it accommodates the price spikes in 2008 and 2011, which correspond to high values with low frequency. Second, statistical tests we have conducted fail to reject the log-normal assumption. Third, such distribution is consistent with the academic literature. Our sensitivity analyses suggest, however, that the distributional assumption does not drive the model results.
- 141 To determine the world price suppression (see equation (12) and the trade damage to cotton producers worldwide (see equation (15)), we establish a historical relationship between farm-level prices, AWP, and world prices (A-Index) and world production on the one hand, and US harvest prices (as measured by October futures for a December crop) on the other hand (see footnotes 109, 122, and 127, above). This allows us to appropriately adjust world supply and world prices for higher and lower price scenarios.

- 142 In reality, each cotton producer forms yield expectations based on private information. The anticipated yield can be either higher or lower than the projected yield in her insurance policy. However, we take comfort in the fact that our yield assumption is codified in the US rules for STAX. See Federal Crop Insurance Act, 7 U.S.C. 1508b(b)(4)(B).
- 143 We use information on yields per planted acre for the purposes of our model, because the US subsidies allow for mechanisms to remove the effects of crop acre abandonment from the yield history used.
- 144 We measure the variability of yield relative to a linear trend trajectory year-on-year, to remove the impacts of technological changes in cotton planting.
- 145 The log-normal assumption is consistent with the agronomic fact that the density of cotton yield is usually skewed to the right. However, our sensitivity analyses suggest that the distributional assumption does not drive the model results.
- 146 The 20 per cent increase in the variability of yield is consistent with the findings from Ramirez, Misra, and Field (2003) in which nine farms in Texas were surveyed and the standard deviation of yield at an average farm was found to be 23 per cent larger than the standard deviation of yield in the respective counties.
- 147 While the assumption of a spread around the projected county yield as a mean is reasonable, other relationships are conceivable. More research will have to be done on this issue.
- 148 We assume that county-level yields are uncorrelated with national farm prices. This assumption is reasonable, given the relatively large geographic spread of cotton farming in the US. A statistical test that we have employed failed to reject the null hypothesis that the correlation between county yield and national price is zero. We note that Copper (2010) outlines methods of generating a revenue distribution where correlation exists.
- 149 Note that we use season-averaged farm prices to evaluate market revenues. Based on the price relations over the past ten years, the season-averaged farm price is lower than the projected futures price by 7 per cent (or USD 0.044/lb.). See (i) U.S. Baseline Briefing Book: Projections for Agricultural and Biofuel Markets (March 2015) FAPRI-MU Report #01-15), Microsoft Excel tables with historical data, available at [http://www.fapri.missouri.edu/wp-content/uploads/2015/03/FAPRI-MU\\_2015\\_baseline\\_tables.xlsx](http://www.fapri.missouri.edu/wp-content/uploads/2015/03/FAPRI-MU_2015_baseline_tables.xlsx) (last visited 14 July 2015) and (ii) NCC, Monthly Prices, available at: <https://www.cotton.org/econ/prices/monthly.cfm> (last visited 14 July 2015).
- 150 We emphasise that our results are generally consistent with the CBO projected expenditure of about USD 300 million a year for STAX premium subsidies at price levels similar to our base scenario of USD 0.70/lb. See <https://www.cbo.gov/sites/default/files/cbofiles/attachments/44202-2015-03-USDA.pdf> (last visited 5 August 2015). In contrast to the figure reported by the CBO – which relates to premium subsidies only – our figure for expected disbursements reflects indemnity payments based on (i) US Government premium subsidies, (ii) cotton producers' premium payments, (iii) US Government payments of administrative and overhead costs that artificially reduce premium amounts, and (iv) losses covered by the US Government. In this respect, we note that cotton crop insurance policies often have loss ratios that exceed 1, which means that there will be significant US Government contributions through the reinsurance scheme, not reflected in the CBO data. See Sections 3.2.2 and 3.2.3, above.
- 151 A bale of cotton is equal to 480 lbs.

- 152 International Cotton Advisory Committee, "Cotton: World Statistics - Bulletin of the International Cotton Advisory Committee," May 2014, p. 7, 18.
- 153 See, e.g., Appellate Body Report, *US - Large Civil Aircraft*, para. 1290 ("a panel is subject to the constraint that it must employ an approach that will enable it to take due account of all of the subsidies that provide a relevant and identifiable competitive advantage to the recipient and its product in the market and that relate to alleged adverse effects phenomena. Only by doing so can a panel ensure a full appreciation of all of the challenged subsidies that may be contributing, or conducing, to the serious prejudice").
- 154 Decision of the Arbitrator, *US - Upland Cotton (Article 7.10 and 22.6)*, p. 119.
- 155 In addition to the SCM Agreement disciplines on the use of subsidies that cause harm to the trade interests of other WTO Members, we recall that Article 3 thereof also prohibits subsidies that are either contingent upon (i) export performance or (ii) the use of domestic over imported goods. For agricultural goods, the prohibition on export subsidies is subject to the Member having scheduled the limited right to provide export subsidies within the limits of its reduction commitments, both in terms of quantities exported with export subsidies and in terms of budgetary expenditure on export subsidies. See Article 3.1(a) of the SCM Agreement in connection with Articles 3.3, 8, 9 and 10 of the AoA.
- 156 See AoA, Articles 3.1, 3.2, 6 and 7 as well as Annex 2.
- 157 Glauber and Westhoff (2015).
- 158 [https://www.wto.org/english/tratop\\_e/agric\\_e/chair\\_texts08\\_e.htm](https://www.wto.org/english/tratop_e/agric_e/chair_texts08_e.htm) (last visited 14 July 2015).
- 159 The 2014 Farm Bill retains a programme similar to the CCP, known as price loss coverage (PLC). However, PLC is no longer available for cotton. See, e.g., Glauber and Westhoff (2014); Townsend (2015) available at <http://www.choicesmagazine.org/choices-magazine/submitted-articles/the-2014-us-farm-bill-and-cotton-proof-that-the-wto-matters> (last visited 14 July 2015).





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- Argentina's Agricultural Trade Policy and Sustainable Development. By Marcelo Regúnaga, Agustín Tejada Rodríguez. Issue Paper No. 55, 2015.
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