A Dynamic Model of the U.S. Tobacco Economy

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A 14-equation recursive model is developed for (1) flue-cured acreage, (2) burley acreage, (3) flue-cured price, (4) burley price, and (5) consumer demand for cigarettes. The coefficients are estimated using data for 1954-70. The reduced form and the impact multipliers are derived. The multipliers are used to illustrate the impact of a 3.5-cent increase in the support rate for flue-cured tobacco. A comparison of the reduced-form estimated values with observed values of 14 endogenous variables showed a good fit for the model over the period studied.

Keywords: Flue-cured, burley, recursive model, multipliers.

Recent public consciousness about the problem of smoking and health, and changes in advertising policy for cigarettes are critical factors which may modify the demand for tobacco products. The production, distribution, and manufacturing processes are faced with several potential technological innovations (*3*).[1] These, combined with Government policy programs aimed at controlling the supply of certain types of tobacco, are the major features of the dynamics of the tobacco market.

To analyze the effects of potential changes, an econometric model of the U.S. tobacco economy is constructed. The model, based on annual data, will be useful in studying long-run changes in the tobacco economy.[2] The model includes five behavioral equations: (1) flue-cured leaf production, (2) burley leaf production, (3) flue-cured leaf price, (4) burley leaf price, and (5) consumer demand for cigarettes. Flue-cured and burley tobacco account for over 90 percent of total tobacco production. These two types of tobacco, along with small quantities of Maryland and imported oriental types, are used in the manufacture of cigarettes. The analysis thus includes the major part of the U.S. tobacco economy.

Flue-cured tobacco is grown mainly in Virginia, North Carolina, South Carolina, Georgia and Florida. Burley is produced principally in Kentucky, Tennessee, Ohio, Indiana, West Virginia, Virginia, North Carolina and Missouri. After harvesting, the tobacco is cured, a process which involves drying by the application of regulated heat for flue-cured and air circulation for burley. The cured tobacco is moved to the auction market for sale. There it is purchased by representatives of manufacturers or dealers, or if it is eligible for price support and the bid is not high enough, it is taken by the cooperative association. In either case it is put into storage after redrying or stemming.

The two important features of Government policy are marketing quotas and price support. A national marketing quota for each type of tobacco is proclaimed for 3 years, and the quota for each year is announced annually. Acreage allotments are used to implement the marketing quotas for tobacco.[3] These quotas have to be approved by the producers in a referendum every 3 years. A national quota is proclaimed if the total supply exceeds the reserve supply level. The reserve supply is the normal supply plus 5 percent to meet domestic and foreign demand in years of drought, flood, and other adverse conditions. Normal supply is the normal year's domestic consumption and exports (average domestic consumption and exports for the last 10 marketing years adjusted for trends) plus 175 percent of a normal year's domestic consumption and 65 percent of a normal year's export as an allowance for a normal carryover.

For those years in which the marketing quota has not been disapproved by the producers, the support level is determined by adjusting the 1959 support price upward or downward in proportion to a change in a 3-year moving average of the parity index. If the marketing quota is disapproved by the producers, no price support is available for that year.

The model is set up in terms of a recursive system including supply equations, leaf price equations, and cigarette demand equation. These behavioral equations are tied together into the system by a set of identities

Footnotes are on p. 85.

describing certain technical and marketing characteristics of the tobacco economy.

Variables

The following 14 variables are treated as endogenous in the system. They are recursively determined in a system of 14 equations by the predetermined variables included in the system. The dividing line between endogenous and predetermined variables is arbitrary and changes as the scope of research expands. For example, behavioral equations can be developed for tobacco and cigarette exports, and those variables will move from the predetermined to the endogenous group.

AF_t = acreage of flue-cured tobacco (1,000 acres)

AB_t = acreage of burley tobacco (1,000 acres)

PF_t = average price per pound to growers, flue-cured (cents per pound)

PB_t = average price per pound to growers, burley (cents per pound)

QPF_t = production of flue-cured tobacco (million pounds)

QPB_t = production of burley (million pounds)

SF_{t+1} = year-end inventory, flue-cured (million pounds)

SB_{t+1} = year-end inventory, burley (million pounds)

DF_t = flue-cured tobacco used in cigarette manufacturing (million pounds)

DB_t = burley tobacco used in cigarette manufacturing (million pounds)

QC_t = per capita cigarette consumption (in terms of population 18 years old and over)

QCC_t = total domestic cigarette consumption (billions)

PC_t = consumer price index for tobacco products, deflated by the consumer price index (1967 = 100)

QCP_t = production of cigarettes (billions).

The following variables are treated as predetermined in the present analysis. These variables include policy, technological, and other outside factors affecting the tobacco economy.

ALF_t = acreage allotted, flue-cured (1,000 acres)

ALB_t = acreage allotted, burley (1,000 acres)

SF_t = beginning year stocks of flue-cured (million pounds)

SB_t = beginning year stocks of burley (million pounds)

SPF_t = support price, flue-cured (cents per pound)

SPB_t = support price, burley (cents per pound)

QF_t = percent of total flue-cured crop which is choice, fine, and good quality

QB_t = percent of burley crop which is choice, fine, and good quality

XF_t = exports of flue-cured tobacco (million pounds)

XB_t = exports of burley tobacco (million pounds)

ODF_t = flue-cured tobacco used for other products (million pounds)

ODB_t = burley tobacco used for other products (million pounds)

FL_t = percent of cigarettes filter-tipped

I_t = per capita disposable income (1958 dollars)

QCX_t = quantity of cigarettes exported (billion)

The following multiplicative factors are used to make the units in various markets comparable. Values for these factors for each year can be inserted in the system and will satisfy the necessary equilibrium condition. However, to simplify the computational work, average values for the 3-year period 1968-70 were used in the following analysis.

YF = yield per acre, flue-cured (1,000 pounds)

YB = yield per acre, burley (1,000 pounds)

F = pounds of flue-cured tobacco used per 1,000 cigarettes

B = pounds of burley tobacco used per 1,000 cigarettes

P = population 18 years old and over (billion)

The Model

The model consists of five behavioral equations and nine technological and market clearing identities. The system brings together the forces of Government policy, technological factors, market mechanism, and consumer decisionmaking.

The coefficients of the behavioral equations are estimated from data for 1954-70. As the system is recursive, the coefficients are estimated by ordinary least squares. The estimated model is discussed below. The values in parentheses under the coefficients are the t values of the coefficients. *DW* stands for the Durbin-Watson statistic, and is reported only for those equations in which the lagged value of the dependent variable is not included in the regression (*1*, p. 410). The squared multiple correlation has been corrected for degrees of freedom.

Both flue-cured and burley tobacco were subject to acreage allotments and price support during the years studied. (See, however, footnote 3.) The model takes these policy instruments into account. The acreage equations are of cobweb type. The acreage is a function of lagged acreage, lagged price, and acreage allotted.

$$(1)\ AF_t = -323.18040 + \underset{(0.84499)}{0.08671}AF_{t-1} + \underset{(2.33589)}{3.53768}PF_{t-1} + \underset{(10.10719)}{1.03551}ALF_t$$

$$R^2 = 0.978$$

$$(2)\ AB_t = -77.00651 + \underset{(1.55789)}{0.14865}AB_{t-1} + \underset{(0.50540)}{0.33717}PB_{t-1} + \underset{(16.21848)}{1.01089}ALB_t$$

$$R^2 = 0.984$$

In each case the variables included explain 98 percent of the variation in acreage. The signs of the coefficients are also correct. The acreage allotted has a strong effect on acres harvested as indicated by the high t values. From these acreage estimates, production is obtained by multiplying by average yield.

$$(3)\ QPF_t = YF \times AF_t$$

$$(4)\ QPB_t = YB \times AB_t$$

Up to this stage, we have explained acreage and production (endogenous variables) in terms of predetermined variables only. This means that the model can be modified so that exogenously estimated acreage or production can be brought in at this stage. This enables us to study the effect of technological changes in the production sector in several ways and incorporate those into the model.

The price equations represent the process of price formation in the auction markets. The supply, consisting of production from current year's crop, is inelastic and must be sold as the farmer has very limited storage facilities. However, at the same time, the auction price has to be more than the support rate.[4] On the side of the buyers, the size of existing stocks to which the current purchases are to be added is a potential factor in determining the price bid.

$$(5)\ PF_t = -14.51534 - \underset{(0.22426)}{0.00109}(QPF_t + SF_t) + \underset{(4.15982)}{1.35435}SPF_t + \underset{(0.90356)}{0.26428}QF_t$$

$$R^2 = 0.884 \qquad DW = 1.650$$

$$(6)\ PB_t = 59.90805 - \underset{(2.78366)}{0.02081}(QPB_t + SB_t) + \underset{(3.66681)}{0.51084}SPB_t + \underset{(4.10601)}{0.44542}QB_t$$

$$R^2 = 0.789 \qquad DW = 1.403$$

During those years when producers approve the quota, the price support is available. The support rate sets the lower limit to the price in the auction markets. This explains the high t values for this variable in the above equations.

The tobacco markets satisfy the following market-clearing identities:

$$(7)\ SF_{t+1} - SF_t = QPF_t - DF_t - XF_t - ODF_t$$

$$(8)\ SB_{t+1} - SB_t = QPB_t - DB_t - XB_t - ODB_t$$

This means that the excess of production over domestic disappearance and export is inventory demand and is added to stocks of tobacco. In actual practice, production for the current year is added to the carryover, and tobacco for domestic disappearance and export comes out of aged stocks. This can be shown by rewriting the above identities appropriately.

In the absence of any limitations on the availability of data, we could postulate the following price linkage between the retail price of cigarettes and the price to growers for flue-cured and burley tobacco:

$$PC_t = a_1 PF_t + a_2 PB_t + M$$

where a_1 is the pounds of flue-cured tobacco required per pack of cigarettes, and a_2 the pounds of burley per pack. M is the marketing and manufacturing margin, including taxes and the cost of other tobaccos used. But we are using an index of consumer prices for tobacco products as a proxy for the retail price of cigarettes.[5] Moreover, a crudely defined margin, which includes heterogeneous items, will have no operational usefulness. Therefore, we use an empirically estimated equation which resembles the price linkage identity discussed above but the coefficients do not have a precise interpretation. The major role of this equation is to make the system complete.

(9) $PC_t = 40.34429 + 0.72355 PF_t + 0.14827 PB_t$

Consumer demand for cigarettes is studied in terms of per capita consumption of cigarettes for the population 18 years old and over. The use of per capita consumption is based on the underlying consumer theory of the individual. Consumer demand is influenced by the habit-forming nature of the product and reaction to the issue of smoking and health. These factors are embodied in the lagged value of consumption and percent of cigarettes filter-tipped.

(10) $$QC_t = 3302.04150 + \underset{(0.47442)}{0.07195 I_t} + \underset{(4.22992)}{0.72692 QC_{t-1}} - \underset{(3.43241)}{26.71665 PC_t} + \underset{(1.81266)}{9.50125 FL_t}$$

$$R^2 = 0.885$$

Total cigarette consumption is the product of per capita consumption and population 18 years and over.

(11) $QCC_t = P \times QC_t$

The quantity of cigarettes produced has to satisfy the technical relationships in terms of flue-cured and burley tobacco disappearance.

(12) $DF_t = F \times QCP_t$

(13) $DB_t = B \times QCP_t$

Finally, to complete the system we have a market-clearing identity for cigarettes:[6]

(14) $QCP_t = QCC_t + QCX_t$

Framework for Policy Analysis

This structural system of 14 equations and identities embodies the a priori specifications and restrictions of the model. The strategic technological and policy variables included in the structural system can be appropriately modified to trace the impact on the market. The system can be solved for the 14 endogenous variables to obtain the reduced form of the system. The reduced form, given in appendix table 1, expresses each endogenous variable as a linear function of the several predetermined variables, including the lagged endogenous variables. The table of reduced form gives the impact of per unit changes in an exogenous variable on each of the endogenous variables. For example, the effects of flue-cured acreage and price on the endogenous variables in the following year are given in the first two columns of the table. The reduced form was used to generate the estimated values of the 14 endogenous variables, which were compared with the observed values to evaluate the "track record" of the model. However, the estimates generated by a model can be no better than the data which are used.

However, for a dynamic analysis of the system, we can eliminate the lagged values of the endogenous variables by successive substitutions, obtaining a system of endogenous variables in terms of the exogenous variables only.[7] This system of multipliers for years 1-5 and the long-run multipliers are given in appendix tables 2-7.

To illustrate the use of the multipliers, consider a possible 5 percent increase in the support rate for flue-cured tobacco. This comes to an average of about 3.5 cents per pound. Using the coefficients from the column headed *SPF* in appendix tables 2-7, the effects on the following variables are calculated: Flue-cured acreage, flue-cured price, flue-cured year-end stocks, per capita cigarette consumption, flue-cured production, flue-cured cigarette use, cigarette consumption, retail tobacco price index, and cigarette production. These effects for years 1-5 and the long-run effects are given in table 1. Note that a rise in the support rate is estimated to lead to a rise in the price of flue-cured tobacco, increased production, and higher carryover. The higher price of tobacco is estimated to lead to higher tobacco product prices, decline in cigarette consumption and production, and, hence, less use of flue-cured tobacco i

Table 1.–Impact of a possible 3.5-cent increase in support rate for flue-cured tobacco

Variable	Year					Long run
	1	2	3	4	5	
Flue-cured acreage (1,000)	---	16.77	18.05	17.94	17.69	---
Flue-cured price (¢/lb.)	4.74	4.69	4.63	4.56	4.49	---
Flue-cured year-end stocks (million pounds)	12.9	67.00	129.84	196.62	265.47	4348.89
Per capita cigarette consumption (number)	–91.63	–156.51	–201.17	–230.64	–248.77	–.09
Flue-cured production (million pounds)	---	32.06	34.50	34.30	33.82	---
Flue-cured cigarette use (million pounds)	–12.9	–22.04	–28.33	–32.48	–35.03	---
Cigarette consumption (billion)	–12.14	–20.73	–26.64	–30.54	–32.95	–.01
Retail tobacco price (index)	3.43	3.36	3.27	3.16	3.04	---
Cigarette production (billion)	–12.14	–20.73	–26.64	–30.54	–32.95	–.01

cigarette manufacturing. These effects will, however, in practice be mitigated by the influence of other factors like exports and other policy variables. But the model enables us to isolate, for analytical purposes, the impact of a single possible policy change.

Another question which may be analyzed is the impact of increased exports (or reduced exports, assuming that an alternate source of supply, Rhodesia, opens up). A new reduced form can be calculated by changing the multiplicative factors, which represent the impact of technological change. The average yield per acre embodies the technological change in production[8] and the pounds of tobacco used per 1,000 cigarettes in the manufacturing sector. The impact of changes in any or all of these coefficients on the tobacco market can be traced. Similarly, we can study the effect of change in percent of cigarettes filter-tipped, which embodies the changing trend in tastes and habits.

Literature Cited

(1) Durbin, J. and G. S. Watson. "Testing for Serial Correlation in Least Squares Regression. I." Biometrika, Vol. 37, Parts 3 and 4, December 1950.

(2) Goldberger, Arthur S. Econometric Theory. John Wiley and Sons, Inc., New York, 1964.

(3) U.S. Department of Agriculture. Potential Mechanization in the Flue-Cured Tobacco Industry. Agr. Econ. Rpt. No. 169, September 1969.

Footnotes

[1] Italic numbers in parentheses refer to Literature Cited.

[2] This article is a preliminary report of the results of a more comprehensive study of resource adjustment in the U.S. tobacco economy being conducted by an ERS task force.

[3] The burley program is now entirely based on a poundage quota. However, as the poundage quota can be converted to acres by using an appropriate average yield, the present analysis is applicable to the new program.

[4] Although this depends on the distribution of grades of tobacco sold in the auction market, during the period under discussion the average price received by producers for flue-cured and burley was above the average support rate.

[5] The consumer price index includes index numbers for (a) cigarettes, nonfilter tip, regular size, and (b) cigarettes, filter, king. The index for tobacco products includes these two along with other tobacco products. Cigarettes are given a weight of over 90 percent in this index.

[6] To overcome the fact that the data for tobacco are reported by crop year and cigarette consumption and exports are reported by calendar year, the identity (14) was rewritten as

$$QCP_t = QCC_t + QCX_t + QCO_t,$$

where QCO is a residual item which has no operational significance. However, for the sake of completeness, the coefficients for this variable are reported in appendix table 1.

[7] For details, see Goldberger (2, p. 375).

[8] This is only one dimension of the problem, since output is measured in terms of land. Another equally important aspect of technological change is output in terms of labor.

Table A-1.—Reduced form of the system

Endogenous variables	Predetermined variables										
	AF_{t-1}	PF_{t-1}	*ALF*	AB_{t-1}	PB_{t-1}	*ALB*	*SF*	*SPF*	*QF*	*SB*	*SPB*
AF	.08671	3.53768	1.03551								
AB				.14865	.33717	1.01089					
PF	–.00018	–.00737	–.00216				–.00109	1.35435	.26428		
PB				–.00768	–.01742	–.05222				–.02080	.51084
QPF	.16576	6.76288	1.97955								
QPB				.36915	.83730	2.51037					
SF_{t+1}	.16527	6.74281	1.97368	–.00428	–.00972	–.02913	.99703	3.68696	.71945	.01160	.28498
SB_{t+1}	–.00036	–.01472	–.00431	.36600	.83108	2.48901	–.00218	2.70455	.52775	.99149	.20904
DF	.00049	.02007	.00587	.0428	.00972	.02913	.00297	–3.68696	–.71945	.01160	.28498
DB	.00036	.01472	.00431	.00314	.00713	.02137	.00218	–2.70455	–.52775	.00851	–.20904
QC	.00349	.14250	.04171	.03042	.06899	.20684	.02107	–26.18071	–5.10875	.08239	–2.02358
QCC	.00046	.01887	.00552	.00403	.00914	.02739	.00279	–3.46737	–.67660	.01091	–.26800
PC	–.00013	–.00533	–.00156	–.00114	–.00258	–.00774	–.00079	.97994	.19122	–.00308	.07574
QCP	.00046	.01887	.00552	.00403	.00914	.02739	.00279	–3.46737	–.67660	.01091	–.26800

Endogenous variables	*QB*	*XF*	*XB*	*ODF*	*ODB*	*I*	QC_{t-1}	*FL*	*QCX*	*QCO*	Constant
AF											–323.18040
AB											–77.00651
PF											–13.84192
PB	.44542										63.88569
QPF											–617.81428
QPB											–191.23258
SF_{t+1}	.24848	–1.00000		–1.00000		–.01013	–.10237	–1.33804	–1.06333	–1.06333	–933.08240
SB_{t+1}	.18227		–1.00000		–1.00000	–.00743	–.07509	–.98151	–.78000	–.78000	–422.49581
DF	–.24848					.01013	.10237	1.33804	1.06333	1.06333	315.26813
DB	–.18227					.00743	.07509	.98151	.78000	.78000	231.26324
QC	–1.76443					.07195	.72692	9.50125			2,238.68415
QCC	–.23368					.00953	.09627	1.25835			296.49133
PC	.06604										39.80130
QCP	–.23368					.00953	.09627	1.25835	1.00000	1.00000	296.49133

Table A-2.—Multiplier effects of a unit change in exogenous variables on endogenous variables in the immediate year

Endo-genous variables	Exogenous variables												
	ALF	*ALB*	*SPF*	*QF*	*SPB*	*QB*	*XF*	*XB*	*ODF*	*ODB*	*I*	*FL*	*QCX*
AF . . .	1.03551												
AB . . .		1.01089											
PF . . .	–.00216		1.35435	.26428									
PB . . .		–.05222			.51084	.44542							
SF . . .	1.97368	–.02913	3.68696	.71945	.28498	.24848	–1.00000		–1.00000		–.01013	–1.33804	–1.06333
SB . . .	–.00431	2.48901	2.70455	.52775	.20904	.18227		–1.00000		–1.00000	–.00743	–.98151	–.78000
QC . . .	.04171	.20684	–26.18071	–5.10875	–2.02358	–1.76443					.07195	9.50125	
QPF . .	1.97955												
QPB . .		2.51037											
DF . . .	.00587	.02913	–3.68696	–.71945	–.28498	–.24848					.01013	1.33804	1.06333
DB . . .	.00431	.02137	–2.70455	–.52775	–.20904	–.18227					.00743	.98151	–.78000
QCC . .	.00552	.02739	–3.46737	–.67660	–.26800	–.23368					.00953	1.25835	
PC . . .	–.00156	–.00774	.97994	.19122	.07574	.06604							
QCP . .	.00552	.02739	–3.46737	–.67660	–.26800	–.23368					.00953	1.25835	1.00000

Table A-3.—Multiplier effects of a unit change in exogenous variables on endogenous variables in the second year

Endo-genous variables	Exogenous variables												
	ALF	*ALB*	*SPF*	*QF*	*SPB*	*QB*	*XF*	*XB*	*ODF*	*ODB*	*I*	*FL*	*QCX*
AF . . .	1.11766		4.79125	.93494									
AB . . .		1.14355			.17224	.15018							
PF . . .	–.00448	.00003	1.34035	.26155	–.00031	–.00027	.00109		.00109		.00001	.00146	.00116
PB . . .	.00009	–.11085	–.05625	–.01098	.49759	.43387		.02080		.02080	.00015	.02042	.01622
SF . . .	4.09385	–.11204	19.14383	3.73561	.76888	.67040	–1.99703	.01160	–1.99703	.01160	–.02751	–3.6336	–2.11445
SB . . .	–.01636	5.26800	7.32402	1.42917	.99172	.86472	.00218	–1.99149	.00218	–1.99149	–.02018	–2.66520	–1.55104
QC . . .	.11657	.58880	–44.71846	–8.72610	–3.43609	–2.99605	–.02107	–.08239	–.02107	–.08239	.12343	16.29883	–.08667
QPF . .	2.13649		9.15930	1.78729									
QPB . .		2.83982			.42773	.37295							
DF . . .	.01642	.08291	–6.29757	–1.22887	–.48390	–.42192	–.00297	–.01160	–.00297	–.01160	.01738	2.29532	1.05112
DB . . .	.01205	.06082	–4.61949	–.90142	–.35495	–.30949	–.00218	–.00851	–.00218	–.00851	.01275	1.68369	.77104
QCC . .	.01543	.07797	–5.92243	–1.15567	–.45507	–.39679	–.00279	–.01091	–.00279	–.01091	.01635	2.15859	–.01148
PC . . .	–.00323	–.01640	.96148	.18762	.07355	.06413	.00079	.00308	.00079	.00308	.00003	.00408	.00324
QCP . .	.01543	.07797	–5.92243	–1.15567	–.45507	–.39679	–.00279	–.01091	–.00279	–.01091	.01635	2.15859	.98852

Table A-4.–Multiplier effects of a unit change in exogenous variables on endogenous variables in the third year

Endogenous variables	Exogenous variables												
	ALF	*ALB*	*SPF*	*QF*	*SPB*	*QB*	*XF*	*XB*	*ODF*	*ODB*	*I*	*FL*	*QCX*
AF . . .	1.11656	.00011	5.15717	1.00634	–.00110	–.00096	.00386		.00386		.00004	.00516	.00410
AB . . .	.00003	1.14350	–.01897	–.00370	.19338	.16861		.00701		.00701	.00005	.00688	.00547
PF . . .	–.00679	.00012	1.32274	.25811	–.00084	–.00073	.00217	–.00001	.00217	–.00001	.00003	.00395	.00230
PB . . .	.00034	–.16865	–.15136	–.02954	.48022	.41872	–.00005	.04106	–.00005	.04106	.00042	.05508	.03198
SF . . .	6.19812	–.26582	37.09689	7.23887	1.38415	1.20688	–2.98162	.04290	–2.98162	.04290	–.04989	–6.58856	–3.13698
SB . . .	–.03847	7.99473	13.21426	2.57855	1.92480	1.67830	.00808	–2.95111	.00808	–2.95111	–.03652	–4.82306	–2.29327
QC . . .	.21462	1.09366	–57.47679	–11.21569	–4.38391	–3.82248	–.05706	–.22229	–.05706	–.22229	.15944	21.05466	–.23406
QPF . .	2.13440	.00021	9.85838	1.92371	–.00210	–.00183	.00737		.00737		.00007	.00986	.00784
QPB . .	.00008	2.83970	–.04710	–.00919	.48022	.41872		.01742		.01742	.00013	.01709	.01358
DF . . .	.03023	.15400	–8.09427	–1.57947	–.61738	–.53831	–.00804	–.03130	–.00804	–.03130	.02245	2.96507	1.03037
DB . . .	.02219	.11297	–5.93734	–1.15858	–.45286	–.39486	–.00590	–.02296	–.00590	–.02296	.01647	2.17495	.75582
QCC . .	.02842	.14483	–7.61211	–1.48538	–.58059	–.50624	–.00756	–.02944	–.00756	–.02944	.02112	2.78844	–.03099
PC . . .	–.00487	–.02489	.93464	.18238	.07060	.06156	.00157	.00607	.00157	.00607	.00008	.01102	.00640
QCP . .	.02842	.14483	–7.61211	–1.48538	–.58059	–.50624	–.00756	–.02944	–.00756	–.02944	.02112	2.78844	.96901

Table A-5.—Multiplier effects of a unit change in exogenous variables on endogenous variables in the fourth year

Endogenous variables	Exogenous variables												
	ALF	*ALB*	*SPF*	*QF*	*SPB*	*QB*	*XF*	*XB*	*ODF*	*ODB*	*I*	*FL*	*QCX*
AF . . .	1.10830	.00044	5.12661	1.00038	–.00305	–.00266	.00801	–.00004	.00801	–.00004	.00011	.01442	.00848
AB . . .	.00012	1.12401	–.05385	–.01051	.19066	.16624	–.00002	.01489	–.00002	.01489	.00015	.01959	.01160
PF . . .	–.00907	.00029	1.30324	.25431	–.00150	–.00131	.00323	–.00005	.00323	–.00005	.00005	.00715	.00340
PB . . .	.00079	–.22435	–.27207	–.05309	.46095	.40192	–.00017	.06061	–.00017	.06061	.00075	.09931	.04710
SF . . .	8.27060	–.50128	56.17711	10.96207	2.08016	1.81375	–3.95175	.09925	–3.95175	.09925	–.07556	–9.97953	–4.12460
SB . . .	–.07209	10.61267	19.88748	3.88073	2.91308	2.54002	.01873	–3.87274	.01873	–3.87274	–.05513	–7.28196	–3.00083
QC . . .	.32810	1.67810	–65.89587	–12.85854	–4.98369	–4.34545	–.10331	–.40078	–.10331	–.40078	.18383	24.27469	–.42247
QPF . .	2.11861	.00084	9.79993	1.91230	–.00583	–.00509	.01531	–.00009	.01531	–.00009	.00021	.02757	.01621
QBF . .	.00029	2.79129	–.13374	–.02610	.47347	.41284	–.00004	.03697	–.00004	.03697	.00037	.04866	.02880
DF . . .	.04622	.23629	–9.27987	–1.81082	–.70184	–.61196	–.01456	–.05643	–.01456	–.05643	.02589	3.41854	1.00383
DB . . .	.03391	.17334	–6.80697	–1.32827	–.51481	–.44888	–.01068	–.04140	–.01068	–.04140	.01899	2.50757	.73635
QCC . .	.04344	.22223	–8.72712	–1.70296	–.66002	–.57550	–.01368	–.05307	–.01368	–.05307	.02435	3.21489	–.05595
PC . . .	–.00645	–.03302	.90262	.17613	.06726	.05865	.00232	.00894	.00232	.00894	.00015	.01989	.00944
QCP . .	.04344	.22223	–8.72712	–1.70296	–.66002	–.57550	–.01368	–.05307	–.01368	–.05307	.02435	3.21489	.94405

Table A-6.–Multiplier effects of a unit change in exogenous variables on endogenous variables in the fifth year

Endo-genous variables	Exogenous variables												
	ALF	*ALB*	*SPF*	*QF*	*SPB*	*QB*	*XF*	*XB*	*ODF*	*ODB*	*I*	*FL*	*QCX*
AF . . .	1.09953	.00106	5.05496	.98640	–.00558	–.00486	.01213	–.00017	.01213	–.00017	.00020	.02655	.01277
AB . . .	.00029	1.10233	–.09974	–.01946	.18376	.16023	–.00006	.02265	–.00006	.02265	.00028	.03640	.01760
PF . . .	–.01131	.00054	1.28259	.25028	–.00226	–.00197	.00428	–.00011	.00428	–.00011	.00008	.01082	.00447
PB . . .	.00148	–.27769	–.40851	–.07971	.44075	.38431	–.00039	.07938	–.00039	.07938	.00113	.14958	.06151
SF . . .	10.30898	–.82442	75.84984	14.80090	2.81942	2.45833	–4.90653	.18393	–4.90653	.18393	–.10327	–13.63890	–5.07378
SB . . .	–.11802	13.11157	26.98183	5.26507	3.91950	3.41756	.03474	–4.75414	.03474	–4.75414	–.07506	–9.91302	–3.67128
QC . . .	.45117	2.30925	–71.07632	–13.86943	–5.32511	–4.64315	–.15635	–.60369	–.15635	–60369	.19951	26.34528	–.63713
QPF . .	2.10184	.00203	9.66296	1.88557	–.01067	–.00930	.02319	–.00032	.02319	–.00032	.00038	.05075	.02441
QPB . .	.00071	2.73744	–0.24769	–.04833	.45634	.39790	–.00015	.05625	–.00015	.05625	.00068	.09038	.04372
DF . . .	.06355	.032517	–10.00938	–1.95317	–.74993	–.65388	–.02203	–.08501	–.02203	–.08501	.02809	3.71013	.97360
DB . . .	.04664	.23853	–7.34204	–1.43268	–.55008	–.47963	–.01616	–.06236	–.01616	–.06236	.02061	2.72145	.71417
QCC . .	.05974	.30581	–9.41321	–1.83683	–.70524	–.61493	–.02070	–.07994	–.02070	–.07994	.02642	3.48911	–.08437
PC . . .	–.00797	–.04074	.86746	.16927	.06373	.05556	.00305	.01168	.00305	.01168	.00023	.02999	.01235
QCP . .	.05974	.30581	–9.41321	–1.83683	–.70524	–.61493	–.02070	–.07994	–.02070	–.07994	.02642	3.49811	.91563

Table A-7.—Long-run equilibrium effects of a unit change in exogenous variables on endogenous variables

Endogenous variables	Exogenous variables												
	ALF	*ALB*	*SPF*	*QF*	*SPB*	*QB*	*XF*	*XB*	*ODF*	*ODB*	*I*	*FL*	*QCX*
AF . . .	.39445	.82783	–.00007	–.00001	–.00003	–.00002	.34112	–.28075	.34112	–.28075	.00502	.66238	.14374
AB . . .	.22282	.46737	.00065	.00013			–.10280	.24418	–.10280	.24418	.00283	.37392	.08115
PF . . .	–.19088	.21371	–.00002		–.00001	–.00001	.08806	–.07248	.08806	–.07248	.00129	.17100	.03711
PB . . .	.56261	–1.81805	.00164	.00032	–.00001	–.00001	–.25957	.61656	–.25957	.61656	.00715	.94414	.20491
SF . . .	174.36091	–197.64935	1242.53874	242.46153	.00605	.00485	–81.44377	67.02940	–81.44377	67.02940	–1.19756	–158.14641	–34.31867
SB . . .	–27.60224	86.24553	–.08042	–.01568	24.56003	21.41484	12.73474	–30.24881	12.73474	–30.24881	–.35072	–46.31999	–10.05284
QC . . .	5.35050	11.24312	–.02532	–.00494	.00017	.00014	–2.46851	–3.81292	–2.46851	–3.81292	.06812	8.99367	–5.59892
QPF . .	.75402	1.58247	–.00013	–.00002	–.00005	–.00004	.65207	–.53667	.65207	–.53667	.00959	1.26619	.27477
QPB . .	.55333	1.16065	.00161	.00031	–.00001	–.00001	–.25529	.60639	–.25529	.60639	.00703	.92856	.20153
DF . . .	.75405	1.58254	–.00013	–.00002	–.00005	–.00004	–.34789	–.53669	–.34789	–.53669	.00959	1.26625	.27478
DB . . .	.55333	1.16064	.00161	.00031	–.00001	–.00001	–.25529	–.39361	–.25529	–.39361	.00703	.92856	.20153
QCC . .	.70856	1.48894	–.00398	–.00078	–.00002	–.00002	–.32690	–.50495	–.32690	–.50495	.00902	1.19126	–.74147
PC . . .	–.05503	–.11432	–.00142	–.00028	.00009	.00008	.02539	.03877	.02539	.03877	.00200	.26374	.05724
QCP . .	.70856	1.48894	–.00398	–.00078	–.00002	–.00002	–.32690	–.50495	–.32690	–.50495	.00902	1.19126	.25853