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Abstract

In this paper we estimate the impact of the 2004 U.S. tobacco quota buyout in both the U.S. and foreign tobacco markets. It is important to understand the impact of the buyout given the trend of decreasing demand for U.S. tobacco in domestic and international markets. While some empirical research has estimated the impact of the tobacco buyout, none has estimated the impact on both flue-cured and burley tobacco separately, and accounted for the response of imports. Using a multi-market partial equilibrium model with elasticity estimates from the tobacco literature and tobacco production cost data, we simulate the impact of the quota buyout on prices and shipments for U.S. and foreign suppliers in U.S. and foreign markets. We find that shipments of both U.S.-produced burley and flue-cured tobacco increase to both markets, while shipments of foreign produced tobacco falls to both markets. Also, assuming that supply is highly elastic from all sources, market prices for U.S.-produced tobacco are estimated to fall by about 20 to 23 percent, while market prices for foreign-produced tobacco are estimated to fall by less than one percent.

Introduction

In 2004, the U.S. Congress terminated the federal tobacco program, eliminating price supports and geographic and quantitative restrictions on U.S. tobacco production. The termination of the program was precipitated by a crisis in the U.S. tobacco farming sector, which experienced a steady decline in domestic and international demand and led to a sharp reduction in U.S. production and farm receipts. A variety of factors contributed to the decline including strong competition from low-cost international suppliers, falling domestic cigarette consumption, and tobacco-saving technological advancements in cigarette manufacturing. Under a deregulated market, in which associated program costs are eliminated, the U.S. growing sector expects that more competitively-priced U.S. tobacco will regain some of its lost domestic market share, but views its greatest opportunity in international markets that require flavor-quality tobacco.

In this paper we estimate the impact of the 2004 termination of the federal tobacco program in both the U.S. and foreign tobacco markets. The analysis focuses on world production of flavor-quality processed tobacco (stemmed and stripped) that competes with U.S.-produced flue-cured and burley tobacco in world markets. For flue-cured tobacco, these suppliers include

Brazil, Zimbabwe, and Argentina; and for burley, Brazil, Malawi, and Argentina.[1] Using a multi-market partial equilibrium model and based on elasticity estimates from previous studies, we simulate the impact of the quota buyout on U.S. and foreign-produced tobacco prices and shipments in the U.S. and foreign markets based on 2004 production and trade data.

The elimination of the tobacco program is modeled as the removal of a production tax equivalent to the price wedge generated by the land and quota costs (quota license and rental fees) associated with the tobacco program. The analysis reveals the equilibrium level of U.S. flue-cured and burley production, exports and imports, once production adjusts to equilibrium in the deregulated market. We realize that it will take several years for tobacco markets to reach the equilibrium level estimated by the model.

It is important to understand the impact of the buyout given the decline of U.S. production under the federal program and the expectations of domestic growers that lower-priced U.S. tobacco will stimulate demand, particularly in export markets. It is also important to understand the output and trade effects of federal farm program deregulation. While some research has provided quantitative estimates of the impact of modifying the tobacco buyout, none has estimated the impact on both flue-cured and burley tobacco separately and for the response of imports to deregulated production. Flue-cured and burley tobacco are analyzed separately because demand for flue-cured is more elastic than demand for burley, and exhibit different responses to shifts in prices. Conducting separate simulations for flue-cured and burley tobacco provides a more detailed understanding of the potential effects of deregulation on shipments and trade of these principal U.S. tobacco varieties.

We find that shipments of both U.S.-produced flue-cured and burley tobacco increase to both markets, while shipments of foreign-produced tobacco fall to both markets. Also, assuming

[1] Certain other countries, such as India, China, Thailand, Italy, and others produce some flavor-quality tobacco; however, a substantial portion of their production is lower-quality, filler-grade leaf, which is not directly substitutable with higher-quality U.S. tobacco. Because of data limitations, the portion of those countries flavor-quality tobacco production could not be determined.

that supply is highly elastic from all sources, market prices for U.S.-produced tobacco are estimated to fall by about 20 to 23 percent, while market prices for foreign-produced tobacco are estimated to fall by less than one percent. The results of this study should be of interest to tobacco sector participants as well as those interested in the output and trade effects of farm policy deregulation.

Background

Flue-cured and burley tobacco leaf account for over 90 percent of U.S. tobacco production. These leaf types, combined with imported oriental tobacco, are the basic tobacco ingredients of the *American blend* cigarette. Both U.S-produced tobacco types are regarded as flavor-quality leaf in the U.S. and international markets. Flavor-quality tobacco imparts the taste and aroma characteristics to cigarettes, in contrast to lower-quality, filler-type tobacco. Although tobacco is produced worldwide, only a relatively small number of suppliers produce flavor-quality leaf. From the time of the program's establishment during the Great Depression in 1938 until 2004, flue-cured and burley tobacco were produced under the supply management system of the federal tobacco program administered by the U.S. Department of Agriculture (USDA).[2]

The federal tobacco program was designed to maintain high and stable prices for farmers by restricting output through a system of marketing (production) quotas to correspond with expected demand.[3] Under the program, national production quotas for flue-cured and burley were set annually based on a formula of domestic cigarette manufacturers purchasing intentions, the preceding 3-year average of exports, and stock level adjustments. The national quotas were then subdivided among quota holders allotting the number of pounds/acreage corresponding to the quantity of flue-cured or burley that could be produced and marketed by a farm. In return for limiting production, farmers were provided support prices. Marketing quotas were allocated to

[2] The federal program was dependent on quota owner and farmer referendum. In almost all years farmers approved production limits and price support. For more information see , Serletis. *U.S. Tobacco Quota Buyout;* and Capehart, *U.S. Tobacco Industry Responding to new Competitors, New Challenges*.
[3] The program was based on the commodity support legislation, the Agricultural Adjustment Act of 1933. The marketing quota and price support legislation was included in the Agricultural Adjustment Act of 1938.

farms based on geographic production levels in 1938.[4] The right to produce and market tobacco conferred economic value to the quotas which, under certain rules, principally geographic restrictions, could be leased or rented.

The federal tobacco program worked well as long as U.S. tobacco commanded premium prices based on superior quality; however, as low-cost foreign suppliers, particularly Brazil, improved their quality and increased output, relatively high-priced U.S. leaf steadily lost market share in the United States and key export markets. In addition to strong competition from foreign suppliers, other factors affecting demand for U.S. tobacco included declining rates of domestic cigarette consumption, owing to increased health concerns; falling exports of cigarettes, as U.S. manufacturers shifted production to foreign markets; and technological advancements in cigarette manufacturing, which allowed for lower-value leaf and less tobacco per cigarette.

Falling demand since the late 1990s led to a significant contraction of the national marketing quotas. During 1997-2004, the national marketing quotas for flue-cured and burley fell by 51 percent and 62 percent, respectively.[5] Farm output of flue-cured decreased from 460 million mt farm sales weight (FSW) to 237 million mt, while production of burley fell from 285,000 mt to 133,000 mt.[6] Slipping demand in established high-income Asian and European markets during the period, led to a substantial fall in exports. U.S. exports of processed flue-cured declined by over 40 percent in volume (112,000 mt to 64,000 mt) and value ($807 million to $468 million). Although the volume of burley exports rose 3 percent (to 58,000 mt) during the same period, the value of exports fell by 18 percent (to $366 million) as shipments were diverted to lower-income markets.[7] Not only did U.S. tobacco lose market share in foreign markets, but demand in the domestic market also contracted as U.S. cigarette manufacturers increasingly

[4] The traditional major U.S. flue-cured producing areas are in North Carolina and Virginia, while burley production has been centered in Kentucky and Tennessee. Under the federal program, strict geographic limitations were set for tobacco farming.
[5] Capehart. *Tobacco Outlook*, September 23, 2005. p. 28.
[6] USDA, National Agricultural Statistics Service (NASS). *Crop Production*. May 2006.
[7] USITC DataWeb.

switched to lower-cost imported tobacco. U.S. tobacco imports more than doubled during the early 1990s before leveling off at historically high levels.

The sharp decline in the national flue-cured and burley marketing quotas brought the federal tobacco program to the breaking point. In 1938, when the tobacco program was initiated, only active farmers held marketing quotas. By the late 1990s and early 2000s, a substantial portion of quotas, as many as one-third to one-half of the total, were held by non-producing absentee owners who leased or rented their production rights. Active tobacco farmers who did not own quotas, or needed additional marketing quotas to maintain incomes were required to rent or lease quotas. As the national flue-cured and burley quotas declined, farmers bid up the rental and lease prices of quotas to historically high levels.[8] At the time of the termination of the tobacco program, quota rental and lease expenses accounted for as much as one-third of production costs. Moreover, although the number of U.S. tobacco farmers contracted substantially since the program's inception in 1938, it encouraged a large number of less efficient tobacco growers to continue farming.

The policy debate surrounding terminating the federal program through a quota buyout had been simmering for over a decade with the first significant Congressional buyout legislation introduced in 1997.[9] In 2000, a Presidential Commission examined the crisis in the U.S. tobacco growing sector and concluded that the U.S. tobacco program was no longer capable of providing sufficient income for the number of farmers and non-productive quota owners who participated in

[8] The sharp rise in rental and lease prices during the early 2000s resulted from active farmers being forced to acquire additional quotas to compensate for the falling production levels that each quota allowed them to produce and market. This resulted in farmers bidding up the quota rental and lease prices to high, and according to many industry observers at the time, unsustainable levels.

[9] During negotiations between tobacco product manufacturers and States Attorneys General on a settlement to compensate States for health care costs incurred from tobacco-related disease. The eventual 1998 Master Settlement Agreement did not include a quota buyout, but farmers and quota owners were to be paid $5.15 billion over a 12-year period. See Capehart, Thomas*: Is There A Quota Buyout in the Future?* Agricultural Outlook, USDA,ERS. August 2002.

the system. The Commission recommended a buyout coupled with Food and Drug Administration regulation of tobacco products.[10]

As demand continued to erode, a buyout became increasingly attractive to growers and quota holders. The proposal was embraced by tobacco farmers whose income had dwindled since the 1990s and absentee owners who saw their quota assets diminishing or potentially becoming worthless if the program collapsed. The buyout legislation, The Fair and Equitable Tobacco Reform Act of 2004, became law in October, making the 2005 growing season completely deregulated. The buyout, costing $10 billion and funded by assessments on tobacco product manufacturers and importers, compensated quota holders for the value of their marketing rights and provided payments to tobacco farmers to transition out of tobacco farming or make substantial new investments to participate in a more competitive free-market environment.[11]

Literature Review

Beghin and Chang (1992) and Brown and Martin (1996) estimated the impact of potential changes to the tobacco quota by assuming that demand changes by the amount the quota is assumed to change by (therefore assuming that the quota remains binding). Brown, Snell, and Tiller (1999) and Brown, Rucker, and Thurman (2007) estimated the impact of eliminating the tobacco program by assuming that program elimination drives the price of tobacco down to marginal cost.[12] While Brown, Snell, and Tiller (1999) use average marginal cost from across the United States, Brown, Rucker, and Thurman (2007) use state, and in some cases, county-level

[10] *Tobacco at a Crossroad, A Call for Action*, Final Report of the President's Commission on Improving Economic Opportunity in Communities Dependent on Tobacco Production while Protecting Public Health, Issued May 14, 2001. The eventual legislation excluded FDA oversight over tobacco products.

[11] For additional information on the Buyout USDA, Farm Service Agency website found at: http://www.fsa.usda.gov/FSA/webapp?area=home&subject=toba&topic=landing; and Womach. *Tobacco Quota Buyout*.

[12] The typical method for estimating the impact of eliminating quotas is to estimate the removal a price wedge which represents the difference between the observed market price with the quota and an estimate of the underlying marginal cost. If the quota licenses are tradeable, the license prices can be used a proxy for this price wedge. For an example of this applied to textile quotas, see USITC, Import Restraints, 4th update, pp. 69-77.

marginal costs derived from quota lease rates, tobacco price differentials, and the nationwide level of price support taken from Rucker, Thurman, and Sumner (1995).

Given large changes in the industry over the last decade, the estimated impact from most of the previous studies may not be directly comparable to our work. One exception is Brown, Rucker, and Thurman (2007), which using 2003 base data, estimate that the 2004 tobacco buyout would increase production of U.S.-produced flue-cured tobacco to about 684 million pounds to 878 million pounds, which is an increase of about 45 percent to 86 percent. However, they do not estimate the impact on burley tobacco or the impact on foreign-produced tobacco in any market.

Even if the estimated impact of previous studies is not directly comparable to our work, the price elasticities of demand estimated in these papers should provide some insight into the degree to which consumers of tobacco respond to price changes. Although the estimated own and cross price elasticities of demand elasticities vary by study, they suggest that demand for flue-cured tobacco is more elastic than demand for burley tobacco, that export demand for U.S. produced tobacco is more elastic than demand in the U.S. market, that demand for imported tobacco is less elastic than demand for U.S.-produced tobacco in the U.S. market, and that U.S.-produced and imported tobacco are substitutes to some extent.[13]

Model structure

To estimate the impact of removing the U.S. tobacco production quotas, we use the multi-market partial equilibrium model GSIM (Global Simulation Model) model developed in Francois and Hall (2003). The benefit of using a multi-market model is that we can simultaneously estimate the impact of removing the production quota on shipments of U.S.-produced tobacco and foreign-produced tobacco to U.S. and foreign markets. The GSIM model assumes national product differentiation, a constant aggregate elasticity of demand, and constant import supply elasticities, and solves for global equilibrium prices that can be used to estimate

[13] See Appendix A for a more detailed review of elasticities.

changes in national price and shipments.[14] The GSIM model is similar in structure to the log-linear version of the single market COMPAS model described in Francois and Hall (1997), but account for linkages between multiple markets.[15]

Market data

The GSIM model requires market shares for the United States and foreign suppliers of flavor-quality tobacco in both the U.S. and foreign markets. These data are derived by using values of tobacco production, exports, and imports for each supplier. Export and import data are available from suppliers' official trade statistics; however, there are no available data for the value of processed (stemmed and stripped) tobacco for all suppliers. Therefore, we estimate the values of processed tobacco using export unit values and farm sales weight (FSW) production data. FSW production is converted to processed weight, and then valued at the export unit price. For flue-cured tobacco, the conversion factor from FSW to processed weight is 0.65; for burley tobacco, the conversion factor is 0.60.[16] The conversion factor accounts for the loss of moisture from curing and drying, and byproducts such as stems and scraps from the stemming and redrying process. The market data used in the model are presented in tables 1 and 2.

Simulating the removal of the U.S. tobacco quota

The estimated impact of removing the production quotas is based on the latest available USDA flue-cured and burley tobacco costs and returns data.[17] The removal of the costs of land and quota associated with the tobacco program is modeled as the removal of a production tax equivalent to the price wedge generated by these program costs, estimated to be 27 percent for burley tobacco and 31 percent for flue-cured tobacco. This is equivalent to a 0.79 percent

[14] We used the "expanded stand-alone" version of the GSIM model for which domestic production, domestic production subsidies, and bilateral export subsidies are included.
[15] See Francois and Hall (2003) for the equations underlying the model.
[16] Conversion factors based on conversations with tobacco industry representatives.
[17] The price wedge for the tobacco program costs was estimated using data from Linda Foreman, *Tobacco Production Costs and Returns.*

production subsidy for burley tobacco and a 0.76 percent production subsidy for flue-cure tobacco.[18]

When the production tax, as measured by the program costs, is removed, the market supply curve shifts from S^1_{us} to S^2_{us} ,where S^k_i is the market supply curve for tobacco produced in country i for k=1 when the production quotas are in place and k=2 when the production quotas have been removed (see figure 1).[19] The shift in supply allows for increased production of tobacco, which causes the price of U.S. produced tobacco to decrease from P^1_{us} to P^2_{us} , quantity supplied for U.S. produced tobacco in both the U.S. and foreign markets to increase from $q^1_{us,us}$ to $q^2_{us,us}$, and $q^1_{us,for}$ to $q^2_{us,for}$ respectively, with total U.S. shipments increasing from Q^1_{us} to Q^2_{us}, where P^k_i is the price of tobacco from source i , $q^k_{i,j}$ is the quantity demanded from source i in market, and $Q^k_i = q^k_{i,i} + q^k_{i,j}$, all for k = 1, 2. Supply is assumed to increase until the price of each type of tobacco is equal to its marginal cost.

Since U.S. and foreign tobacco are imperfect substitutes, the decrease in the price of U.S.-produced tobacco causes demand of foreign-produced tobacco in the U.S market to decrease from $D^1_{for,us}$ to $D^2_{for,us}$, demand of foreign-produced tobacco in the foreign market to decrease from $D^1_{for,for}$ to $D^2_{for,for}$, and total market demand for foreign-produced tobacco to decrease from D^1_{for} to D^2_{for} , where D^k_{ij} is market demand for tobacco from source i in market j, $D^k_i = D^k_{i,i} + D^k_{i,j}$, all for k = 1, 2. The decrease in demand causes the price of foreign produced tobacco to decrease from P^1_{for} to P^2_{for}, quantity demanded for foreign produced tobacco in both the U.S. and foreign markets to decrease from $q^1_{for,us}$ to $q^2_{for,us}$, and $q^1_{for,for}$ to $q^2_{for,for}$ respectively, with total foreign shipments decreasing from Q^1_{us} to Q^2_{us}.

[18] These price wedges are based on 2004 data. Using 2003 data, the price wedge generated by the license fee is estimated to be 29 percent for burley tobacco and 28 percent for flue cured tobacco. This is equivalent to a 0.78 percent production subsidy for both burley tobacco and flue-cured tobacco.

[19] In cases where no change occurs as a result of the change in production quotas, k may remain equal to 1.

In addition, the decrease in price for foreign-produced tobacco encourages purchasers to substitute foreign tobacco for U.S. tobacco to some extent, decreasing demand for U.S. tobacco in both the U.S. and foreign markets which dampens, but does not dominate the increases in the price and quantity demanded. This impact was omitted from figure 1 so as not to clutter the figure.

To account for the uncertainty of the values of elasticities, we estimate the model for a range of values of substitution, aggregate demand, and supply elasticities. To capture the estimated impact of the various combinations of elasticities values within these ranges, we repeated draw elasticity values from independent uniform distributions and for each draw and solve for the equilibrium.[20] The range of the uniform distributions used to draw the substitution and aggregate demand elasticites were chosen so that the resulting own-price and cross-price elasticities of demand are similar to those estimated in the literature as described in appendix A. A range of 30 to 70 was used for the uniform distribution from which the supply elasticities were chosen to reflect a highly elastic supply as a result of the ending of the production quotas. The assumption of highly elastic supply will assure that the estimated percentage change of volume will be greater than the estimated percentage change in price. The reported results are a range of the results generated from 5,000 draws from these distributions.

Table 3 shows the baseline data and assumptions used to estimate the impact of removing the quotas on flue-cured and burley tobacco. The model was estimated using 2004 baseline data since the quota removal effectively took effect in 2005.[21] The corresponding ranges of own and

[20] Brown, Rucker, and Thurman (2006), use a similar approach in reporting their results, except that they use distribution other than the uniform. We use the uniform distribution since we do not have any information regarding the distribution of the substitution, aggregate demand, and supply elasticities.

[21] For comparison, the simulation was also run using 2003 baseline data (see tables B-1 to B-3 in appendix B). Differences in results between the two base years are mostly due to differences in market shares and differences in the license price in the two years. Other factors held constant, a larger license price will have a larger impact on changes in prices and volumes and a larger market share will increase the cross price elasticity and therefore lead to a greater impact on the price and volume from that source into the market in question. The cross price elasticities are a more important factor in determining the magnitude of the impact on prices and volume of foreign-produced tobacco than the impact on U.S.-produced tobacco since

cross price elasticities that are derived from aggregate demand and substitution elasticities and based on 2004 market shares.

Results

Because demand for U.S.-produced burley tobacco is assumed to less elastic than for flue-cured tobacco in all markets, U.S. shipments of flue-cured tobacco will tend to increase by more than U.S. shipments of burley tobacco. Table 4 reports that U.S. shipments of flue-cured tobacco to all markets are estimated to increase from 42 percent to 55 percent, and for burley from 18 percent to 36 percent.

The assumption that foreign markets for tobacco are more price sensitive than the U.S. market means that U.S. exports will tend to increase by more than domestic shipments. Table 4 indicates U.S. flue-cured exports rise by 78 to 99 percent and burley exports increase by 24 to 48 percent. This compares to more modest gains in domestic shipments of flue-cured (15-25 percent) and burley (1-4 percent).

The assumption that supply is highly elastic for both U.S. produced and foreign produced tobacco means that most of the impact of quota elimination will be seen in changes in the market price for U.S. produced tobacco and little will be seen in changes in the price received by U.S. producers. Table 5 indicates market prices for U.S.-produced tobacco are estimated to fall by about 22 percent to 23 percent for flue-cured tobacco and 20 percent to 21 percent for burley tobacco, while foreign-produced tobacco falls by less than one percent for both tobacco types. Prices received by both U.S. and foreign producers increase by less than two percent.

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the cross price elasticities determine the degree of the primary impact on foreign-produced tobacco, but only the feedback effects for U.S.-produced tobacco.

For example, the impact on the volume of U.S. shipments is lower on average using the 2003 data since the license price is smaller in 2003 while the impact on the volume of shipments of foreign produced burley tobacco and the price of U.S. produced burley tobacco are larger on average because of the larger market share for U.S. produced burley tobacco in 2003. The impact on shipments of U.S. flue-cured tobacco is slightly larger on average in 2003 for shipments to the U.S. market because the impact of the smaller market share and larger license price, while the impact on shipments of U.S.-produced flue-cured tobacco to the other markets is smaller since the impact of a larger market share dominates the impact of the larger license price.

Conclusion

We estimate that the removal of the flue-cured and burley production quotas will increase U.S. shipments of both tobacco types and decrease shipments of foreign-produced tobacco. By incorporating the assumption that foreign markets for tobacco are more price sensitive than the U.S. market, the simulation also confirms the expectation of many U.S. growers that export markets will experience the largest gains from elimination of the tobacco program. With the assumption that demand for flue-cured tobacco is more elastic than burly, the simulation results indicate that U.S.-produced flue-cured and to a lesser extent burley tobacco will see the largest percentage gains from the elimination of the federal tobacco program.

Our estimates of U.S. production and exports seem realistic since the estimated increase in shipments of U.S.-produced tobacco, post-buyout, is of the same magnitude as the actual increase between 2004 and 2006. The estimated impact on U.S.-produced flue-cured tobacco also lies within the upper range of estimates by Brown, Rucker, and Thurman (2007). Although our results indicate elimination of the program will cause U.S.-produced tobacco prices to fall, they will still remain significantly higher than foreign-supplied tobacco. Moreover, the simulation estimates that deregulation in and of itself will not lead to a recovery of U.S. production and exports to the levels of the 1990s.

Table 1 Flue-cured tobacco: flavor-quality production and trade, 2004

Supplier/Item	FSW production (MT)	Stemmed/ stripped production (MT)	Export unit value ($/kg)	Stemmed/ stripped value ($1,000)	Exports ($1,000)	Imports ($1,000)
United States	236,567	153,768	7.394	1,125,738	467,702	131,550
Brazil	1,008,150	458,250	2.99	1,370,168	1,052,607	6,240
Zimbabwe	69,518	45,187	2.01	124,715	190,332	NA
Argentina	91,200	59,280	2.78	164,798	89,151	769

Note: Export and import data only apply to flavor-quality tobacco. For example, U.S. imports show shipments from Brazil, Zimbabwe, and Argentina to the United States.

Sources: United States: FSW production, USDA/NASS, *Crop Production*. May 2006. Export unit value (HTS 2401.20.80.10), exports, imports, USITC *DataWeb*. Brazil: FSW production, USDA, FAS *Brazil Tobacco and Products Annual*, GAIN Rpt.# BR5014; Export unit value (HS 2401.20.30), exports and imports, Global Trade Atlas (GTA). Zimbabwe: FSW production, USDA/FAS Gain Report # RH5004. Export unit value GTA (HS 2401.20); exports GTA and USITC *DataWeb*. Argentina: FSW production, USDA, FAS *Argentina Tobacco and Products Annual*, GAIN Rpt.# AR5013; export unit value (HS 2401.20.30), exports and imports, GTA.

Table 2 Burley tobacco: flavor-quality production, exports and imports, 2004

Supplier/Item	Production FSW (MT)	Production stemmed/ stripped (MT)	Export unit value ($/kg)	Stemmed/ stripped value ($1,000)	Exports ($1,000)	Imports ($1,000)
United States	132,528	79,517	6.35	504,774	365,500	91,253
Brazil	147,000	88,200	2.88	254,016	224,179	1,052
Malawi	151,000	90,600	2.01	182,106	182,106	NA
Argentina	56,400	33,840	2.88	97,459	77,347	NA

Note: Export and import data only apply to flavor-quality tobacco. For example, U.S. imports show shipments from Brazil, Malawi, and Argentina to the United States.

Sources: United States: FSW production, USDA/NASS, *Crop Production,* May 2006. Export unit value (HTS 2401.20.80.20), exports, imports, USITC *DataWeb*. Brazil: FSW production, USDA, FAS *Brazil Tobacco and Products Annual*, GAIN Rpt.# BR5014; Export unit value (HS 2401.20.40), exports and imports, Global Trade Atlas (GTA). Malawi: FSW production, Universal Corp *Supply and Demand*. Export unit value (HS 2401.20), exports and imports, GTA. Argentina: FSW production, USDA, FAS *Argentina Tobacco and Products Annual*, GAIN Rpt.# AR5013, Export unit value (HS 2401.20.30) exports and imports GTS.

Table 3 Baseline data and assumptions-2004 base data

	Destination			
	Flue-cured		Burley	
Source	US	Foreign	US	Foreign
Baseline values (thousands of dollars)				
US	658,036	467,702	139,274	365,500
Foreign	131,550	1,593,748	91,253	442,328
Market shares (percent)				
US	81.8	21.8	58.4	43.9
Foreign	18.2	78.2	41.6	56.1
Elasticity assumptions (uniform distribution)				
Aggregate demand	-0.550 to -0.850	-0.350 to -0.650	-0.009 to -0.011	-0.050 to -0.250
Supply	30 to 70	30 to 70	30 to 70	30 to 70
Substitution	1.10 to 2.10	4.40 to 5.40	0.10 to 0.40	2.00 to 4.00
Own-price elasticities of demand generated from elasticity assumptions and market shares				
US	-0.65 to -1.08	-3.52 to -4.36	-0.05 to -0.17	-1.15 to -2.34
Foreign	-1.00 to -1.87	-1.24 to -1.68	-0.06 to -0.24	-0.92 to -1.89
Cross-price elasticities of demand generated from elasticity assumptions and market shares				
US	0.21 to 1.26	0.82 to 1.10	0.05 to 0.23	0.77 to 1.72
Foreign	0.05 to 0.28	2.94 to 3.94	0.04 to 0.16	0.98 to 2.20

Note: Shipments of U.S. production to the U.S. market are calculated as the difference between production and exports, effectively assuming that inventory levels are unchanged. Shipments of U.S. production to other countries are assumed to be U.S. exports. Shipments of production from other countries to the United States are assumed to be U.S. imports from countries which produce flavor-quality tobacco. Shipments of foreign production to the foreign market are calculated as the difference between production in each country which produces flavor quality tobacco minus U.S. imports from these countries. The exception is for flue-cured tobacco produced in Zimbabwe which export is used instead of production since exports exceed production due to sales of inventories.

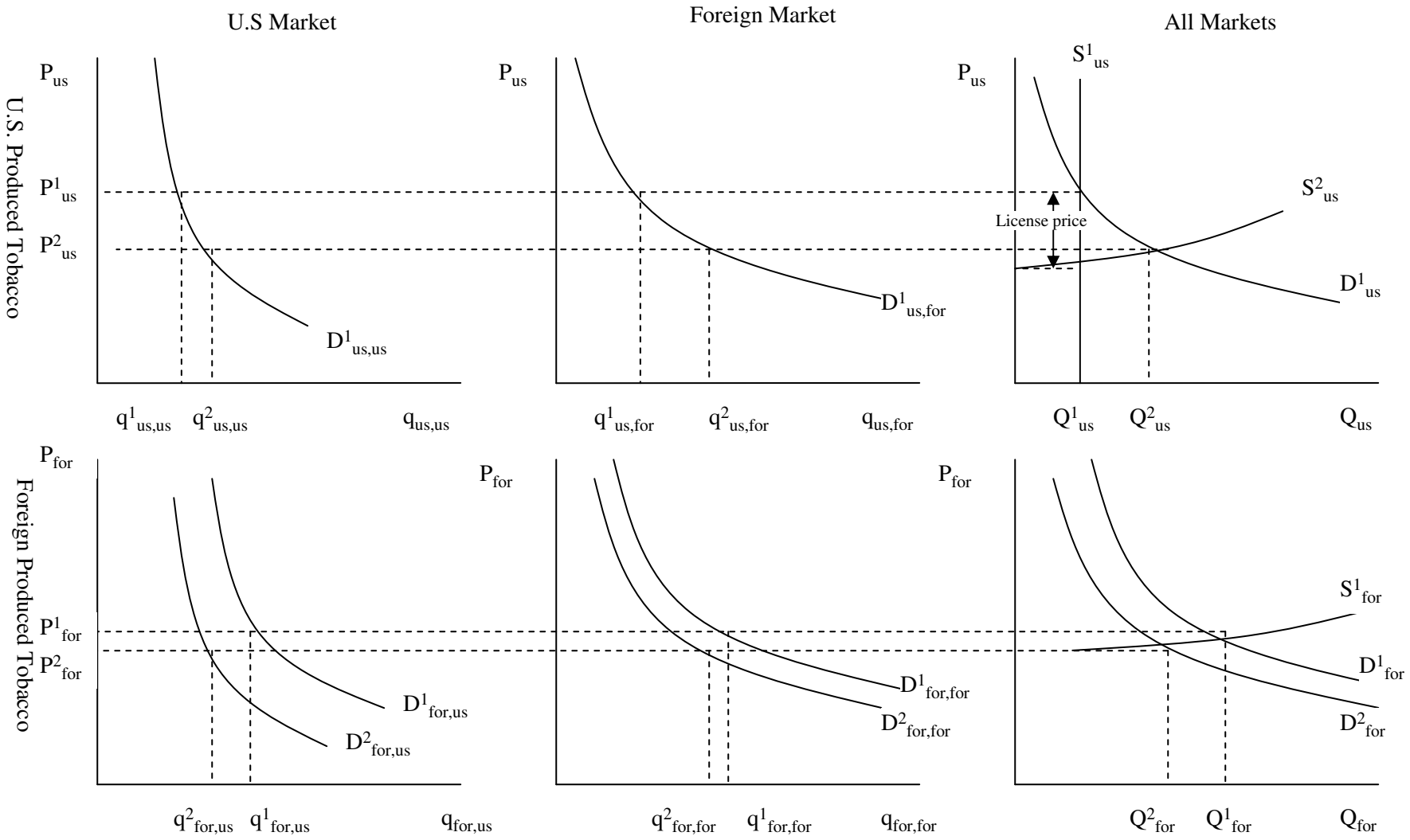
Table 4 Changes in Quantity and Value-2004 base data

	Destination					
	Flue-cured			Burley		
	US	Foreign	Total	US	Foreign	Total
Source						
Quantity (percent)						
US	15 to 25	78 to 99	42 to 55	1 to 4	24 to 48	18 to 36
Foreign	-4 to -29	-18 to -25	-17 to -25	-1 to -5	-16 to -35	-13 to -29
Value at consumer price (percent)						
US	-4 to -12	38 to 53	10 to 20	-18 to -20	-2 to 17	-7 to 7
Foreign	-5 to -29	-18 to -25	-18 to -25	-1 to -5	-16 to -36	-14 to -30
Total	-7 to -12	-5 to -8	-6 to -9	-13 to -13	-9 to -12	-10 to -12

Table 5 Changes in Price-2004 base data

	Source/Destination	Flue-cured (percent)	Burley (percent)
Market Price	US	-22 to -23	-20 to -21
	Foreign	0 to -1	0 to -1
Producer Price	US	1 to 2	0 to 1
	Foreign	0 to -1	0 to -1

Figure 1- Direct impact of removing quota



Appendix A

Beghin and Chang (1992) report point estimates of the own price elasticities of demand to be -0.92 for flue-cured tobacco and -0.09 for burley tobacco, which suggests that demand for flue-cured tobacco is more elastic than demand for burley tobacco.[22] However, Johnson and Norton (1983) report a much more inelastic estimate of U.S. demand elasticity for flue-cured tobacco, -0.2. Sumner and Alston (1987) estimate the own price elasticity of demand for both burley and flue-cured tobacco combined of -2.3, which is much higher than the estimates of Beghin and Chang (1992) for both types of tobacco.[23] Rezitis, Brown, and Foster (1998) use a dynamic model which provides an estimate for both flue-cured and burley tobacco combined ranging from -0.23 to -0.40 between the short and long run, which is between the estimates of Beghin and Chang (1992) for each type of tobacco.

Johnson and Norton (1983) estimate an own price elasticity of demand for U.S.-produced tobacco in export markets of -2.3, which compared to their estimate of -0.2 for the U.S. market implies that export demand is more elastic than U.S. demand. Brown, Snell, and Tiller (1999) assume that export demand has become even more elastic because of the close substitutability of non U.S.-produced flue-cured tobacco, since Johnson and Norton (1983), and assume an elasticity of -3. Brown, Snell, and Tiller (1999) also assume that own price elasticity of demand for U.S.-produced burley tobacco is -1.5 based on the differences in elasticity estimates for flue-cured and burley tobacco of Beghin and Chang (1992) mentioned earlier.

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[22] Beghin and Chang (1992) also report standard errors which measure the sampling error (error for using a sample instead of the population) in their point estimates by accounting for model fit, sample size, and dispersion of the independent variables used to estimate their elasticities. Confidence intervals constructed from their point estimates and standard errors of 0.0 to -1.8 for flue-cured tobacco and 0.4 to -0.5 for burley tobacco overlap, suggesting that there is less than a 95 percent chance that demand for flue-cured tobacco is more elastic than burley tobacco. However, the fact that their point estimate for flue-cured tobacco is more elastic than the one for burley tobacco indicates that there is a least a 50 percent chance that flue-cured tobacco is more elastic than burley tobacco. These intervals are based on our calculations of two sided 95 percent confidence interval with 14 degrees of freedom, and standard errors of 0.37 and 0.18 for flue-cured and burley tobacco respectively.

[23] Sumner and Alston (1987) also report standard errors. The fact that the 95 percent confidence interval of -1.8 to -2.8 calculated using estimates from Sumner and Alston (1987) does not overlap either of the intervals calculated above using the estimates from Beghin and Chang (1992) implies that there is at least a 95 percent chance that the estimates of Sumner and Alston (1987) are more elastic. This confidence interval is based on our calculations of a two-sided 95 percent confidence interval with on a reported standard error of 0.23 and 25 degrees of freedom.

Sumner and Alston (1987) estimate the cross price elasticity of demand of U.S.-produced tobacco for imported tobacco to be 2.03 and the cross price elasticity of demand of imported tobacco for U.S. produced tobacco to be 0.65, suggesting that U.S. produced and imported tobacco are substitutes to some extent.[24] Again estimating smaller elasticities with their dynamic model, Rezitis, Brown, and Foster (1998) estimated cross price elasticity of demand of U.S. produced tobacco for imported tobacco to range from about 0.01 to 0.02 between the short run and long run and the cross price elasticity of demand of imported tobacco with for U.S.-produced tobacco to range from 0.08 to 0.12 between the short and long run.

Sumner and Alston (1987) estimate the U.S. import price elasticity of demand for both flue-cured and burley tobacco to be -0.25, which compared to their estimate for demand for U.S.-produced tobacco implies that import demand is less elastic.[25] Kee, Nicita, and Olarreaga (2004) estimate a much higher U.S. import price elasticity of demand to be -1.89 for the six-digit HS category (HS 2401.20) which contains flue-cured and burley tobacco.[26] Johnson and Norton (1983) estimate the U.S. supply elasticity to be 1.0. Citing Goodwin and Sumner (1990), Brown, Snell, and Tiller (1999) assume that supply elasticity under the tobacco program is 4 and that without the tobacco program, the aggregate long run supply elasticity is perfectly elastic.

[24] Even when standard errors are taken into account, the estimates by Sumner and Alston (1987) imply that there is a least a 95 percent chance that U.S.-produced and imported tobacco are substitutes to some extent because the 95 percent confidence intervals calculated from their estimates of 1.62 to 2.44 and 0.50 to 0.80 for the cross price elasticities of U.S. and imported tobacco respectively include only positive numbers. These intervals are based on our calculations of a two-sided 95 percent confidence interval with 25 degrees of freedom and reported standard errors of 0.19 and 0.061 for U.S. and foreign produced tobacco respectively.

[25] This is also true with a least 95 percent probability when the standard error is taken into account since the 95 percent confidence interval of 0.39 to -0.89 using estimates from Sumner and Alston (1987) does not overlap the interval using their estimates the own price elasticity of demand of -1.8 to -2.8 calculated above. This confidence interval is based on our calculations of a two-sided 95 percent confidence interval with on a reported standard error of 0.27 and 25 degrees of freedom.

[26] The estimate found by Sumner and Alston (1987) is strictly smaller than the one found by Kee, Nicita, and Olarreaga (2004) even when standard errors are taken into account. The standard error of 0.49 reported by Kee, Nicita, and Olarreaga (2004) suggests a 95 percent confidence interval of -0.91 to -2.87 (assuming infinite degrees of freedom), which does not overlap the 95 percent confidence interval construction from the estimates from Sumner and Alston (1987) of 0.39 to -0.89 calculated above.

Appendix B

Table B-1 Baseline data and assumptions-2003 base data

	Destination			
	Flue-cured		Burley	
Source	US	Foreign	US	Foreign
Baseline values (thousands of dollars)				
US	485,470	510,129	303,867	333,231
Foreign	197,148	1,069,097	98,850	300,342
Market shares (percent)				
US	68.9	31.2	73.8	51.3
Foreign	31.1	68.8	26.2	48.7
Elasticity assumptions (uniform distribution)				
Aggregate demand	-0.550 to -0.850	-0.350 to -0.650	-0.009 to -0.011	-0.050 to -0.250
Supply	30 to 70	30 to 70	30 to 70	30 to 70
Substitution	1.10 to 2.10	4.40 to 5.40	0.10 to 0.40	2.00 to 4.00
Own-price elasticities of demand generated from elasticity assumptions and market shares				
US	-0.72 to -1.24	-3.15 to -3.91	-0.03 to -0.11	-1.01 to -2.07
Foreign	-0.93 to -1.71	-1.62 to -2.13	-0.08 to -0.30	-1.06 to -2.16
Cross-price elasticities of demand generated from elasticity assumptions and market shares				
US	0.18 to 1.06	1.17 to 1.57	0.07 to 0.29	0.90 to 2.01
Foreign	0.08 to 0.48	2.58 to 3.46	0.02 to 0.10	0.85 to 1.91

Table B-2 Changes in Quantity and Value-2003 base data

	Destination					
	Flue-cured			Burley		
	US	Foreign	Total	US	Foreign	Total
Source						
Quantity (percent)						
US	15 to 26	64 to 82	41 to 54	1 to 2	22 to 45	12 to 25
Foreign	-3 to -22	-23 to -33	-21 to -30	-1 to -6	-20 to -44	-15 to -34
Value at consumer price (percent)						
US	-1 to -9	30 to 43	11 to 22	-20 to -22	-5 to 13	-3 to -13
Foreign	-4 to -22	-24 to -33	-21 to -31	-2 to -7	-20 to -44	-16 to -34
Total	-5 to -9	-6 to -9	-6 to -9	-17 to -17	-11 to -15	-13 to -16

Table B-3 Changes in Price-2003 base data

(percent)	Source/Destination	Flue-cured	Burley
Market Price	US (source)	-21 to -21	-22 to -22
	Foreign (source)	0 to -1	0 to -1
Producer Price	US (source)	1 to 2	0 to 1
	Foreign (source)	0 to -1	0 to -1

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