The Effects of Domestic Offset Programs on the Cotton Market

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November 2010

Introduction

A cap-and-trade program for greenhouse gases to address climate change has been proposed in the American Clean Energy and Security Act (ACES). Although the bill as paused by the House of Representatives is essentially dead, it is still useful to gather information on potential effects on agriculture should Senate legislation be reintroduced at a late date. Among other elements of the bill, the program used carbon offsets to manage the production impacts of carbon emissions caps similar to the European Union's Emissions Trading Scheme.

The bill covered seven greenhouse gas (GHGs): carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). Entities covered by the proposal included: large stationary sources emitting more than 25,000 tons per year of GHGs, producers (i.e., refineries) and importers of all petroleum fuels, distributors of natural gas to residential, commercial and small industrial users (i.e., local gas distribution companies), producers of "F-gases," and other specified sources. The bill established emission caps that would reduce aggregate GHG emissions for all covered entities to 3% below their 2005 levels in 2012, 17% below 2005 levels in 2020, 42% below 2005 levels in 2030, and 83% below 2005 levels in 2050.

To meet these targets, ACES established a system of tradable permits called "emission allowances" modeled after the Clean Air Act program to prevent acid rain. Emitting industries like oil refineries, electric utilities and others would be required to reduce their emissions of greenhouse gases, mainly carbon dioxide, over time. This market-based approach provides economic incentives for industry to reduce carbon emissions at the lowest cost to the economy. However, the “acid rain” emission markets were geographically concentrated and based on a measurement pollutant. It is unclear whether a national market based on a naturally occurring gas (CO2) is workable or effective.

ACES allowed capped sources to increase their carbon emissions if they could obtain offsetting emission reductions from uncapped sources at a lower cost. The legislation allowed capped sources to use offsets to acquire up to 2 billion tons of emission credits (offsets) annually. Offsets are verifiable greenhouse gas reductions created by a business (e.g., the agriculture sector) that can be sold to a business in a capped industry and used by that business as a greenhouse gas reduction in meeting its emissions cap. These offsets act as a “credit” to be used in meeting the regulated entity’s emissions reduction threshold.

ACES required that major U.S. sources of emissions obtain an allowance for each ton of carbon or its equivalent emitted into the atmosphere. EPA estimates that in 2005 dollars, these allowances will cost $11 to $15 in 2012, $13 to $17 in 2015, $17 to $22 in 2020, and $22 to $28 in 2025. The U.S. would distribute these offsets to parties engaged in the mitigation or sequestration of CO_2 or its equivalent (CO_2-e), with one offset being exchanged for every metric ton of CO_2-e that is mitigated or sequestered. The holders of these offsets could then sell them to capped polluters, raising the polluter’s emissions cap by one metric ton for every offset they purchase while increasing the revenue potential of the offset practitioners (ACES 2009; Brown et al. 2010).

Two offset programs were created in the ACES: a domestic program and an international program. The former was to be run by the U.S. Department of Agriculture

(USDA) and the latter run by the Environmental Protection Agency (EPA). Each of them distributed one billion offset credits. Not like domestic programs, the international offset program did not specify which programs would qualify for offsets but instead gave the EPA administrator full discretion in making the determination. Offsets could not be obtained from sources in a foreign nation until the United States has entered into an agreement with the originating nation establishing the terms of the offset program. Due to the complexity and ambiguity of the international offset portion of ACES, only the domestic portion of ACES will be addressed here, although we will address some potential implications of the international program later in the paper.

The domestic program provided for offsets to be distributed to entities engaged in carbon mitigation or sequestration in the agricultural, forestry, and manure sectors. Specifically, it allowed offset credits to be distributed for programs that represent “verifiable” greenhouse gas emission reductions, avoidance, or increases in sequestration. ACES listed the specific types of practices that were to qualify for the offsets. They were split into categories involving agriculture and grassland, land-use change and forestry, and manure management and disposal. The program required the exchange of one offset credit for each metric ton of CO_{2}-e that the USDA determined had been reduced, avoided, or sequestered during a specified time span: 5 years for agricultural practices, 20 years for forestry practices, and 10 years for all others. The domestic offset program focused on practices involving agriculture and forestry, creating opportunities for farmers to become offset holders. According to the U.S. Environmental Protection Agency (2009), one likely outcome of the climate change bill was the conversion of a large amount of poor-quality cropland to forests. This transition would be a boon to some farmers and landowners. Based on the different values of the various offset practices, many farmers would find it in their financial interest to take land out of production and devote it to carbon sequestration.

The purpose of this study is to evaluate the effects of the domestic offset program on the U.S. and international cotton industries. We use simulation results from Brown et al. (2010) to project aggregate changes in farmland and upland cotton acreage and use those results to project impacts on U.S. and world cotton prices, production, and trade.

Literature Review

Several studies have addressed the effects of the offset programs on land allocation issues between agricultural land and afforestation. Babcock (2009) and the Economic Research Service of USDA (USDA-ERS 2009) examine the costs and benefits of ACES to the agricultural sector. The Energy Information Agency (EIA, 2009) calculates the impacts of ACES on the U.S. economy with and without the use of offsets. Outlaw et al. (2005) and Baker et al. (2009) simulate the economic impacts of ACES on the agricultural and forestry sectors. Both de la Torre Ugarte et al. (2009) and Brown et al. (2010) analyze the ACES agricultural offset program and project modest increases in domestic commodity prices.

De la Torre Ugarte et al. projects small increases in domestic commodity prices and a net gain in domestic cropland. However, they include some offset practices such as dedicated energy crops that are not found in ACES and attribute greater value to dedicated energy crop production than to afforestation. As a consequence, these authors project no afforestation under the offset program. Due to the inclusion of energy crops and the resulting skewed acreage shifts, we opted not to utilize these projections in the present analysis, but do include sensitivity analysis to account for variations in acreage responses to ACES.

Baker et al. (2009) and EPA (2005) provides a comprehensive and extensive overview of the ability of agricultural and forestry offsets to mitigate CO_2-e emissions. The study uses FASOM-GHG (the Forest and Agricultural Sector Optimization Model/Greenhouse Gases) as its simulation model. Its economic analysis is limited to determining how widespread adoption of offset practices would be under various scenarios and how many acres of land would be impacted by these practices. However, there is no region-specific analysis and no discussion of how the agricultural sector would be directly affected by adoption of the offset practices. Baker et al. simulate the economic effects of greenhouse gas offsets on the U.S. forestry and agricultural sectors and report a net benefit to the agricultural sector under ACES. The practices analyzed in these two studies include agriculture soil sequestration, afforestation, forest management, and minor practices. The total acreage converted to forest by land-use type (cropland and pasture) is measured on a national scale.

Brown et al. focus on the results of the EPA and Baker et al. analysis. They use the ISU-CARD model to evaluate whether the number of acres diverted into affroestation in the EPA studies is reasonable based on ACES and other economic factors. They adopted the total nationwide acres from EPA's $30 per metric ton (EPA 2005) and assumed the price would be reached by 2023. The domestic offset price is equal to the price of emission allowances (i.e. the price on carbon) in accordance with EIA. The price assumption is consistent with EPA, the U.S. Congressional Budget office's analysis of

ACES (CBO 2009), EIA (2009) and CRA International (Montgomery et al. 2009). EPA projects the afforestation of roughly 100 million acres of land throughout the U.S. under $30/metric ton carbon price scenario, 50 million of which will occur on cropland (EPA 2005). The EPA study also provides the sequestration potential from afforestation practices for Corn Belt, Lake States, Pacific States, Rocky Mountains, South Central, and Southeast. To separate the South Central region into Delta and Southern plains, Brown et al. adopted the sequestration rates calculated in Lewandrowski et al. (2004) and Birdsey (1996). After the sequestration potential and rates for different regions were calculated, the total number of acres projected to be afforested are estimated.

Following the estimates supplied by Brown et al., total U.S. cropland would decrease 4.2% in 2015, 9.2% in 2020, and 11.6% in 2023 if the carbon price is $30 per metric ton. For specific regions, Texas, for example, they expected that it would decrease by 3.5% in 2015, 7.5% in 2020, and 9.5% in 2023 (See Brown et al. and Table 1 for detail). Because Brown et al. focus emphasizes afforestation impacts of ACES, we also assume an intermediate effect of 50% of the above cropland changes (i.e., 2.1% in 2015, etc.).

After calculating the reduction of planted area in each of the regions through the projection period, the reduction of areas in each region were distributed across crops based on each crop’s share of total area in the baseline. Based on these assumptions, they expected that U.S. upland cotton harvested area would decrease by 8.3% in 2015/16, 13.5% in 2019/20, and 16.3% in 2023/24. Corn belt and Delta states have more significant decreases than the far west, southeast and southern plains (Table 2). Following their estimation, the U.S. upland cotton acreage would decrease 4.2% in 2015 and 11.6%

in 2023 with significant decreasing in Delta region. The cotton estimates are the basic acres used for our estimation of the offset program on cotton market.

Methods and Procedures

Basic Model Structure

Our study utilizes a modified version of the International Cotton Model created by the Cotton Economic Research Institute at Texas Tech University. The world fiber model includes 28 major cotton importers and exporters: (1) Asia (China, India, Pakistan, Taiwan, South Korea, Japan, Vietnam, Bangladesh, Indonesia, and other Asia); (2) Africa (Egypt and Other Africa); (3) North America (Mexico, United States and Canada); (4) Latin America (Brazil, Argentina, and Other Latin America); (5) Australia; (6) Middle East (Turkey and Other Middle East); (7) Europe (European Union, Central and Eastern Europe, and Other Western Europe); (8) Former Soviet Union (Uzbekistan, Russia and other FSU). A complete description and documentation of the world fiber model can be found in Pan et al. (2004). The representative country models include supply, demand and the market equilibrium for cotton and man-made fibers.

In the supply side, we include both cotton and man-made fiber production. Area sown to cotton is modeled in a two-stage framework. The first stage determines gross cropping area. The second stage uses economic variables such as expected net returns to allocate area among cotton and competing crops. Similarly, man-made fiber supply is estimated by modeling capacity and utilization separately. Cotton acreage is specified as a function of the expected return of growing cotton and growing competing crops, while cotton yield is specified as a function of cotton price and a time trend. All cotton price support programs are taken into account in the expected net returns.

On the demand side, cotton demand is also estimated following a two-step process. In the first step, total textile consumption is estimated and in the second step, allocations among various fibers such as cotton, wool, and polyester (as a representative for man-made fibers) are estimated based on relative prices. Total textile consumption is divided into textile cotton consumption and textile non-cotton consumption. The model specifies the fiber equivalent of textile consumption as a function of textile fiber price index and income. Total textile production fiber equivalent is calculated as a residual of the total textile fiber consumption and textile net trade.

Cotton export and import equations are specified as a function of domestic and international prices of cotton. For import equations, international prices are calculated by converting world price in domestic currency equivalent after including appropriate tariffs. Similarly, in export equations international prices are calculated by converting the world representative price into the domestic currency equivalent. An ending stock equation is specified as a function of domestic cotton price, cotton production, and beginning stock

Finally, a market clearing equilibrium condition is used to solve for the world cotton price, domestic textile price index, domestic cotton and polyester prices. Polyester price and A-index price are endogenous and determined by equalizing world exports and imports.

Scenarios

To impose the acreage changes due to the offset program, we let the U.S. acreage exogenous to the model based on the percentage reductions found in Table 2. The approach used was to develop a fifteen-year baseline (2009/10-2023/24) assuming continuation of current domestic and border protection policies in all countries. We then compared the projected outcomes under the current situation (called "base") and projected outcomes if carbon offsets are implemented (called "offsets"). We divided the simulation into two scenarios. First, we assumed that the full acreage shifts under Brown et al. are realized ("full offsets"). Second, we assume a more conservative intermediate scenario where 50% of the acreage changes in Brown et al. are realized ("mid offsets").

To evaluate the effects of the domestic offset program on the cotton market, the world cotton market was allowed to react to the resulting price signals from the U.S. domestic offset program over a fifteen year period. The effects were measured by comparing the world cotton price of the baseline to the world cotton price after the U.S. upland cotton harvested area decreases following the assumption made by Brown et al. in scenarios 1 and 2 above. Additionally, the effects of the program on cotton production, consumption, and trade for the world's major users and producers of cotton were derived by comparing baseline projections to their respective quantities with the offset program.

Simulation Results and Welfare Analysis

Simulation Results

Results are reported as average annual changes over the period 2015/16-2023/24 in terms of deviations from baseline estimates. Table 3 gives the principal global results regarding prices and trade for the offset program scenarios for the three years indicated by Brown et al.

Under the full offset scenario, the A-index increases by 3.79%, 3.98% and 3.29% in the three years, which correspond to an average of 6 cents per pound over the baseline. World cotton net trade decreases by 0.24, 0.46 and 0.46 million bales (all less than 1%) in 2015/16, 2019/20, 2023/24, following the adoption of offset program. World cotton production decreases around 0.5-1.5 million bales each year. World cotton mill use would decrease around 0.4-1.5 million bales. Thus, an adoption of the U.S. domestic offset program resulting in the full acreage changes under Brown et al. for the cotton market results in a higher world price and decreases the quantity produced and traded. Overall the effects in the mid-offset scenario are all approximately 50% of the full offset case.

In the United States, the full offset scenario models the effects of adoption of the U.S. domestic offset program on the cotton market based on the assumption of the full acreage shifts found in Brown et al. Baseline estimates of the U.S. domestic price, production, and usage of cotton are reported in Table 4. The baseline domestic cotton farm price is projected to range from about 61.67 cents in 2015/16 to 67.79 cents in 2023/24. With the adoption of the domestic offset program, the domestic U.S. price is estimated to be roughly 5-8 cents higher than the baseline each year. In the final year of analysis, the U.S. domestic price reaches 76.21 cents (Note: these estimates are produced prior to the current increase in cotton price).

For the major cotton traders, major importers such as China, Bangladesh, Pakistan, and Vietnam are projected to reduce their cotton imports (Table 5) while major cotton exporters are projected to increase their cotton exports because of significant increases in the A-index (Table 6). The major gainers include India, Uzbekistan, Brazil, Australia and Western & Central African countries.

Conclusion

This paper analyzed the effects of the U.S. domestic offset program on the world cotton markets using a partial equilibrium model following the assumption given by Brown et al. (2010). Following their estimation, with carbon prices as at $30 per metric ton, the U.S. cotton acreage would decrease 8-16%. As a result, it would increase the world cotton price between 3-4%; U.S. farm price around 8-11%. The results in our study are largely similar to those of Baker et al. and Brown et al., confirming that study's findings that ACES, and its domestic offset program in particular, would cause increases in the domestic prices of several agricultural commodities. However, the overall effects of this increase in the world price on total world trade is tempered by increased exports from India, Brazil, Uzbekistan, Australia, and Western & Central African countries.

These results can provide usefull information into the impacts of offsets on the cotton sector. The domestic offset program encourages landholders to take cropland out of production and convert it to forest by offering strong financial incentives. One of the main reasons for objection to the offset program in cotton industry is that cotton farmers would lose cotton income due to the program. However, because most of the cotton produced in the U.S. is in the southwest and the land transferred to forest is relatively small compared to other regions, cotton farmers in the region may benefit from the price increase if the offset program is adopted, especially compared to other regions in the U.S.

This study contains several limitations. First, the results are based on a study recently done by Brown et al. The simulation results have may vary substantially based on different acreage reduction assumption. Second, as Brown et al. indicates, they used baseline shares to determine the amount of afforestation within each region which did not account for variations in productivity. Third, they did not consider the conversion costs of cropland to forest when Brown et al. estimated the cropland acreage reduction.

References

ACES, 2009. The American Clean Energy and Security Act (Waxman-Markey Bill). Available at http://www.pewclimate.org/acesa.

Babcock, Bruce A. Costs and Benefits to Agriculture from Climate Change Policy. *Iowa Ag Review,* Vol. 15 No. 3, Summer 2009, pp. 1-3.

Brown, Tristan, Amani Elobeid, Jerome Dumortier, and Dermot Hayes. Market Impact of Domestic Offset Programs. Iowa State University CARD Working paper 10-wp 502. Available at http://www.card.iastate.edu/publications/DBS/PDFFiles/10wp502.pdf.

Baker, Justin S., Bruce A. McCarl, Brian C. Murray, Steven K. Rose, Ralph J. Alig, Darius Adams, Greg Latta et al. The Effects of Low-Carbon Policies on Net Farm Income. Working Paper 09-04, Nicholas Institute for Environmental Policy Solutions, Duke University, 2009.

De la Torre Ugarte, Daniel., Burton C. English, Chad Hellwinckel, Tristam O. West, Kimberly L. Jensen, Christopher D. Clark, and R. James Menard. Implications of Climate Change and Energy Legislation to the Agricultural Sector. 25x’25, November 2009.

EPA (Environmental Protection Agency). Analysis of H.R. 2454 in the 111th Congress: The American Clean Energy and Security Act of 2009. Washington DC, June 2009.

———. Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture. Washington DC, November 2005.

Outlaw, Joe L., James W. Richardson, Henry L. Bryant, J. Marc Raulston, George M. Knapek, Brian K. Herbst, Luis A. Ribera, et al. Economic Implications of the EPA Analysis of the Cap and Trade Provisions of H.R. 2454 for U.S. Representative Farms. AFPC Research Paper 09-2, Agricultural Food and Policy Center, Texas A&M University, August 2009.

Pan, S. and S. Mohanty. Technical Documentation of the World Fiber Model. Unpublished memo, 2004.

USDA-ERS (U.S. Department of Agriculture, Economic Research Service). A Preliminary Analysis of the Effects of HR 2454 on U.S. Agriculture. Office of the Chief Economist, Economic Research Service, Washington DC, July 2009.

Table 1. Assumptions on the Change in U.S. Crop Planted Area under Full offset Scenario

	2015	2020	2023
U.S.	-4.20%	-9.20%	-11.60%
Alabama	-1.50%	-2.90%	-3.70%
Florida	-0.20%	-1.10%	-1.50%
Georgia	-1.50%	-3.20%	-3.90%
New Mexico	-3.00%	-6.90%	-8.80%
Oklahoma	-5.40%	-12.20%	-15.90%
Texas	-3.50%	-7.50%	-9.50%
North Carolina	-1.30%	-2.70%	-3.30%
South Carolina	-0.80%	-1.70%	-2.00%
Tennesee	-1.50%	-3.40%	-4.30%
Virginia	-1.50%	-3.40%	-4.40%
Missouri	-8.50%	-18.50%	-23.60%
Mississippi	-30.30%	-66.30%	-84.50%
Louisiana	-29.20%	-64.00%	-81.50%
Arkansas	-34.50%	-75.50%	-96.30%
Far West	-1.50%	-3.20%	-4.10%

Data source: Brown et al. (2010).

Table 2. Assumption on US Upland Cotton Planted Area under Full offset Scenario

	15/16	20/21	23/24
US total	-8.3%	-13.5%	-16.3%
Alabama	-1.5%	-1.3%	-0.8%
Florida	-1.9%	-2.7%	-2.9%
Georgia	-1.9%	-2.9%	-3.3%
New Mexico	-3.1%	-4.0%	-4.4%
Oklahoma	-3.1%	-4.0%	-4.4%
Texas	-3.7%	-5.5%	-6.3%
North Carolina	-1.7%	-2.1%	-2.2%
South Carolina	-1.7%	-2.2%	-2.4%
Tennesee	-1.7%	-2.1%	-2.1%
Virginia	-1.8%	-2.7%	-3.1%
Missouri	-18.4%	-31.8%	-39.6%
Arkansas	-43.4%	-78.2%	-99.0%
Louisiana	-43.5%	-78.2%	-98.8%
Mississippi	-44.2%	-78.1%	-97.7%
Far West	2.5%	5.4%	6.9%

Data source: Brown et al. (2010).

Table 3. Effects of Offset Program on World Cotton Market

		2015/16	2019/20	2023/24
		Cents per pound		
A-index	Base	78.13	81.16	85.29
	Full offset Scenario	81.09	84.38	88.09
	Full Offset change	3.79%	3.98%	3.29%
	Mid offset Scenario	79.60	82.76	86.21
	Mid offset Change	1.89%	1.98%	1.08%
		Thousand Bales		
World Production	Base	127348.16	135494.3	141131.5
	Full offset Scenario	126856.26	134861.1	139551.3
	Full Offset change	-0.39%	-0.47%	-1.12%
	Mid offset Scenario	127101.41	135175.17	140037.14
	Mid offset Change	-0.19%	-0.24%	-0.78%
World Trade	Base	41936.17	45439.61	49621.90
	Full offset Scenario	41694.96	44978.12	49158.21
	Full Offset change	-0.58%	-1.02%	-0.93%
	Mid offset Scenario	41814.98	45208.14	49485.08
	Mid offset Change	-0.29%	-0.51%	-0.28%
World Mill Use	Base	126768.86	135092.81	141301.22
	Full offset Scenario	126349.11	134476.04	139835.91
	Full Offset change	-0.33%	-0.46%	-1.04%
	Mid offset Scenario	126557.94	134781.50	140284.84
	Mid offset Change	-0.17%	-0.23%	-0.72%

Data source: estimated by authors.

Table 4. Effects of Offset Program on U.S. Cotton Market

		2015/16	2019/20	2023/24
		Cents per pound		
US farm price	Base	61.67	64.72	67.79
	Full offset Scenario	66.49	71.67	76.21
	Full Offset change	7.82%	10.74%	12.42%
	Mid offset Scenario	64.03	68.09	71.47
	Mid offset Change	3.83%	5.20%	5.42%
		Thousand Bales		
US cotton production	Base	16627.69	17362.80	17824.86
	Full offset Scenario	15254.03	15185.58	14911.92
	Full Offset change	-8.26%	-12.54%	-16.34%
	Mid offset Scenario	15940.86	16274.19	16368.39
	Mid offset Change	-4.13%	-6.27%	-8.17%
Export	Base	13760.08	14572.72	15794.16
	Full offset Scenario	12436.92	12458.41	12972.40
	Full Offset change	-9.62%	-14.51%	-17.87%
	Mid offset Scenario	13097.76	13514.25	14374.21
	Mid offset Change	-4.81%	-7.26%	-8.99%
mill use	Base	2844.56	2768.11	2164.68
	Full offset Scenario	2818.81	2723.28	2123.99
	Full Offset change	-0.91%	-1.62%	-1.88%
	Mid offset Scenario	2831.99	2746.57	2158.05
	Mid offset Change	-0.44%	-0.78%	-0.31%
Ending stock	Base	4420.40	4276.94	3948.59
	Full offset Scenario	4285.81	4101.12	3760.57
	Full Offset change	-3.04%	-4.11%	-4.76%
	Mid offset Scenario	4354.47	4191.82	3867.33
	Mid offset Change	-1.49%	-1.99%	-2.06%

Data source: estimated by authors.

Table 5. Effects of Offset Program on Major Cotton Importers (thousand Bales)

		2015/16	2019/20	2023/24
China	Base	18159.92	19205.27	20892.85
	Full offset Scenario	18155.32	19202.16	20891.46
	Full Offset change	-0.03%	-0.02%	-0.01%
	Mid offset Scenario	18157.61	19203.70	20891.83
	Mid offset Change	-0.01%	-0.01%	0.00%
Bangladesh	Base	5094.64	5665.83	6238.16
	Full offset Scenario	5093.48	5664.51	6236.78
	Full Offset change	-0.02%	-0.02%	-0.02%
	Mid offset Scenario	5094.06	5665.18	6237.68
	Mid offset Change	-0.01%	-0.01%	-0.01%
Pakistan	Base	2549.11	3758.38	6280.00
	Full offset Scenario	2488.40	3708.87	6248.31
	Full Offset change	-2.38%	-1.32%	-0.50%
	Mid offset Scenario	2533.71	3733.52	6277.22
	Mid offset Change	-0.60%	-0.66%	-0.04%
Vietnam	Base	1788.78	1968.92	2148.60
	Full offset Scenario	1785.91	1965.78	2145.83
	Full Offset change	-0.16%	-0.16%	-0.13%
	Mid offset Scenario	1787.35	1967.35	2147.68
	Mid offset Change	-0.08%	-0.08%	-0.04%

Data source: estimated by authors.

Table 6. Effects of Offset Program on Major Cotton Exporters (thousand Bales)

		2015/16	2019/20	2023/24
India	Base	8814.15	8806.25	10584.60
	Full offset Scenario	9556.22	10019.00	12693.53
	Full Offset change	8.42%	13.77%	19.92%
	Mid offset Scenario	9184.73	9411.85	11851.84
	Mid offset Change	4.20%	6.88%	11.97%
Brazil	Base	3137.12	3606.50	5182.45
	Full offset Scenario	3183.19	3689.15	5202.58
	Full Offset change	1.47%	2.29%	0.39%
	Mid offset Scenario	3160.90	3649.42	5198.13
	Mid offset Change	0.76%	1.19%	0.30%
Uzbekistan	Base	2131.83	2299.18	2798.39
	Full offset Scenario	2201.90	2377.46	2859.88
	Full Offset change	3.29%	3.40%	2.20%
	Mid offset Scenario	2166.71	2338.19	2815.87
	Mid offset Change	1.64%	1.70%	0.62%
Australia	Base	2354.72	2629.37	2583.90
	Full offset Scenario	2436.52	2757.48	2719.26
	Full Offset change	3.47%	4.87%	5.24%
	Mid offset Scenario	2395.62	2693.19	2634.95
	Mid offset Change	1.74%	2.43%	1.98%
WCA countries	Base	2189.98	2333.74	2529.91
	Full offset Scenario	2231.31	2391.80	2549.85
	Full Offset change	1.89%	2.49%	0.79%
	Mid offset Scenario	2210.52	2362.69	2543.39
	Mid offset Change	0.94%	1.24%	0.53%

Data source: estimated by authors.