Impact of US Cotton Subsidies on Export and Production: Do the Cotton Dispute and WTO Settlement Matter?

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1. Introduction

Although cotton accounts for a tiny proportion of income for developed countries, it is an important tradable commodity among less developed economies. For example, cotton amounts to 30% of the total exports of four West African nations: Benin, Burkina, Chad, and Mali. Revenue from cotton makes up a large proportion of income for millions of poor farmers in that region (Minotand and Daniels, 2001, cited in Sumner, 2005). Nonetheless income source for the poor from cotton revenue has been considerably shrinking as a consequence of consistently low cotton world price induced by highly distorting cotton subsidization undertaken by developed nations. Hence, cotton subsidy and particularly its distorting effect on export and production have caused a huge debate among WTO members in the context of Doha Development Agenda (DDA). US domestic support for cotton has been brought to WTO Panel from 2002 and is an ongoing challenge highlighting that cotton subsidization and policy reform are an extremely contentious issue.

In the strand of literature on our topic of interest, the price effect of subsidies on cotton's world price has been well documented and can be found in Goreux (2003), Sumner (2003b), Alston and Brunke (2006), and Anderson and Valenzuela (2006). The magnitude of the price effect is controversial and largely depends on cotton supply and demand elasticities, although generally estimates lie between 12% and 16% of the typical values of assumed elasticities. In addition, Goreux (2003) points out that once cotton subsidies by the US, EU, and China are eliminated, US cotton production will drop 16.2%. Sumner (2003b) uses a multi-country and multi-commodity simulation framework to evaluate the impact of US cotton subsidies on domestic production and export of this commodity. When domestic and export subsidies for cotton are completely removed, cotton output decreases 26.3%-27.4% while its export falls by 41.2%-43%. Anderson and Valenzuela (2006) report that the removal of domestic subsidies has a major impact on the world cotton price and welfare gain (almost 90%), leaving the impact of removing the tariff and export subsidy small at 10%. This is a distinguishing feature of cotton in that the overall agriculture domestic subsidization has a relatively small impact (5%) compared with tariffs (93%) (Anderson, Martin, and Valenzuela, 2006).

The key objective of this paper is to investigate the impact of cotton subsidy conducted in a long time period by US on its export and production. We exploit a strong variation in subsidy payments across states (see Figure 1) and within state over time to quantify the effect by using a modern gravity model. Figure 2-4 illustrate within state variation over sample period for Texas for which subsidy payment is largest, for Arizona with support in the middle range, and New Mexico whose payment is at the bottom among states with positive subsidy receipt. The strong variation of subsidy payment across states and within state over a reasonably long time period allows us to quantify the effect of subsidy on export and production. The US as world largest subsidizer for cotton, the third largest producer and leading exporter of this commodity (behind China and India) suggests that understanding the impact of its subsidization on export and production is an important for trade negotiators and policy makers in the context of on going DDA.

This study features the methodological advance over the existing literature in that we address the problem of expectation error when identifying the effect. Expectation error may arise due to program payments that hinge on market price at harvest time and unknown to producers at planting time including Counter Cyclical Payment (CCP) and Average Crop Revenue Election (ACAE) program. Importantly, US cotton subsidy is under threat to be reformed under WTO settlement process generating an uncertainty about cotton subsidization in the coming years. These factors point out that farmers' expected subsidy payment which drive their cotton production decision may differ from actual government payments. Sumner (2003b) comes close to our approach in that he takes into account the problem of expectation error caused by the program payments whose rate and actual payment depend on market conditions by using the weighted average of actual market price in the past to represent cotton growers' expectation. However, expectation error from the second source is scant in his study. We exploit the quasi-experiment of policy changes to tackle the problem of expectation error. In particular, the mutual agreement between the US and Brazil in 2010 recognizing that actual subsidization policy changes for cotton would not occur until the next farm bill in 2013 reduces the problem of expectation error. Nonetheless, that subsidy legislation in the 1996 Federal Agriculture Improvement and Reform Act of 1996 (FAIR Act) support producers base on their historic production with a predetermine rate for a course of 7 years period allows us to generate a set of IVs to address the problem of expectation error.

Our regression results document a strong and significant impact of cotton subsidization on its export for 2002-2011 when the subsidy policy for cotton is not likely to change in 2011. In particular, a one percentage point increase in cotton subsidy promotes its export value at 0.4%. On the other hand, due to a threat of removal from the list of major crops in renewed farm bill 2013 which indicate in the Senate-passed and House-passed proposed changes for cotton subsidization, the impact of the cotton subsidy on its export in 2002-2012 is weaker though still meaningful. Also, the production estimates substantiates export results in that subsidy stimulates extra domestic production, and the impact is greater for the former period. In addition, our results reveal that excessive export, induced by subsidies, to less developed countries is larger than export to EU countries. One potential explanation for this divergence is that cotton subsidization granted by less developed countries is marginal compared with EU countries making this commodity from the former group less competitive. When countries with notable use of domestic support are dropped, the estimated effect is similar for the two groups of destinations. Finally, in line with the WTO panel's conclusion, we find that crop insurance has less impact on trade than the remaining program. The points mentioned above are true for both 2002-2011 and 2002-2012.

The rest of the paper is organized as follows. Section 2 provides background on the US subsidization policy and cotton legal dispute, followed by data and descriptive statistics. The empirical framework and identification is presented in Section 4 while results are analyzed in the following section. Section 6 describes the robustness check and sensitivity analysis, and Section 7 concludes this paper.

2. Institutional Background

A. Overview of US Subsidization for Cotton

U.S subsidization for major crops, including cotton, has a long history, since the Great Depression of the 1930s. Since then, subsidization policies have encountered a number of changes to meet General Agreement on Tariffs and Trade (GATT)/WTO disciplines. The 1996 FAIR Act shifted subsidy programs toward "decoupled" payments that support farmers based on their historical production. From 1998 to 2000, however, a drop in market price triggered a new support called market loss assistance payment and this payment lasted through 2001 for cotton. The Farm Security and Rural Investment Act of 2002 (FSRI Act) and the following farm bills in 2008 officially continued this payment under the name Counter Cyclical Payment (CCP), which grants subsidies on farmers' historical production when the market price falls below the price set in the statute. The 2008 farm bill introduced ACAE to ensure minimum revenue for major commodities, including cotton. It is triggered when the national price and state yield of cotton fall below a certain threshold. Producers can opt only for either ACAE or CCP.

According to Kirwan (2009), subsidy payments for the period after 1996 follow a consistent estimate

$$subsidy_{ijt} = \lambda_{jt}\bar{y}_{ij}a_{ijt}s_{jt} \quad (1)$$

where $subsidy_{ijt}$ is subsidy payment for farm i on crop j in year t; λ_{jt} is a scaling factor; $\bar{y}_{ij}$ is average crop yield in the period 1980-1984; a_{ijt} is the number of acres called base acres that qualify for subsidy and participate in year t; s_{jt} is the national subsidy rate for crop j in year t. The subsidy rate is normally determined when a farm bill is passed and is valid until the next farm bill.

B. Brazil's Challenges of U.S Cotton Subsidization at the WTO

The US's subsidization for cotton is a long-running dispute and was brought to the WTO in 2002 by Brazil, a major cotton producer and exporter. In the fall of 2004, the WTO panel ruled that provisions of domestic subsidy such as CCP and price-related programs for cotton violate the WTO agreement for agricultural subsidy. Also, US step 2 payments and agricultural export credit guarantees are prohibited export subsidies under the WTO disciplines. These programs are highly likely to distort international trade and hence should be withdrawn. In 2005, the US made some changes in GSM-102 programs and step 2 payments, leaving domestic subsidy payment unchanged. Brazil, however, argued that the US response was inadequate and pursued the complaint. Four years later, a WTO arbitration panel allowed retaliation in that Brazil was authorized to impose trade countermeasures on the US. This retaliation includes a fixed annual payment of $147.3 million and a variable annual amount based on US GSM-102 program spending. Furthermore, cross-retaliation may also apply in the US copyright and patent areas. To avoid the threat of retaliation, the US and Brazil entered a temporary mutual agreement in June 2010. The agreement includes (1) US annual payment of $147.3 million to the Brazilian Cotton Institute to provide technical support to Brazil's cotton industry, (2) regular discussions on limits of the US trade-distorting subsidy for cotton, and (3) modifications to the GSM-102 guarantee followed by semi-annual reviews. The actual changes for cotton subsidization necessary to limit its distortion on trade, as in (2) above, however, would not be implemented until the next farm bill in 2013. Furthermore, proposed changes for cotton subsidization were agreed upon in both the Senate-passed and House-passed 2013 farm bill. The key point of those proposed changes included removing cotton from the list of major commodities that receive price and income support. Instead, a stand-alone, county-based revenue insurance policy called the Stacked Income Protection Plan (STAX) would be delivered. The mutual agreement and proposed changes in US cotton policy since 2010 are more adequate, significant and generate a more firmness and validity compared with changes in 2005. This implies that US's response in this period reduced the expectation error from uncertainty of policy changes to a larger extent compared with 2005 changes.

3. Data and Descriptive Statistics

This study uses data of cotton exports of 45 US states with the 100 biggest trading partners, which accounts for 98% of the US total trade (sum of imports and exports). Alaska, North Dakota, South Dakota, Wyoming, the District of Columbia, and Kansas[1] are excluded from the sample as their trade flows are negligible. These regions together account for less than 2% of the total trade value. Cotton export data are extracted from the Harmonized System at the 6-digit level from *USA Trade Online*. Data on domestic subsidies per annum for each state are obtained from the Farm Subsidy Database of the Environmental Working Group (EWG).[2] Disaggregated data used in this study include data for crop insurance and non-crop insurance programs.

In the model we control for standard gravity variables including gross domestic product (GDP) whose data are collected from the US Department of Commerce (Bureau of Economic Analysis). Finally, the bilateral distance between one state and its trading

[1] In chapter 1 we use a sample of 46 US states including Kansas. For cotton, however, Kansas receives little subsidy and is coded as zero in the database. So we drop this state in the analysis.

[2] The EWG database can be accessed via the following link: farm.ewg.org.

partner is the flight distance between two corresponding capital cities and representing for transaction cost calculated by the author using the website Worldatlas.

The outcome for cotton production, including output, planted area, harvested area, and yield, is acquired from the US Department of Agriculture. Data on weather covariates, the precipitation index, and the temperature index are collected from the National Oceanic Atmospheric Administration. State-level data on population are obtained from the Administration for Commodity Living.

Figure 5 illustrates the means of cotton subsidy, its production, and export averaging across 45 states for each year. Meanwhile, the means of these variables over 11 years (2002-2012) for each state are presented in Figure 6. In addition, Figure 7 demonstrates means for each year of cotton production and export for the group of states with subsidy payment versus states without subsidy payment. Similarly, the mean values (production and export) for each group of states (with and without payment) are drawn in different colors in Figure 8. It is apparent from these figures that there is co-movement among cotton subsidy, cotton production, and cotton export. In addition, the mean value of cotton production and export is notably higher in states with positive payments compared to their counterparts.

Descriptive statistics for the main variables are presented in Table 1. On average, each state annually exports approximate $1.39 million in cotton. The value of the average cotton subsidy receipt is more than 32 times higher than that at $44.9 million. Note that the payment for cotton varies considerably across states; 29 states received no payment in the sample period from 2002-2012 while the other 16 states received payment in all years. If the average cotton subsidy is calculated on these states, the subsidy level goes up to \$126 million per annum. In addition, states receiving the largest amount of support include Texas with annual payment of \$687 million, Mississippi with \$269 million, and California with two-thirds of Mississippi's payment. Likewise, the subsidy granted also differs across years. For instance, the average subsidy payment is almost 8 times higher in 2005 than in 2012. Furthermore, as can be seen from columns 2 and 3 of Table 1, cotton production including cotton output, planted area, and harvested area are large among states with positive subsidy payment. Average cotton output is 1128.8 (million tons) among these states for example. By contrast, states without subsidy payment produce no cotton at all. This is understandable as cotton payment based either on past or present production. As a result, the former group's export value at \$3.8 million is 65 times higher than its counterpart's. In short, statistics show that cotton export, production, and subsidy payments differ substantially across states and time and that the positive association between cotton receipt and its production and export value is unambiguous.

4. Empirical Strategy—Identification

4.1 Unobserved Heterogeneity

To evaluate the impact of cotton subsidy on export, I use the gravity model is as follows:

$$Ln(V_{ijt}) = a_{jt} + b_i + c_{rt} + \alpha Ln(subsidy^*_{it}) + \beta Z_{ijt} + \varepsilon_{ijt} \quad (2)$$

where V_{ijt} is export value from state *i* to importer *j* in year *t*. $subsidy^*_{it}$ is the variable of interest representing subsidy value granted by state *i* in year *t*. Z_{ijt} is a vector of standard gravity model as described[3]. Vector of importer by year interaction, $\boldsymbol{a}_{jt}$, is used to account for importers' characteristics over time.[4] More importantly, state dummies are included to

[3] When state specific factors are included, *coastline* is droped from this vector due to multi-collinearity.

[4] This releases the demand for using data on basic gravity model variables, especially data on the subsidy granted by importer countries whose quality and credibility are questionable due to a number of missing observations and inaccurate notifications (Nuetah et al., 2011). Adding these dummies also addresses the

capture productivity-related factors which might be associated with both subsidy payments and cotton export capability. This is because US geography is diversified so several states are blessed with climate patterns and soil topology which is more suitable and favorable for agricultural production than others. It is likely that heterogeneity would bias the effect of the cotton subsidy upward as these unobservable factors have a positive correlation with both the cotton subsidy payment and cotton's export. State-specific dummies also capture the potential endogeneity of the subsidy in case the federal government sets export achievement as a hidden target behind the visible target of supporting farmers' income[5]. Moreover, region year interaction indicators capture the impact of time-varying omitted variables common for states within the same region. These time-varying variables may include transient shocks such as drought or pests that affect cotton production and export. In addition they also capture any spillover effect within a region which may result from interstate trade and re-export. This evidences in our sample as several states have positive export values while they do not producce cotton at all.

The estimating equation in this study is the first differencing of equation (2); time-invariant variables, including distance, land border, and state-specific factors, are dropped, resulting in[6]:

problem of "multilateral resistance" from the importer side which will bias gravity coefficient estimates if not accounted for (See Anderson and Van Wincoop, 2004 for a discussion)

[5] Like vector of importer year interaction, this set of dummies reduce the multilateral resistance from the state side.

[6] It is worth highlighting that equation (3) absorbs all exporter-importer specific factors along with distance and land border. For example, this vector of dummies takes into account potential omitted variables such as an export subsidy, which is substantially used in the case of cotton in the investigated period. It is likely that the export subsidy has a positive correlation with the domestic subsidy. This correlation stems from the fact that the export subsidy can be used as a means to push extra production resulting from a domestic subsidy into the world market (Chokeman, Francis, and Olarreaga, 2004). An export subsidy is often offered in the form of export tax reduction/exemptions, support for product marketing, or entitlement to credit access. An export subsidy is normally destination-specific. The targeted export subsidy destinations may be changed over time, although this is rare. So, the export subsidy can be considered a pair-specific

$$\Delta Ln(V_{ij}) = a_j + d_r + \alpha \Delta Ln(subsidy_i^*) + \beta \Delta Ln(GDP_i) + \Delta \varepsilon_{ij} \quad (3)$$

4.2. Expectation Error

The most significant obstacle to overcome in identifying the effect of the cotton subsidy on its production and export is the attenuation bias. This type of bias can come from two sources. First, the cotton dispute and WTO settlement may have an impact on farmers' perspective on the cotton subsidy in the investigated period. Second, with the farm bill of 2002, although subsidy rates are set in the legislation, the actual rate of payments for a number of programs such as CCP and ACAE is not determined until harvest time when the market price is known. The contingency of payment on market conditions at harvest time and the uncertainty regarding the policy changes due to the WTO settlement would likely result in expectation error. Producers do not know about the next year's payment at the time of cultivation. Their expectation about the support itself would drive their incentives for cotton growing. If producers have a gloomy prediction about the cotton subsidization policy, they would probably shift to other more compelling commodities. Otherwise, they would engage in cotton cropping and/or expand their production. The observed cotton government payment, thus, would probably differ from farmers' expectation, resulting in errors in variables. Actual cotton subsidy payments will equal the expected government payment and the expectation error, that is,

$$subsidy_{it} = subsidy_{it}^* + \varepsilon_{it}^g \quad (4)$$

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variable and that is why it can be captured by the vector of state-country dummies. If so, not controlling for this omitted variable would lead to an upwardly biased estimate of the subsidy effect. Furthermore, the set of exporter-importer dummies also tackles the problem of multilateral resistance related to the pair of countries in the sample. Finally, note that the tariff is not included in the model as our data are at the state level, so the tariff for a given destination and year is the same for all states. In addition, any variation in the tariff is partially captured by the importer-year and exporter-importer fixed effect.

Similar to Kiwan (2009), we also assume that the expected subsidy and the expectation error are uncorrelated, that is, $Cov(subsidy_{it}^{*}, \varepsilon_{is}^{g}) = 0$ for all *t*; *s* implies that using the observed government payment instead of expected payments would lead to the problem of classical errors in variables, namely, attenuation bias. This would bias OLS estimate downward when expected sign is positive as in this situation (Wooldridge, 2002, p.75).

The FAIR Act which took into effect from 1996-2002 with rate of payment known to farmers and hence its payments are not likely to suffer from expectation error from both sources offers opportunity for IVs formation. We therefore generate a number of IVs as follows. Along with the 1997 payment as the first instrument, which is used by Kiwan (2009) to instrument the 1992-1997 subsidy change, we used an additional three IVs to boost the efficiency of IV estimates. These IVs were generated by the formula $subsidy_{it} - subsidy_{is}$ where (t, s) are (2001, 2000), (2000, 1999), and (2001, 1998), respectively. We take differences of subsidy in these pairs to remove unanticipated payment which was granted from 1998-2001, that is, $subsidy_{it} = subsidy_{it}^{*} + \lambda_{it}$ where $subsidy_{it}^{*}$ is a deterministic subsidy in year t as set in the FAIR Act, and λ_{it} is an ad hoc payment in the same year. Subtracting these payments would eliminate the ad hoc component given that they are roughly the same[7]. Also, it helps to remove the component that is not deterministic and common in the two years in a given pair. It is likely that all

[7]At the state level, the amount of payment was almost identical for 1999 and 2000. This figure for 2001 was marginally lower than for 1999 (2000), and for 1998 it was smaller than for 2001 to a slightly larger extent. The data on these figures are not available, though they are depicted in the charts in the Environment Working Group website. For more details, visit http://farm.ewg.org/progdetail.php?fips=00000&progcode=cotton.

these four IVs are largely correlated with the change of subsidy payment in 2002-2011 as they all contain the deterministic components (yield and base acres) as in formula (1). These variables will be good instruments if they contain no information for idiosyncratic errors in the 2002-2011 subsidy change ($\varepsilon^{g}_{i,2011} - \varepsilon^{g}_{i,2002}$).

Expected and actual payment differences for 2002 and 2011 can be written as $subsidy_{i,2011} = subsidy^{*}_{i,2011} + \varepsilon^{g}_{i,2011}$ and $subsidy_{i,2002} = subsidy^{*}_{i,2002} + \varepsilon^{g}_{i,2002}$. Substituting each of these two years in equation (3) yields the estimating equation as[8]:

$$\Delta Ln(V_{ij}) = a_j + d_r + \alpha\left(Ln(subsidy_{i,2011}) - Ln(subsidy_{i,2002})\right) + \beta \Delta Ln(GDP_i) + \Delta\varepsilon_{ij} + \left(\varepsilon^{g}_{i,2011} - \varepsilon^{g}_{i,2002}\right) \quad (5)$$

Regarding the impact of cotton payment on its production, we use a similar framework with original and estimating equations, as below:

$$Ln(Y_{it}) = b_i + d_{rt} + \delta Ln(subsidy^{*}_{it}) + \lambda LnX_{it} + \varepsilon_{ijt} \quad (3')$$

$$\Delta Ln(Y_{ij}) = d_r + \delta\left(Ln(subsidy_{i,2011}) - Ln(subsidy_{i,2002})\right) + \lambda \Delta Ln(X_i) + \Delta\varepsilon_{ij} + \left(\varepsilon^{g}_{i,2011} - \varepsilon^{g}_{i,2002}\right) (5')$$

where Y_{it} denotes outcome for cotton production including cotton output, planted area, harvested area, and yield. X_{it} is a vector of explanatory variables, namely, weather index (precipitation and temperature index) and population. For the outcome for cotton output and harvested area, we control for planted area in the model along with the variables defined in X_{it}.

5. Estimation and Results

Here we present estimation results for export, export by group of destination, and by program categories. We then substantiate the analysis of export effect by uncovering subsidy effect on production, a primary and important mechanism through which subsidy

[8] We do the same way for estimates of 2002-2012 period.

affect exports. We present estimates for 2002-2011 and 2002-2012 subsidy changes at the same time. Before proceeding to regression results it is worth highlighting that the expectation error would not be large for the 2002-2011 subsidy change compared with 2002-2012 period. First, the temporary mutual agreement between the US and Brazil in June 2010 minimizes expectation error from the first source (uncertainty about subsidy policy changes induced by the WTO settlement). This is because the agreement recognized that actual subsidy changes would not occur until the next farm bill (the then-current farm bill expired at the end of 2012). Second, although expectation error from the second source (the contingency of subsidy rates on market price at harvest time) does not completely disappear in 2011, we argue that it is not substantial. The two program payments that could have caused expectation error in this period are CCP and ACAE, whose subsidy rates are determined by market price at harvest time. CCP was not granted in 2010 and 2011 while the other program, involving ACAE payments, was delivered in three successive years from 2009-2011 at a quite similar level.[9] Therefore, if farmers have rational expectation as normally assumed in that they expect current year's payments basing on the previous year's payments, errors in expected payments from these two programs would be low. Likewise, the expectation from both sources would also be low for 2002. The cotton case was brought to the WTO by Brazil in the fall of 2002 when the cultivation time for cotton had passed. Thus, for this year, the expectation error from the first source (uncertainty about future changes due to the WTO settlement) was likely to be small. This type of expectation error might have been present if US farmers and US cotton trading partners had known the information about Brazil's plan to

[9] The exact figure for this program payment is not available, but it is illustrated by the chart in the Environment Working Group website.

challenge the US cotton subsidy at the time of the growing season through informal channels or information leaks. Even so, the expectation error in this situation would be small provided a common understanding that the WTO settlement would involve a long process. Regarding the potential expectation error from the second source, at the time of cotton growing from March to May, the FAIR Act was still valid until the new farm bill was signed into law in May. The expectation error in 2002, therefore, was likely absent as the subsidy rates are predetermined in the FAIR Act. For 2002-2012 subsidy change, although expectation error for the year 2002 and expectation error from the first source for the year 2012 are the same as 2002-2011 subsidy change, expectation error from the second source could be much more substantial. This is because although subsidy payment for CCP and ACAE is similar for three successive years from 2009-2011, it is not granted in year 2012. Therefore if assumption about conditional expectation holds, expectation error would be large for 2002-2012 subsidy change.

5.1. Impact of cotton subsidies on its export

a. Overall Impact of Cotton Subsidy

As said earlier, this study takes advantage of longitudinal data to tackle the problem of heterogeneity across states and the potential endogeneity stemming from the nature of the subsidy policy, which may confound the relationship between cotton payment and its export. To see how these confounders affect the estimate, columns (1) and (2) of Table 2 panel A report estimates for pooled data from two years (2002 and 2011) and for the whole period (2002 to 2011), respectively. To be more specific, these estimates use specification (2) without the state fixed effect. The estimate shows a large impact of cotton payment on its export at 0.67-0.69 that is strongly significant at the 1%

level. When the vector of state indicators is included and the first differencing specification as in (3) is used, the coefficient of cotton subsidy falls by more than half to 0.296 and becomes insignificant (t=1.41). This confirms the earlier argument that states differ in the time-invariant characteristics associated with both cotton payment and cotton export. The estimate of the subsidy coefficient after controlling for heterogeneity, however, may be confounded by attenuation bias, as depicted in equation (4). The coefficient in column 4 of Table 2 increases to 0.4 and becomes significant at the 5% level when expectation error is addressed by the set of IVs. The increase in IVs estimate demonstrates that IVs do a good job in eliminating the expectation error which downwardly bias estimate toward zero as indicated by econometric literature. The export-promoting impact of the cotton subsidy, after accounting for expectation error, is 0.4, indicating that US cotton exports to the world market would fall 40% if subsidization were abolished. This percentage is equivalent to $24.65 billion reduction in export value for the whole period[10] (2002-2011).

Estimates for period 2002-2012 presented in Table 2 panel B follow exact pattern as the period 2002-2011; subsidy effect before controlling for state specific is large at 0.56-0.65 and immediately drop to 0.007 when fixed effect is controlled for. IVs also appear to work well in reducing attenuation bias as IV estimate substantially increase to 0.26. The effect of subsidy on export is smaller in magnitude compared with year 2011 and statistically insignificant. This is because 2012 is a transition year before a probably unfavorable change in cotton subsidy in year 2013. Producers may gradually shift their

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[10] Taking a partial derivative of export value with respect to subsidy from equation (3), we have $\frac{d\ln V}{d\ln subsidy} = \frac{dV/V}{dsubsidy/subsidy} = \alpha$. This is equivalent to $dV = \alpha.V$ if the subsidy change is equal 100%. The sum of US export for cotton from 2002-2012 is 61.62 billion, the estimate of α is 0.4, resulting in extra cotton exports of 24.65 billion (61.62*0.4).

production toward other commodities which are not under obvious threat of removal from the subsidized list. Also US' cotton importers may response to this disadvantageous change by seeking and setting up a new trading relationship.

As analyzed before endogeneity problem is mild for 2002-2011 estimate (F-statistic is statistical significance at the 10% level) while it is strong (statistically at 1% level) for 2002-2012. Shear's partial R-square is substantially high at 0.91 and 0.76 for 2002-2011, and 2002-2012 estimate and strongly reject null hypothesis indicating that the problem of weak instrument variables is not a concern.

As a set of IVs is used, the adequacy of these IVs should be questioned if the IV estimate is sensitive to the use of each different IV instead of all of them. The same standard error with and without pair cluster in regressions allows us to conduct a Saran test for over identification. The Chi-sq statistic fails to reject null hypothesis at conventional level for both 2002-2012 means that using different IVs in the set does not lead to different estimates.

b. Impact of Cotton Subsidy on Its Export by Groups of Destinations

Cotton subsidization has been used most notably among industrialized countries, namely, the US and EU, while China is the only nation among the less developed countries substantially using this tool. We, therefore, want to see how the effect of US cotton subsidization varies across these two groups of destinations, EU vs. non-EU countries. These two groups of countries are interacted with subsidy variables and the FE and IVs FE for 2002-2011 and 2002-2012 are reported respectively in panel A and B Table 3. The estimate in column (2) of both panels shows that less developed markets are the major destination for the excessive US cotton production. Similar to overall estimate, the effect is stronger for 2002-2011 compared with 2002-2012. In particular the impact of subsidy on export for the group of less developed country is 0.44 and statistically significant at the 5% level for 2002-2011 while it is 0.287 and statistically insignificant (t=1.55) for 2002-2012 estimate. Meanwhile, these figures are much smaller than that (0.23 for 2002-2011 and 0.17 for 2002-2012) for the EU groups and both are statistically insignificant.

One potential explanation for larger impact of subsidy on export to less developed economies is that cotton support is also a measure used by the EU to support its producers. EU subsidization for cotton helps to protect its domestic cotton producers and, hence, makes the penetration of US cotton exports to the EU market less profound. As subsidization for cotton is considerable for only Greece and Spain among the EU countries and China among the less developed countries, we test the above projection by dropping these three nations from the sample. As expected, the estimation of subsidy impact for EU group significantly goes up to roughly the same as for the group of less developed countries for both periods. The t statistics for EU group estimates also increase considerably though remain insignificant. In short, the evidence indicates that less developed markets in which producers do not receive support from the government are the major destination of extra cotton production induced by US subsidization.

Similar to estimate for overall effect, endogeneity problem is mild for 2002-2011 estimate while it is more severe for 2002-2012 period. The IVs estimates for the two groups of destination also increase for both periods suggesting that they do a good job in eliminating attenuation bias. Shea's partial R-sq is also high confirming that IVs are strong instrumental variables. In addition over-identification test generally shows that using subset of instruments does not lead to different estimates.

c. Cotton Subsidization: Different Programs

Subsidies for a commodity trigger its production to a varying extent. Market price is commonly the most important indicator when producers maximize their utility function. Thus, the subsidy programs that are contingent on market price are the most trade-distorting programs. Programs such as the Direct Payment, which are not price-related and divorce the subsidy from current production decisions by paying based on historical production, have a modest effect on trade flow. In addition to describing the overall effect, this study is also interested in shedding light on the specific effects of different cotton payment programs. The data for cotton programs are not available except for crop insurance payments. Therefore, we can only differentiate the impact between crop insurance and all other programs as an aggregation (hereafter, the non-crop insurance program). The most important payments in the non-crop insurance program box are the CCP, price support payment, and Direct Payment (DP)[11].

Crop insurance is treated as exogenous as this program's payment rate is deterministic and known to producers. Meanwhile non-crop insurance contains market price-related program including CCP and ACAE, so it is treated as endogenous and instrumented by the set of IVs.[12] The result of IVs estimation for the two periods reported in columns 1 and 2 of Table 4 indicate that impact of non-crop insurance programs on

[11] In terms of duration and frequency of payment, crop insurance has been delivered in all years of the investigated period. Price support programs and CCP were paid up to 2009 while DP ended one year earlier. In 2011, the data as depicted by the chart in the Environmental Working Group website show that only payments for crop insurance and "other cotton programs" were positive. The information on what exact programs were included in "other cotton programs" is not available, but it should include the ACAE program, which was introduced in the 2008 farm bill. The ACAE program ensures minimum revenue for farmers and is triggered based on market conditions. In this sense, ACAE is similar to CCP and in fact was introduced to replace CCP.

[12] We also use the set of instruments after subtracting the crop insurance component in each of these variables in estimation and the results are largely the same. These estimates are not presented in this paper and are provided upon request.

cotton exports is larger while that of crop insurance programs is small and statistically insignificant. This finding is consistent with conclusions from the WTO panel in that price-contingent programs, including CCP and price support payments, are trade distorting while non-price contingent programs such as crop insurance and DP do not substantially distort trade.

Similar to previous results, impact of subsidy is greater for 2002-2011 period. Partial R-square reaffirms a strong relationship between instrumental and instrumented variables. In addition endogeneity is severe for 2002-2012 subsidy change while it is not a problem for 2002-2011. Over-identification test rejects null hypothesis for 2002-2012 though this does not hold for 2002-2011 estimation.

5.1. Impact of Cotton Subsidies on Its Production

Impact of cotton subsidization on its production is investigated through four outcome indicators (cotton output, planted area, harvested area, and yield) using equation (5'). Expectation error is addressed by the same set of IVs as in trade equation. The regression results for FE and IVs FE for 2002-2011 subsidy change is presented in Table 5, panel A, while that for 2002-2012 is in panel B. As indicated in column 2, panel A, a 1% increase in cotton subsidies induces a rise of 0.66% in cotton output, which is 0.26% higher than the impact on cotton exports. Note that extra cotton production can be used domestically and impede imported goods as a result. In chapter 2, we found that cotton subsidies inhibit imports by around 0.3%. Evidence in columns (4), (6), and (8) shows that the increase in cotton output comes from an expansion of the planted area, an increase in the area harvested, and yield. Likewise cotton support has positive impact on the four outcomes for 2002-2012 estimates, though as in trade equation, the effect is much smaller compared with that of 2002-2011.

Similar to the export estimation, a high partial R-square in the first stage for all regressions ensures that the IVs are strongly correlated with the instrumented variable. In addition, expectation is not a problem for 2002-2011 while it is more severe for 2002-2012. The magnitude of IVs estimates increase compared with FE when endogeneity severe as in equation with outcome being cotton output and harvested area in 2002-2012 estimation.

6. Robustness Check and Sensitivity Analysis

Robustness Check

As in Deadroff's (1985) theoretical framework, GDP per capita (GDPC) represents a specialization in production (i.e., whether production is labor-intensive or capital-intensive). GDPC, on the other hand, may have a potential correlation with the subsidy level. This correlation may be negative if the US farm bills aim to support poor farmers, for example. Thus, to see whether estimates of subsidy coefficients are driven by omitting this variable, we include it in the model. In addition, because GDP, GDPC, subsidy, and state dummies are also included in the model, it is likely that these variables have high multi-collinearity with each other[13]. We, therefore, drop both GDP and GDPC to see whether potential collinearity is a matter for estimating the subsidy coefficient. IVs estimation, as preferred specification in Table 2 to Table 4, are reported from column (1) to column (5) in Table 6 panel A and panel B for 2002-2011 and 2002-2012 respectively. The estimated coefficient of the subsidy, subsidy interaction with the EU, non-EU

[13] In all estimation with FE, GDP has unexpected negative sign (though statistically insignificant) suggesting that multi-collinearity might be a problem.

country groups, and subsidy by different programs in these scenarios largely coincide with those in the main analysis.

As the estimating equation is in log form and only 16 states received a subsidy in all years, the other 30 states without subsidy grants are dropped. To test whether the subsidy effect is driven by states with positive payments, we take into account information on a zero subsidy payment in the regressions in two ways. First, we treat zero subsidy payments as missing values (when taking log) and use missing dummies in the model[14]. The estimating equation is the same as in the main analysis (i.e., the first differencing equation (5)). In this case, it is not able to apply IV estimation, so we estimate OLS only. The results for 2002-2011 subsidy change presented in column (6) panel A for three scenarios (included only GDP, both GDP and GDPC, and drop both) are slightly larger compared with the results without the missing dummies. For 2002-2012 estimates are around half of those using IVs FE though still positive. Note that the problem of expectation error is mild for 2002-2011 so FE estimate is not largely different IVs FE for this period. Meanwhile the severity of expectation error for 2002-2012 explains for a much smaller size of FE estimate compared with IVs FE for this period as FE downwardly bias estimate toward zero if expectation error is not corrected.

Second, we generate a dichotomous subsidy variable which is equal to 1 if the subsidy is positive and 0 otherwise. As 16 states received a subsidy in all years while the others did not, equation (5) cannot be estimated due to no variation in the subsidy indicator. In addition, expectation error should not be a serious problem in this case. Thus, we estimate equation (3) although state dummies are excluded because the subsidy

[14] We create dummy variables that equal unity for observations with missing data on the explanatory variables as normally do in the literature.

indicator is a time-invariant variable. The estimates reported in column (6) show a large, positive, and strongly significant impact of the cotton subsidy on its export for both periods. Note, however, that the state fixed effect is not controlled for, so these time-invariant variables may upwardly bias the estimate of the subsidy indicator.

The robustness check for the impact of cotton subsides on its production is presented in Table 7. We estimate equation (5') (IV FE) in linear-linear form and results are largely the same as in log-log equation (row 1). We also estimate the impact using subsidy indicator in the linear-linear production equation.[15] The results show a large and significant impact of the cotton subsidy indicator on its production. These estimates, as in export equation, may be upwardly biases as the state fixed effect is not controlled for.

Sensitivity Analysis

A set of 4 IVs is used to instrument for the cotton subsidy in this study. The estimate is not credible if estimates using a different subset of IVs are statistically different. They should be different only in terms of error as more IVs will increase the efficiency (Wooldridge 2002, p.). Therefore, we carry out regressions using all subsets of these four IVs including only one IV each time, a set of combination of every two IVs, and a set of 3 IVs. For the export regressions, the standard error with and without the pair cluster is the same, allowing us to conduct the Sargan test for over-identification. The results are presented in Appendix Table 1 for the impact of the cotton subsidy on its export. Estimates using the subsets of IVs largely coincide with those using all 4 IVs. In particular, for 2002-2011, 27 out of 42 estimates have a magnitude from 0.3-0.44, which is similar to the estimate using all four IVs. Another 6 estimates are around 0.25-0.28, leaving 10 estimates lying outside these ranges. Likewise, for the period 2002-2012

[15] Cotton was not grown in 29 states in all years (2002-2012) and these states at the same time did not receive a subsidy payment. An estimation with missing dummies and subsidy indicator thus does not apply for the log-log equation.

estimates using these subsets of IVs are largely similar to the main estimate when all four IVs are employed. In addition, of the 30 regressions using a subset including 2 and 3 IVs, the Sargan test shows that 26 cases fail to reject the null hypothesis that estimates using each IV are the same for 2002-2011. This hypothesis cannot be rejected for all cases for 2002-2012. The statistical significance of estimates is weaker than when all four IVs are used for both periods and this is as indicated in the econometrics literature, that is, more IVs are better than fewer in terms of efficiency. Likewise, as illustrated in Appendix Table 2, the impact of the cotton subsidy on its production using all subsets of IVs is largely similar to that using all four IVs for both periods.

7. Conclusion

Cotton is one of the commodities that has received the largest amount of support in industrialized countries. This crop makes up a tiny fraction of these rich countries' income while it constitutes a meaningful proportion of GDP and is the most important cash crop for a number of least developed countries especially those in West and Central Africa. As the world's third largest producer and the leading exporter of cotton, the US has granted a huge amount of support to domestic cotton growers, which is believed to have suppressed the world price by stimulating excessive production. In addition, there was no reducing tendency in the level of support through the renewed farm bills in recent decades when agricultural subsidization had been brought to GATT rounds. Thus, US cotton subsidization has given rise to extreme debate. The policy ended up being challenged at the WTO by Brazil in 2002, and the settlement process was long lasting. In this context, a study on the impact of cotton subsidization on its production and export is crucial. This study provides insight into these effects by utilizing longitudinal data for the period when the debate and its resolution were still alive. Our findings are confirmed through various specifications and robustness checks. We report a large effect of cotton subsidization on its export and the mechanism is through stimulating production. US cotton production would fall 66% and result in a 40% or $24.65 billion reduction in export if cotton subsidization is completely removed. Price-contingent programs, including CCP, AEAC, and the price support payment, are the main cause of export promotion. Furthermore, less developed countries where producers are not protected by comparable subsidization are major destinations for US excessive production. These effects went down significantly, though were still meaningful, when implementation of the farm bill of 2013, with its disadvantageous proposed changes for cotton subsidization, was nearing.

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Figure 1: Cotton Subsidy among States with Positive Payment

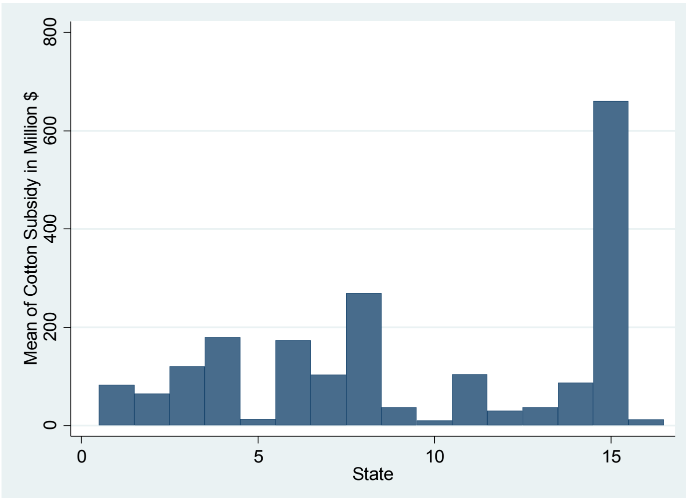


Figure 2: Cotton Subsidy for Texas over Time

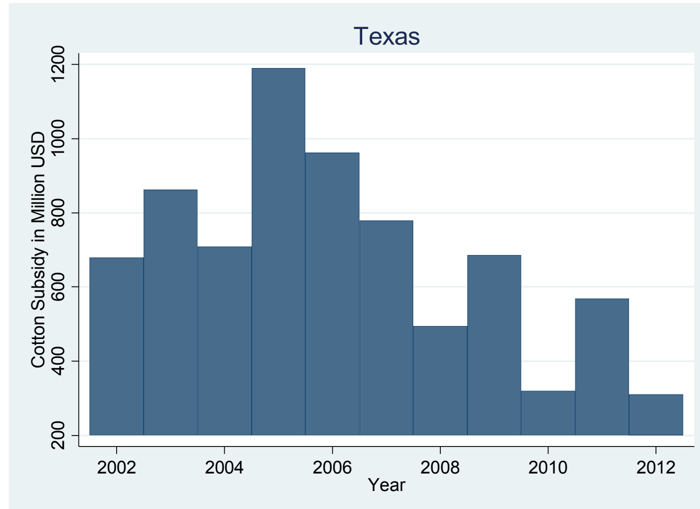


Figure 3: Cotton Subsidy for Arizona over Time

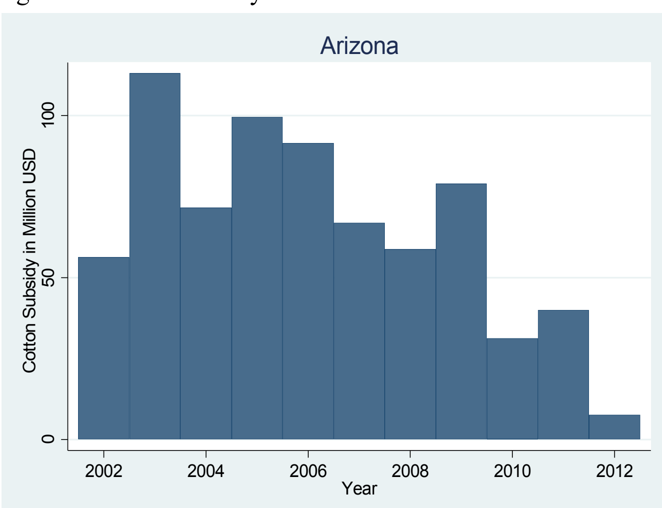


Figure 4: Cotton Subsidy for New Mexico over Time

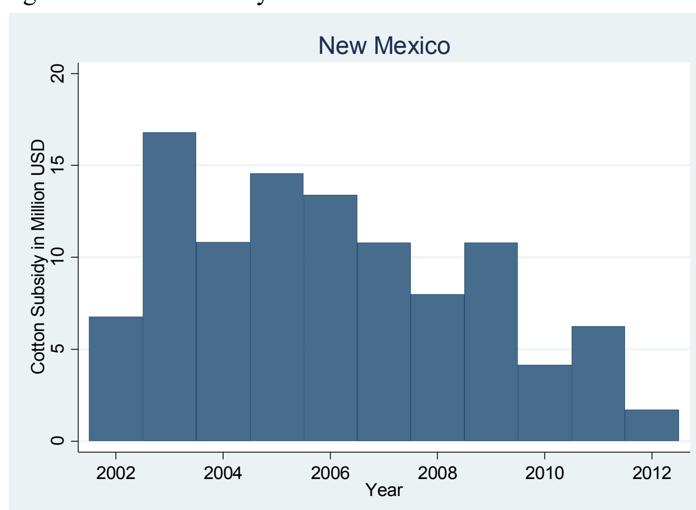


Figure 5: Yearly Mean of Cotton Export and Cotton Subsidy

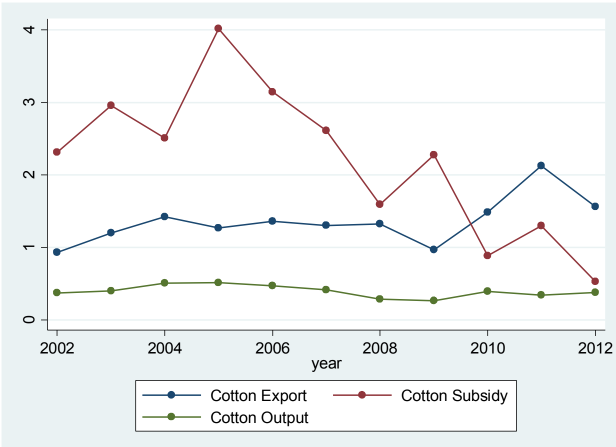


Figure 6: Mean of Cotton Export and Cotton Subsidy for 46 States

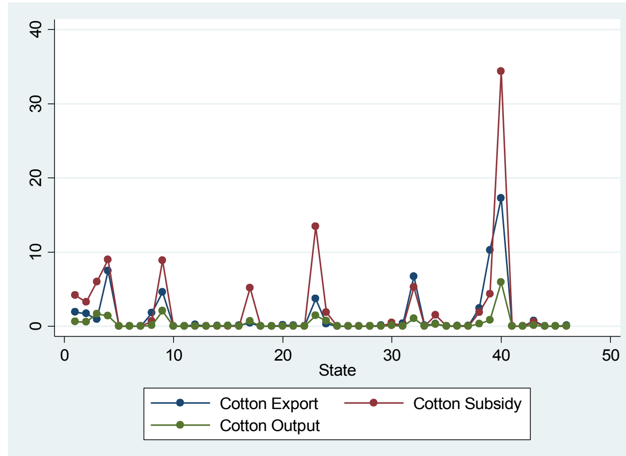


Figure 7: Yearly Mean of Cotton Export for States with and without Subsidy

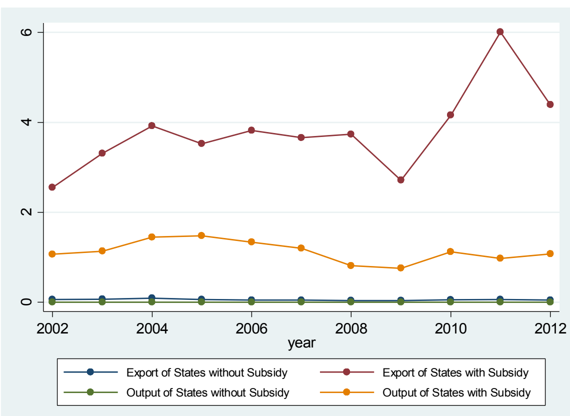
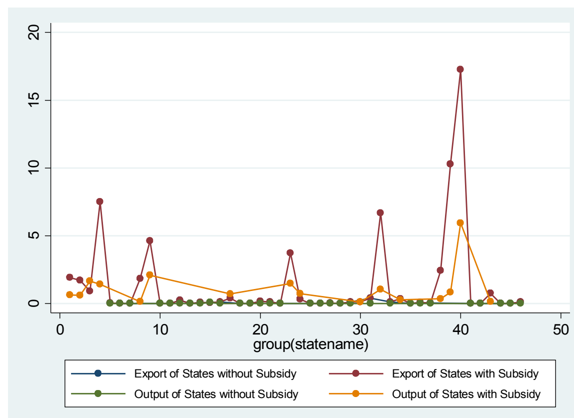


Figure 8: Mean of Cotton Export for States with and without Subsidy



Note: Cotton export and subsidy value are in million U.S dollar; subsidy is divided by 20 to fit in one x-y axis with export value. Cotton output is in thousand (unit).

Table 1: Descriptive Statistics for Main Variables 2002-2012

	(1) All States		(2) States with Zero Payment		(3) States with Positive Payment	
	mean/sd	N	mean/sd	N	mean/sd	N
Cotton export value (in Million Dollar)	1.388	49500	0.0585	31900	3.798	17600
	(16.82)		(0.711)		(28.03)	
Cotton Payment (in Million Dollar)	44.85	495				
	(125.0)					
GDP (in Million Dollar)	277322.3	495	221725.9	319	378090.7	176
	(313009.6)		(210497.3)		(423668.4)	
GDPC (in Dollar)	40782.0	495	42411.6	319	37828.3	176
	(7414.8)		(7820.8)		(5498.5)	
Cotton Output (in Thousand Tons)	401.3	495	0	319	1128.8	176
	(1025.5)		(0)		(1463.9)	
Cotton Planted Area (in Thousand Acres)	277.2	495	0	319	779.8	176
	(893.4)		(0)		(1363.5)	
Cotton Harvested Area (in Thousand Acres)	239.9	495	0	319	674.7	176
	(693.2)		(0)		(1030.3)	
Cotton Yield (in Tons)	892.7	176	.	0	892.7	176
	(258.8)		(.)		(258.8)	
Precipitation Index	37.63	484	38.77	308	35.65	176
	(14.08)		(13.95)		(14.14)	
Temperature Index	629.9	484	600.6	308	681.1	176
	(70.80)		(63.89)		(50.24)	
Population (in Persons)	6555059.1	495	5084362.5	319	9220696.6	176
	(6748906.5)		(4437850.6)		(9038696.5)	

Table 2: Impact of Cotton Subsidies on its Export Value

	(1)	(2)	(3)	(4)
Importer by Year Dummies	Yes	Yes	Yes	Yes
Region by Year Dummies	Yes	Yes	Yes	Yes
Panel A: Period 2002-2011	Pool Data 2002 and 2011	Pool Data 2002-2011	Fixed Effect	IV Fixed Effect
Ln Cotton Subsidy	0.687***	0.672***	0.296	0.401**
	(9.91)	(11.38)	(1.41)	(2.05)
Ln Distance	-2.097***	-1.900***		
	(4.98)	(4.89)		
Ln GDP	0.461***	0.290**	-3.754	-3.201
	(2.99)	(2.24)	(1.32)	(1.20)
Land Border	1.303*	0.342		
	(1.89)	(0.43)		
Coastline	-0.866**	0.179		
	(2.30)	(0.57)		
Number of Observations	1298	6400	486	486
Adjusted R-Sq	0.596	0.595	0.315	0.315
Shea partial R-square (p-value for F test)				0.91 (p=0)
Endogeneity				2.73 (p = 0.099)
Overidentification Test (Chi-Sq)				6.17 (p = 0.104)
Panel B: Period 2002-2012	Pool Data 2002 and 2012	Pool Data 2002-2012	Fixed Effect	IV Fixed Effect
Ln Cotton Subsidy	0.556***	0.650***	0.007	0.258
	(8.02)	(11.23)	(0.05)	(1.47)
Ln Distance	-1.637***	-1.811***		
	(3.21)	(4.48)		
Ln GDP	0.631***	0.354***	-3.959	-0.960
	(4.26)	(2.78)	(1.04)	(0.25)
Land Border	1.812**	0.591		
	(2.56)	(0.75)		
Coastline	-0.828**	0.02		
	(2.23)	(0.06)		
Number of Observations	1275	7014	484	484
Adjusted R-Sq	0.578	0.594	0.278	0.274
Shea partial R-square (p-value for F test)				0.76 (p=0)
Endogeneity				7.98 (p=0.005)
Overidentification Test (Chi-Sq)				0.351 (p = 0.950)

Note: Robust and exporter-importer pair cluster standard errors are in parenthesis. ***, **, and * represent statistical significance at 1%, 5%, and 10% level respectively.

Table 3: Impact of Cotton Subsidy on its Export: EU vs non EU (First Differencing)

	(1)	(2)	(3)	(4)
Importer by Year Dummies	Yes	Yes	Yes	Yes
Region by Year Dummies	Yes	Yes	Yes	Yes
Panel A: Period 2002-2011	FE	IV FE	FE (Dropping Subsidized Countries)	IV FE (Dropping Subsidized Countries)
Ln Cotton Subsidy *EU	0.134	0.225	0.338	0.449
	(0.39)	(0.68)	(0.99)	(1.32)
Ln Cotton Subsidy *non EU	0.330	0.438**	0.351	0.445**
	(1.48)	(2.11)	(1.53)	(2.09)
Ln GDP	-3.797	-3.247	-3.380	-2.852
	(1.33)	(1.22)	(1.12)	(1.02)
N	486	486	462	462
adj. R^2	0.314	0.313	0.305	0.305
Shea partial R-square (p-value for F test)		0.84 (0.87)		0.83(0.89)
Endogeneity		1.35 (p = 0.26)		1.14 (p = 0.32)
Overidentification Test		12.18 (p = 0.06)		10.65 (p = 0.1)
Panel B: Period 2002-2012	(1)	(1)		
	FE	IV FE	FE (Dropping Subsidized EU Countries)	IV FE (Dropping Subsidized EU Countries)
Ln Cotton Subsidy *EU	0.007	0.174	0.053	0.254
	(0.03)	(0.65)	(0.23)	(0.98)
Ln Cotton Subsidy *non EU	0.007	0.287	0.004	0.300
	(0.05)	(1.55)	(0.03)	(1.59)
Ln GDP	-3.959	-0.844	-4.950	-1.497
	(1.04)	(0.22)	(1.23)	(0.38)
N	484	484	462	462
adj. R2	0.276	0.272	0.242	0.236
Shea partial R-square (p-value for F test)		0.64 (0.67)		0.63 (0.69)
Endogeneity		4.248 (p = 0.02)		5.26 (p = 0.01)
Overidentification Test		9.00 (p = 0.17)		7.82 (p = 0.25)

Note: Robust, exporter-importer cluster standard errors are in parenthesis. ***, **, and * represent statistical significance at 1%, 5%, and 10% level respectively.

Table 4: Impact of Cotton Subsidy on its Export: Different Programs

	(1) Period 2002-2011	(2) Period 2002-2012
Ln Crop Insurance	0.166	-0.251
	(0.85)	(0.93)
Ln non Crop Insurance	0.353	0.123
	(1.28)	(1.31)
Ln GDP	-3.703	-2.855
	(1.34)	(0.92)
N	459	460
adj. R^2	0.313	0.268
Shea partial R-square (p-value for F test)	0.81 (p=0)	0.99 (p=0)
Endogeneity	.13 (p = 0.72)	15.55 (p = 0.00)
Overidentification Test	9.39 (p = 0.03)	2.55 (p = 0.47)

Note: Robust, exporter-importer cluster standard errors are in parenthesis. ***, **, and * represent statistical significance at 1%, 5%, and 10% level respectively.

Table 5: Impact of Cotton Subsidies on its Production

	(1) Ln output	(2) Ln output	(3) Ln Planted Area	(4) Ln Planted area	(5) Ln Harvested Area	(6) Ln Harvested Area	(7) Ln Yield	(8) Ln Yield
Period 2002-2011								
Ln Cotton Subsidy	0.808	0.658**	0.289**	0.286***	0.354	0.352	0.240	0.182*
	(1.58)	(2.15)	(2.80)	(4.23)	(0.97)	(1.43)	(1.41)	(1.79)
Ln Planted Area	-1.415	-1.159			-0.671	-0.669		
	(1.00)	(1.44)			(0.68)	(1.06)		
Ln Precipitation Index	-0.123	-0.233	0.557	0.558*	-0.186	-0.187	-0.352	-0.327
	(0.09)	(0.31)	(1.14)	(1.84)	(0.24)	(0.47)	(0.45)	(0.70)
Ln Temperature Index	-1.458	-0.632	-2.289	-2.282***	0.150	0.158	0.091	0.272
	(0.34)	(0.28)	(1.58)	(2.63)	(0.06)	(0.13)	(0.04)	(0.23)
Ln Population	4.775	5.180**	-0.090	-0.078	4.060	4.063**	0.784	1.073
	(1.19)	(2.29)	(0.04)	(0.06)	(1.24)	(2.21)	(0.38)	(1.03)
N	16	16	16	16	16	16	16	16
adj. R^2	0.348	0.333	0.734	0.734	0.071	0.071	0.291	0.273
Shea partial R-square (p-value of F test)		0.76 (p=0.02)		0.81(p=0.01)		0.76 (p=0.02)		0.81 (p=0.01)
Endogeneity		.32 (p = 0.58)		.003 (p = 0.96)		.00 (p = 0.99)		.60 (p = 0.45)
Overidentification Test		7.30 (p = 0.06)		5.68 (p = 0.13)		7.44 (p = 0.06)		2.94 (p = 0.40)
Period 2002-2012								
Ln Cotton Subsidy	0.0999*	0.149***	0.267***	0.215***	0.0119	0.145**	0.176**	0.113**
	(2.00)	(4.80)	(4.44)	(3.87)	(0.10)	(2.56)	(2.68)	(2.39)
Ln Planted Area	1.264***	1.131***			0.935*	0.573***		
	(6.23)	(12.85)			(1.76)	(2.65)		
Ln Precipitation Index	-2.413***	-2.306***	0.800**	0.792***	-0.930	-0.636	-1.223***	-1.231***
	(8.41)	(16.29)	(2.59)	(3.33)	(1.33)	(1.62)	(3.07)	(3.71)
Ln Temperature Index	10.39***	9.902***	-3.383**	-3.224***	3.889	2.557*	5.397***	5.585***
	(7.99)	(15.24)	(2.58)	(3.35)	(1.38)	(1.72)	(3.39)	(4.46)
Ln Population	7.225***	6.866***	-1.825	-1.358	3.247*	2.265***	3.385**	3.942***
	(8.97)	(17.74)	(1.11)	(1.19)	(1.78)	(2.72)	(2.15)	(3.52)
N	16	16	16	16	16	16	16	16
adj. R^2	0.973	0.971	0.829	0.812	0.753	0.710	0.864	0.838
Shea partial R-square (p-value of F test)		0.76 (p=0.06)		0.62 (p=0.03)		0.76 (p=0.06)		0.62 (p=0.03)
Endogeneity		4.58 (p = 0.05)		2.30 (p = 0.15)		14.51 (p = 0.00)		3.30 (p = 0.09)
Overidentification Test		3.69 (p = 0.3)		3.41 (p = 0.33)		3.4 (p = 0.33)		9.65 (p = 0.02)

Note: Robust, exporter-importer cluster standard errors are in parenthesis. ***, **, and * represent statistical significance at 1%, 5%, and 10% level respectively.

Table 6: Impact of Cotton Subsidy on its Export: Robustness Check

	Basic Gravity Variables Include ↓	(1) Ln Subsidy	(2) Ln Subsidy * EU	(3) Ln Subsidy *non EU	(4) Ln Crop Insurance	(5) Ln non Crop Insurance	(6) Ln Subsidy (zero obs included)	(7) Cotton Subsidy Indicator
Panel A: Period 2002-2011								
(1)	Ln GDP & Ln GDPC	0.357	0.199	0.384	0.198	0.207	0.448**	2.009***
		(1.46)	(0.53)	(1.54)	(0.63)	(1.04)	(2.12)	(13.48)
(2)	Ln GDP						0.409**	2.149***
							(2.23)	(16.07)
(3)	None	0.402**	0.288	0.429**	0.267	0.291*	0.415**	2.498***
		(2.25)	(0.90)	(2.22)	(0.97)	(1.76)	(2.30)	(18.20)
(4)	Ln GDP & Ln GDPC		0.459	0.422				
			(1.18)	(1.63)				
(5)	Ln GDP							
(6)	None		0.507	0.436**				
			(1.55)	(2.20)				
Panel B: Period 2002-2012								
(1)	Ln GDP & Ln GDPC	0.243	0.191	0.261	-0.312	0.145	0.102	2.069***
		(1.14)	(0.65)	(1.18)	(1.17)	(1.56)	(0.84)	(15.85)
(2)	Ln GDP						0.091	2.207***
							(0.74)	(19.7)
(3)	None	0.263*	0.187	0.298*	-0.229	0.150	0.106	2.410***
		(1.81)	(0.74)	(1.91)	(0.86)	(1.63)	(0.87)	(20.72)
(4)	Ln GDP & Ln GDPC		0.289	0.294				
			(1.00)	(1.31)				
(5)	Ln GDP							
(6)	None		0.281	0.324**				
			(1.16)	(2.02)				

Note: These estimations include different set of basic gravity variables as presented in column (1). For EU and non EU destination specification, whole sample estimates are in rows (1)-(3) while that for sample without Spain, Greece, China are in rows (4)-(6). Robust, exporter-importer cluster standard errors are in parenthesis. ***, **, and * represent statistical significance at 1%, 5%, and 10% level respectively.

Table 7: Impact of Cotton Subsidy on its Production: Robustness Check

	2002-20011				2002-2012			
	(1)	(3)	(2)	(3)	(4)	(6)	(7)	(8)
Outcomes (in Level)→	Output	Planted Area	Harvested Area	Yield	Output	Planted Area	Harvested Area	Yield
Cotton Subsidy (in Level)	0.658**	0.286***	0.352	0.182*	0.334***	0.134***	0.172***	0.0642**
	(2.15)	(4.23)	(1.43)	(1.79)	(5.25)	(3.21)	(7.41)	(2.06)
Cotton Dummy	260.7***	408.3*	87.13***		279.4***	408.9*	93.47***	
	(3.11)	(1.96)	(4.35)		(3.30)	(1.91)	(4.35)	

Robust, exporter-importer cluster standard errors are in parenthesis. ***, **, and * represent statistical significance at 1%, 5%, and 10% level respectively.

Appendix Table 1: Estimates of Impact of Cotton Subsidies on its Export with Different Set of IVs

IV	Estimate	N	R-square	P-value (Over-identification Test)	Estimate	N	R-square	P-value (Over-identification Test)
1	-0.937 (0.96)	486	0.272		0.134 (0.21)	484	0.275	
1	-0.208 (0.51)	486	0.305		0.132 (0.35)	484	0.277	
1	0.128 (0.41)	486	0.31		0.200 (0.79)	484	0.277	
2	0.166 (0.63)	486	0.313		0.235 (0.95)	484	0.273	
2	0.176 (0.80)	486	0.314		0.225 (1.00)	484	0.275	
2	0.308 (1.59)	486	0.313		0.243 (1.27)	484	0.276	
3	0.887** (2.12)	486	0.306		0.184 (0.73)	484	0.274	
3	0.937** (2.00)	486			0.178 (0.79)	484	0.276	
3	0.942** (2.16)	486	0.299		0.223 (1.28)	484	0.276	
4	0.416 (1.63)	486	0.313		0.344 (0.96)	484	0.270	
4	0.393* (1.73)	486	0.315		0.388 (0.87)	484	0.268	
4	0.420* (1.94)	486	0.314		0.372 (1.15)	484	0.271	
13	0.404 (1.41)	486	0.313	0.13	0.275 (1.23)	484	0.272	0.81
13	0.302 (1.38)	486	0.315	0.13	0.245 (1.26)	484	0.274	0.72
13	0.440** (2.24)	486	0.314	0.2	0.275* (1.81)	484	0.275	0.73
14	0.35 (1.40)	486	0.313	0.16	0.225 (0.95)	484	0.273	0.88
14	0.264 (1.28)	486	0.315	0.17	0.204 (1.01)	484	0.275	0.69
14	0.332* (1.78)	486	0.313	0.42	0.230 (1.40)	484	0.276	0.66
23	0.329 (1.34)	486	0.313	0.11	0.226 (1.03)	484	0.273	0.65
23	0.277 (1.31)	486	0.315	0.11	0.210 (0.99)	484	0.275	0.93
23	0.382** (2.02)	486	0.314	0.14	0.248 (1.49)	484	0.276	0.89
12	0.264 (1.03)	486	0.313	0.19	0.189 (0.76)	484	0.274	0.93
12	0.173 (0.79)	486	0.314	0.26	0.178 (0.78)	484	0.276	0.89
12	0.303 (1.56)	486	0.313	0.48	0.222 (1.28)	484	0.276	0.92
34	0.440* (1.72)	486	0.313	0.18	0.245 (1.01)	484	0.273	0.73
34	0.381* (1.68)	486	0.315	0.16	0.220 (0.98)	484	0.275	0.67
34	0.412* (1.91)	486	0.314	0.15	0.248 (1.30)	484	0.276	0.64
24	0.336 (1.34)	486	0.313	0.05	0.212 (0.88)	484	0.274	0.68
24	0.262	486	0.315	0.05	0.203	484	0.276	0.68

	(1.21)				(0.93)			
24	0.328*	486	0.313	0.34	0.227	484	0.276	0.83
	(1.70)				(1.30)			
123	0.327	486	0.313	0.27	0.235	484	0.273	0.89
	(1.33)				(1.10)			
123	0.267	486	0.315	0.27	0.224	484	0.275	0.89
	(1.31)				(1.17)			
123	0.393**	486	0.314	0.33	0.261*	484	0.275	0.88
	(2.15)				(1.73)			
124	0.417*	486	0.313	0.01	0.327	484	0.270	0.29
	(1.68)				(1.50)			
124	0.413**	486	0.314	0.05	0.255	484	0.274	0.85
	(2.09)				(1.42)			
124	0.348*	486	0.314	0.61	0.237	484	0.276	0.97
	(1.88)				(1.47)			
234	0.328	486	0.313	0.14	0.221	484	0.273	0.92
	(1.34)				(1.03)			
234	0.259	486	0.315	0.14	0.211	484	0.275	0.90
	(1.22)				(0.99)			
234	0.383**	486	0.314	0.34	0.251	484	0.276	0.90
	(2.03)				(1.53)			
134	0.38	486	0.313	0.31	0.250	484	0.273	0.94
	(1.56)				(1.18)			
134	0.302	486	0.315	0.31	0.225	484	0.275	0.92
	(1.51)				(1.21)			
134	0.396**	486	0.314	0.35	0.259*	484	0.275	0.89
	(2.21)				(1.75)			

Note: the order of IVs is as follow: 1: subsidy 2000-1999 change; 2: subsidy 2001-1998 change; 3: subsidy 1997; 4: subsidy 2001-2000 change. Robust, exporter-importer cluster standard errors are in parenthesis. ***, **, and * represent statistical significance at 1%, 5%, and 10% level respectively.

Appendix Table 2: Impact of Cotton Subsidies on its Production with Different Set of IVs

IV	Ln output	Ln Harvested Area	Ln Planted Area	Ln Yield	Ln Production	Ln Harvested Area	Ln Planted Area	Ln Yield
1	-0.0120	-0.0897	-0.0888	0.0856	0.0420	0.162**	-0.00872	-0.127
	(0.04)	(0.40)	(0.40)	(0.62)	(0.51)	(2.51)	(0.06)	(1.11)
2	0.650*	0.408	0.235***	0.152	0.0862	0.226**	0.203***	0.0531
	(1.95)	(1.50)	(2.89)	(1.44)	(1.43)	(2.17)	(3.28)	(0.92)
3	5.503	3.512	0.439*	0.516*	-3.057	0.971	0.380	0.351*
	(0.74)	(0.68)	(1.96)	(1.88)	(0.06)	(0.07)	(1.62)	(1.80)
4	1.868***	1.330***	0.380***	0.202**	0.136	0.417	0.305***	0.125**
	(3.51)	(2.85)	(4.32)	(2.05)	(0.84)	(0.99)	(4.01)	(2.02)
13	0.610**	0.316	0.160*	0.288***	0.0767	0.152**	0.160**	0.0808
	(2.11)	(1.36)	(1.71)	(3.26)	(1.24)	(2.20)	(2.43)	(1.01)
14	0.633**	0.397	0.270***	0.175*	0.0482	0.178**	0.226***	0.0621
	(2.00)	(1.53)	(4.39)	(1.78)	(0.64)	(2.39)	(4.09)	(1.01)
23	0.795**	0.501*	0.257***	0.192**	0.0714	0.229**	0.216***	0.0754
	(2.42)	(1.86)	(3.89)	(2.00)	(1.17)	(2.22)	(4.03)	(1.29)
12	0.660**	0.416	0.292***	0.164	0.0591	0.186**	0.231***	0.0771
	(1.98)	(1.53)	(4.47)	(1.56)	(0.89)	(2.42)	(4.33)	(1.44)
34	1.214***	0.937***	0.365***	0.123	-0.0444	0.449	0.293***	0.0892
	(3.43)	(3.16)	(4.85)	(1.06)	(0.41)	(1.28)	(4.44)	(1.61)
24	0.682**	0.433	0.278***	0.167	0.0751	0.183***	0.215***	0.0614
	(2.05)	(1.59)	(4.31)	(1.64)	(1.40)	(2.64)	(3.72)	(1.08)
123	0.651**	0.358	0.286***	0.173*	0.0767	0.153**	0.230***	0.0786
	(2.18)	(1.48)	(4.44)	(1.70)	(1.24)	(2.21)	(4.35)	(1.44)
124	0.654**	0.412	0.298***	0.160	0.110***	0.191***	0.226***	0.0987**
	(2.02)	(1.55)	(4.39)	(1.49)	(2.99)	(2.80)	(3.89)	(2.19)
234	0.686**	0.372	0.268***	0.182*	0.118***	0.136**	0.203***	0.0764
	(2.16)	(1.46)	(4.17)	(1.86)	(3.38)	(2.33)	(3.69)	(1.27)
134	0.622**	0.331	0.271***	0.173*	0.0840	0.133**	0.221***	0.0686
	(2.13)	(1.40)	(4.40)	(1.76)	(1.44)	(2.07)	(4.09)	(1.08)

Note: The order of IVs is as follow: 1: subsidy 2000-1999 change; 2: subsidy 2001-1998 change; 3: subsidy 1997; 4: subsidy 2001-2000 change. Robust, exporter-importer cluster standard errors are in parenthesis. ***, **, and * represent statistical significance at 1%, 5%, and 10% level respectively.