ECONOMICS BULLETIN

Attribution of injury in the shrimp antidumping case: A simultaneous equations approach

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Abstract

We apply a simultaneous equations framework, similar to that of Prusa and Sharp (2001), to the recent shrimp antidumping investigation in order to determine how much injury to the domestic industry—proxied by deterioration in domestic shrimp prices—is attributable to subject imports versus other market factors. We construct an econometric model then estimated with three−stage least squares (3SLS). We then apply the movements of each explanatory variable over the period of investigation (POI) to its respective coefficient in order to determine how much injury is attributable to that particular market factor. We find that subject and non−subject imports were essentially equal causes of injury to the domestic industry.

The authors would like to thank Dr. James M. Nance at the National Marine Fisheries Service, Galveston Laboratory, for providing “catch per unit effort” (CPUE) data for the Gulf of Mexico. Neither author is a party to United States International Trade Commission Investigations Nos. 731−TA−1063−1068, Certain Frozen and Canned Warmwater Shrimp and Prawns from Brazil, China, Ecuador, India, Thailand, and Vietnam.
Citation: Sharp, David and Kenneth Zantow, (2005) "Attribution of injury in the shrimp antidumping case: A simultaneous equations approach." *Economics Bulletin*, Vol. 6, No. 5 pp. 1−10
Submitted: October 26, 2004. **Accepted:** May 6, 2005.
URL: http://www.economicsbulletin.com/2005/volume6/EB−04F10012A.pdf

1. Introduction

Under U.S. trade law, the administration of antidumping investigations is divided between the Department of Commerce (DOC) and the International Trade Commission (ITC). The DOC determines whether imports subject to the investigation have been sold in the United States at "less than fair value" (i.e., being dumped). For reasons well known and thoroughly discussed in the literature, the DOC almost always rules affirmative on the dumping issue (Blonigen and Prusa 2004, Boltuck and Litan 1991, Lindsey 1999, Prusa and Sharp 2001, Sabry 2000). For cases in which the DOC votes affirmative, the ITC determines whether the petitioning U.S. industry has been "materially injured" by subject imports. Since the ITC rules affirmative on approximately 50 percent of the cases, the material injury phase is considered the principal barrier to domestic industries successfully obtaining antidumping duties on their foreign rivals (Blonigen and Prusa 2004, Durling and McCullough 2005).

In the material injury phase, the ITC is required by international law to distinguish injurious effects caused by subject imports from those caused by other factors (WTO Antidumping Agreement, Article 3.5). However, disentangling the injurious effects of subject imports from other factors appears to pose a serious challenge to the ITC. Although econometric methods for determining attribution of injury have been offered by Grossman (1986), Pindyck and Rotemberg (1987),[1] and Prusa and Sharp (2001), the ITC has traditionally favored a less formal "trends analysis" which makes no serious attempt to disentangle the injurious effects of subject imports from other sources (Blonigen and Prusa 2004, Durling and McCullough 2005, Kaplan 1991, Morke and Kruth 1989). Subsequently, in at least three recent cases, the WTO has found that the ITC's traditional (non-econometric) approach to injury attribution does not meet obligations under the WTO Safeguards and Antidumping Agreements (Durling and McCullough 2005). Citing the gap between the ITC's legal obligations and actual practice, Durling and McCollough (2005) conclude that formal econometric analysis, such as that offered by Prusa and Sharp (2001), can be invaluable in fulfilling the ITC's obligation to disentangle the injurious effects of subject imports from those caused by other factors.

While there is no shortage of trade disputes between the United States and its trading partners, the antidumping petition filed by U.S. shrimpers against their counterparts in Brazil, China, Ecuador, India, Thailand and Vietnam[2] has been dubbed "this season's biggest trade fight" by the national media (King 2004). In this paper we apply a simultaneous equations framework, similar to that of Prusa and Sharp (2001), to the shrimp antidumping case in order to determine how much material injury—proxied by deterioration in domestic shrimp prices—is attributable to subject imports versus other market factors. In Section 2 we present the empirical methodology. Specifically, in Section 2.1 we present the econometric model. In Section 2.2 we provide the empirical results estimated with three-stage least squares (3SLS). In Section 2.3 we apply the movement of each explanatory variable over the period of investigation (POI) to its respective coefficient in order to determine how much injury, in dollar terms, is attributable to that particular market factor. In Section 3 we offer some concluding thoughts.

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[1] Grossman (1986) and Pindyck and Rotemberg (1987) are in the context of escape clause (Section 201) cases.

[2] Investigations Nos. 731-TA-1063-1068, *Certain Frozen and Canned Warmwater Shrimp and Prawns from Brazil, China, Ecuador, India, Thailand, and Vietnam.*

2. An Econometric Model of Supply and Demand: Warmwater Shrimp

In the shrimp antidumping case, the principal allegation is that domestic warmwater shrimpers (Petitioners) have over the POI (2000-2002) faced "increasingly depressed prices for their products due to significant underselling of imports from the subject countries" ("Petition, Volume II," p.1). In this section, we develop a simultaneous equations model to determine how much material injury, proxied by deterioration in the domestic ex-vessel prices of warmwater shrimp, is attributable to subject imports versus market factors other than subject imports. In Section 2.1 we present the model, in Section 2.2 we discuss the model's results, and in Section 2.3 we quantify the domestic price deterioration due to each explanatory variable over the POI.

2.1 The Model

We construct a simultaneous equations model of supply and demand for domestic warmwater shrimp. The model can be expressed generally as,

Demand: $\ell P_D = f(\ell Q_D, \ell P_R, \ell P_{NR}, \ell Fxedp_D, \ell Fish_D, Yearno, Jan - Nov,)$

Supply: $\ell P_D = f(\ell Q_D, Tack\_ice_{D,t-1}, Tack\_ice^2_{D,t-1}, \ell Dsl_D, \ell Sbr_{D,t-1}, \ell Cpue_D, Jan - Nov,)$

where,

ℓP_D	=	Price (ex-vessel) of domestic brown, white and pink shrimp ($/lbs),[3] expressed as natural logarithms
ℓQ_D	=	Quantity (ex-vessel) of domestic brown, white and pink shrimp (in lbs),[2] expressed as natural logarithms
ℓP_R	=	Price of relevant shrimp imports from Respondent (subject) countries ($/lbs),[4] expressed as natural logarithms
ℓP_{NR}	=	Price of relevant shrimp imports from Non-respondent (non-subject) countries ($/lbs),[10] expressed as natural logarithms
$\ell Fxedp_D$	=	U.S. total annual food expenditure at eating and drinking places[5] ($ million), expressed as natural logarithms
$\ell Fish_D$	=	U.S. Producer Price Index (PPI) for fish and seafood (excluding shellfish),[6] expressed as natural logarithms
$Yearno$	=	Number of year, (i.e.1990 = 1, 1991=2, etc.) annual linear trend.
$Jan - Nov$	=	Monthly seasonal (0-1) dichotomous ("dummy") variables, January to November.
$Tack\_ice_{D,t-1}$	=	U.S. PPI for fishing tackle and ice,[7] lagged one month
ℓDsl_D	=	U.S. PPI for diesel fuel,[8] expressed as natural logarithms
$\ell Sbr_{D,t-1}$	=	U.S. PPI for ship building and repairing,[9] expressed as natural logarithms and lagged one month
$\ell Cpue_D$	=	Shrimp "catch per unit effort" for the Gulf of Mexico,[10] expressed as natural logarithms

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[3] From NOAA Fisheries, available at http://www.st.nmfs.gov/st1/ commercial/landings/monthly_landings.html.
[4] From ITC Dataweb, available at http://dataweb.usitc.gov/scripts/user_set.asp.
[5] From USDA, available at http://www.ers.usda.gov/Briefing/ CPIFoodAndExpenditures/Data/table3.htm.
[6] Series ID# PDU2092#3, from BLS, available at www.bls.gov.
[7] Averaged PPI series due to collinearity. ID# WPU15120103 and ID# PDU2097#, available at www.bls.gov.
[8] Series ID# WPU057303, from BLS, available at www.bls.gov.
[9] Series ID# PDU3731#, from U.S. Bureau of Labor Statistics, available at www.bls.gov.
[10] From Dr. James M. Nance, Supervisory Research Fishery Biologist and Chief of Fishery Management Branch; National Marine Fisheries Service, Galveston Laboratory. Data obtained via e-mail request.

The price of domestic warmwater shrimp (ℓP_D) and its quantity (ℓQ_D) are simultaneously determined by the supply and demand equations. The relationships between the exogenous variables and the price of domestic warmwater shrimp may warrant further explanation.

On the demand side, several comments regarding the variables ℓP_R and ℓP_{NR} are in order. Since 1984, the ITC has cumulated imports across countries when determining injury (Blonigen and Prusa 2004). With cumulation, the ITC aggregates all subject products from Respondent countries to assess their combined impact on the domestic industry. In the model above, ℓP_R denotes the average U.S. price (in logarithms) of cumulated subject shrimp imports from the Respondent countries. In a like manner, we have also included cumulated average U.S. prices for the same shrimp products imported from exporting countries that are not a party to the complaint (i.e., the Non-respondent counties, ℓP_{NR}). As imports from Respondents and Non-respondents alike are substitutes for the domestically produced like-product, one would expect positive coefficients for both ℓP_R and ℓP_{NR} . However, assuming that the Petitioners argument is correct, one would expect a relatively stronger price influence from the Respondents (i.e., those explicitly accused of engaging in "significant underselling" in the U.S. market).

While certainly shrimp may be procured for home consumption, the variable $\ell Fxedp_D$, food expenditure at eating and drinking places, is intended to capture the effects of demand for prepared meals on the demand (and hence price) for shrimp. A positive coefficient, therefore, would be expected for that variable. As a proxy for shrimp substitutes, a positive coefficient would be expected on the variable $\ell Fish_D$, as well. If the price of seafood (other than shrimp) were to rise, one would expect consumers to substitute away from it in favor of shrimp, thus causing the price of shrimp to rise.

On the supply side, if diesel fuel prices (ℓDsl_D) or the costs associated with repairing and maintaining vessels ($\ell Sbr_{D,t-1}$) increase, one would expect that shrimp prices would rise accordingly. Thus, positive coefficients are expected on each of these variables. Notably, however, tackle and ice prices were thought to increase prices at a decreasing rate. If, indeed, tackle and ice prices do increase domestic shrimp prices at a decreasing rate, the coefficient on $Tack\_ice_{D,t-1}$ will be positive while the coefficient on $Tack\_ice^2_{D,t-1}$ will be negative.

Finally, increases in catch per unit effort ($\ell Cpue_D$) are expected to drive down prices of domestic warmwater shrimp. A higher catch per unit effort connotes a rightward shift in the supply curve and falling prices. Thus, for this final variable on the supply-side, we would expect a negative and statistically significant coefficient.

2.2 The Results

The shrimp model, described above, was estimated with 3SLS using monthly data from January 1990 through December 2002. The 3SLS estimation results are presented in Figure 1. Figure 2 graphically depicts the model's predicted domestic prices of warmwater shrimp as well as actual domestic prices of warmwater shrimp. From Figure 2, and by the statistical conventions provided in Figure 1, it appears that the econometric model fits well. The fact that the supply curve is upward sloping and the demand curve is downward sloping is not *imposed* on the model, but rather is determined by the data. In Figure 1, all thirty-four coefficients have expected signs, and thirty-two of them are statistically significant at α =0.05 or α =0.01. The system weighted R^2 also indicates that the supply and demand equations have captured most of the variability in the dependent variable (ℓP_D).[11]

According to the model, decreases in either Respondent prices (ℓP_R) or Non-respondent prices (ℓP_{NR}) would adversely affect domestic prices. In fact, the estimated effect of Non-respondent import prices (0.409) is approximately equal to the estimated effect of Respondent import prices (0.403). Further, increases in time (*Yearno*) or catch per unit effort ($\ell Cpue_D$), as well as decreases in food expenditures ($\ell Fxedp_D$), the price of substitutes ($\ell Fish_D$), diesel fuel prices (ℓDsl_D), or the costs associated with repairing and maintaining vessels ($\ell Sbr_{D,t-1}$) would deteriorate domestic shrimp prices. In addition, domestic shrimp prices will rise with the tackle and ice PPI up to a peak of

$$\frac{\partial \ln P_D}{\partial Tack\_ice_{D,t-1}} = 0.243 - 0.001 Tack\_ice_{D,t-1} = 0$$

$$Tack\_ice_{D,t-1} = 243.00 .$$

Beyond that point, domestic shrimp prices will fall as tackle and equipment prices rise.

2.3 Attribution of Injury

To determine how much injury is attributable to subject imports versus other market factors, we apply the movements of each exogenous, explanatory variable over the POI to their respective coefficients from Figure 1. Technically, the percentage effect on the dependent variable (i.e., domestic shrimp prices, P_D) from any given percentage change in the logarithmic independent variables (X_i) is

$$\%\Delta P_D = e^{[\beta_i \ln(1+\%\Delta X_i)]} - 1 , \qquad (1)$$

where X_i represents any of the explanatory variables entered logarithmically (i.e., P_R , P_{NR} , $Fxedp_D$, $Fish_D$, Dsl_D , $Sbr_{D,t-1}$, and $Cpue_D$) and β_i represents that variable's respective coefficient. Likewise, the relationship between domestic shrimp prices and time (*Yearno*) is

$$\%\Delta P_D = e^{[\beta_1 \Delta Yearno]} - 1 . \qquad (2)$$

Further, since the relationship between domestic shrimp prices (P_D) and tackle and ice prices ($Tack\_ice_{D,t-1}$) is log-quadratic, the percentage effect on the dependent variable from a change in tackle and ice prices is, technically

$$\%\Delta P_D = e^{[\beta_1 \Delta Tack\_ice_{D,t-1} + \beta_2 \Delta Tack\_ice^2{}_{D,t-1}]} - 1 . \qquad (3)$$

Equations (1), (2) and (3) were used to calculate the percentage impacts of each market factor on domestic shrimp prices over the POI. The percentage impacts were then multiplied by the actual dollar price of domestic shrimp in 2000 ($2.36/lbs) to determine the dollar effect each market factor had on domestic price deterioration over the POI. Figure 3 summarizes the approximate effect of each market factor on domestic prices over the POI.

As Figure 3 shows, tackle and ice prices ($Tack\_ice_{D,t-1}$) had the greatest effect (in absolute value) on domestic shrimp prices over the POI. In isolation, the increase in $Tack\_ice_{D,t-1}$ from 2000 to 2002 negatively influenced domestic prices by about $0.62/lbs, but this negative effect is almost perfectly offset by the positive effect of catch per unit effort,

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[11] System weighted adjusted R^2 is approximately 1-(1-R^2)(n-1/n-k) = 0.8301.

$Cpue_D$ ($0.60/lbs). Escalating food expenditures ($Fxedp_D$) and building and repairing costs ($Sbr_{D,t-1}$) positively influenced domestic shrimp prices (by $0.32/lbs and $0.49/lbs, respectively), while time (*Yearno*) as well as decreasing prices of substitute seafood goods ($Fish_D$) and diesel prices (Dsl_D) negatively influenced domestic shrimp prices (by -$0.38/lbs, -$0.20/lbs and -$0.11/lbs respectively) over the POI.

The major result, however, concerns the effects of imports. While Respondent import prices (P_R) did have a significant impact on domestic price deterioration over the POI, the effect of Non-respondent import prices (P_{NR}) is almost exactly the same. Specifically, about $0.27/lbs of the domestic price deterioration experienced from 2000 to 2002 is attributable to Respondent shrimp imports, and about $0.28/lbs of it is attributable to Non-respondents (i.e., those countries not explicitly accused of engaging in "significant underselling" in the U.S. market). In short, the Non-respondents—the countries that will not be subject to antidumping duties—had roughly the same influence on declining domestic shrimp prices as their Respondent counterparts.

3. Conclusion

While the model produces a variety of interesting results concerning determinants of domestic shrimp prices, perhaps the most interesting result pertains to the effect of imports. Petitioners in this case alleged that Respondents were responsible for reductions in domestic shrimp prices over the POI. Our findings suggest that about $0.27/lbs of the domestic price deterioration experienced over the POI was attributable to Respondent imports. However, about $0.28/lbs of the domestic price deterioration was attributable to Non-respondent imports. In short, the Non-respondents had roughly the same influence on declining domestic shrimp prices as their Respondent counterparts.

One implication is that the low price of shrimp imports may be due to production and cost differentials, rather than predatory dumping. Most shrimp from exporting countries is farm-raised, which gives these exporters a cost advantage over Petitioner shrimp-boat operators who troll for their catch in open seas. The coefficients and price effects of Respondents and Non-respondents are remarkably close. Do these similarities arise because the entire world is guilty of dumping their shrimp on the U.S. market? Or, do these similarities arise because the rest of the world is using a technology (i.e., aquaculture) that the U.S. is slow to embrace?

The most obvious implication, however, is that Respondents are not any more responsible for the U.S. industry's predicament than the Non-respondents. There are two concerns with punishing the Respondents with antidumping duties. First, it seems inequitable to do so when Respondents are no more responsible than Non-respondents for the domestic industry's injury. Second, it is unlikely that the imposition of antidumping duties on Respondents will alleviate a "problem" equally caused by Non-respondents. Since the protection from competition sought by the domestic industry in this case will not affect imports from the Non-respondents, the anticipated price escalation that the domestic industry seeks may fall short of their expectations. Arguably, with antidumping duties imposed on the Respondents, the Non-respondents—rather than Petitioners—may realize the bigger boon. The elimination of competition from Brazil, China, Ecuador, India, Thailand, and Vietnam is, of course, in the best interests of Non-respondents, as well. Since Mexico (a Non-respondent) has financially supported the Petitioners on this case (King, 2004), there is some evidence that some Non-respondent countries have been anxiously awaiting an affirmative material injury vote from the ITC.

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Figure 1. Simultaneous Equations Model for U.S. Warmwater Shrimp

Dependent variable = ℓP_D, domestic price of warmwater shrimp

Variable	Demand Coefficient	Supply Coefficient
ℓQ_D	-0.385	1.171
	[-4.83]***	[2.83]***
ℓP_R	0.403	
	[3.93]***	
ℓP_{NR}	0.409	
	[2.90]***	
$\ell Fxedp_D$	1.518	
	[2.32]**	
$\ell Fish_D$	0.876	
	[4.24]***	
Yearno	-0.088	
	[-2.71]***	
$Tack\_ice_{D,t-1}$		0.243
		[2.86]***
$Tack\_ice^2{}_{D,t-1}$		-0.001
		[-3.60]***
ℓDsl_D		0.298
		[3.01]***
$\ell Sbr_{D,t-1}$		4.401
		[2.35]**
$\ell Cpue_D$		-0.623
		[2.78]***
Jan	-0.209	0.733
	[-3.22]***	[2.73]***
Feb	-0.224	1.073
	[-2.54]**	[3.07]***
Mar	-0.322	1.179
	[-3.32]***	[2.94]***
Apr	-0.295	0.733
	[-3.88]***	[2.61]**
May	-0.180	-1.286
	[-2.47]**	[-4.49]***
Jun	-0.005	-1.524
	[-0.06]	[-3.83]***
Jul	0.154	-0.896
	[2.16]**	[-3.22]***
Aug	0.224	-0.930
	[3.07]***	[-2.99]***
Sep	0.168	-0.874
	[2.80]***	[-2.99]***
Oct	0.135	-0.971
	[2.09]**	[-3.14]***
Nov	0.044	-0.575
	[0.89]	[-3.17]***
Constant	-16.444	-50.501
	[-2.21]**	[-4.50]***
R^2	0.865	

Brackets contain t-statistics

***=significant at $\alpha = 0.01$

**=significant at $\alpha = 0.05$

Figure 2. Predicted & Actual Monthly U.S. Shrimp Prices

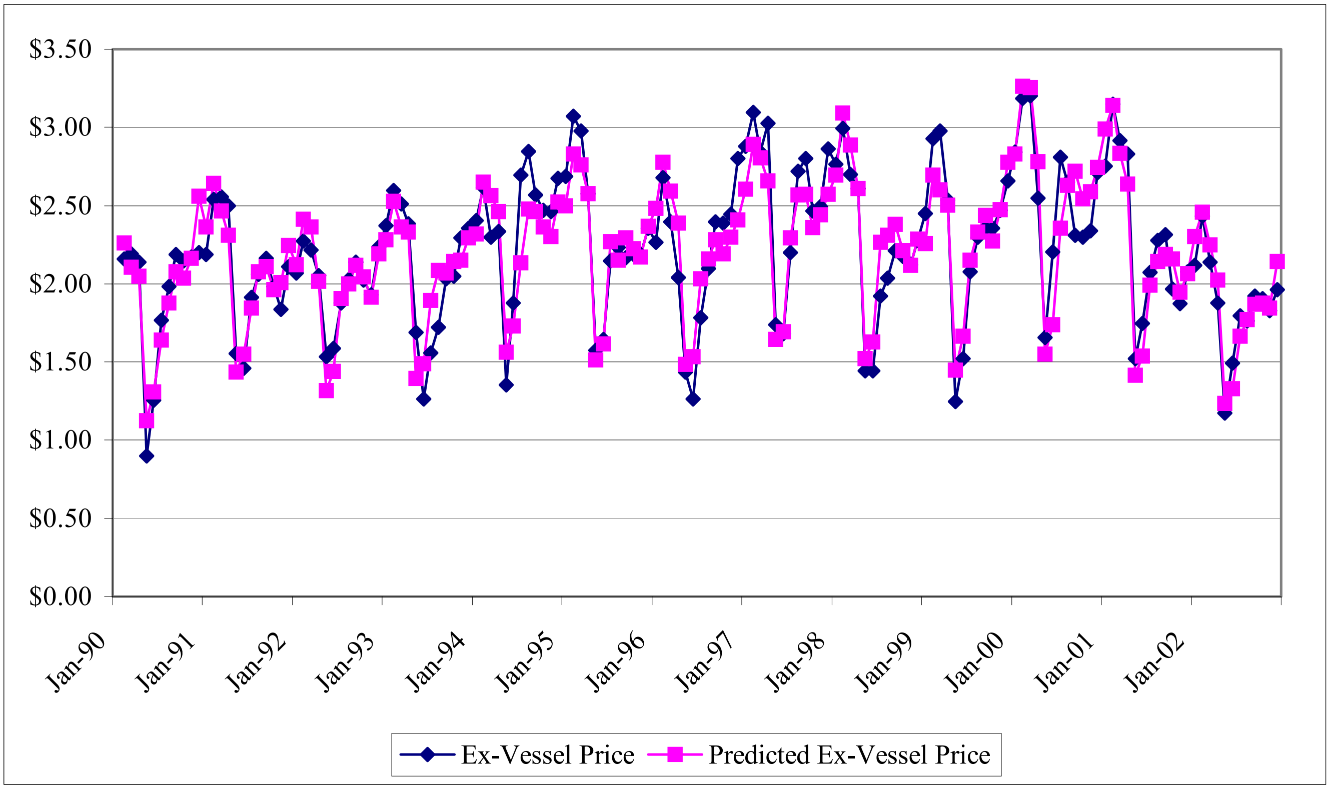

Figure 3. Attribution of Injury Across the POI, 2000-2002

Variable	Label	2000 Value	2002 Value	Coefficient	% Impact on Domestic Price	$ Impact on 2000 Domestic Price
P_R	Respondent prices ($/lbs)	$4.84	$3.57	0.403	-11.54%	-$0.27
P_{NR}	Non-respondent prices ($/lbs)	$5.00	$3.67	0.409	-11.87%	-$0.28
$Fxedp_D$	Food expenditures ($ million)	$281,148	$306,067	1.518	13.76%	$0.32
$Fish_D$	Seafood (excluding shellfish) price index	168.29	152.27	0.876	-8.39%	-$0.20
$Yearno$	Year number	11	13	-0.088	-16.14%	-$0.38
$Tack\_ice_{D,t-1}$	Tackle and ice price index	139.20	146.30	0.243	-26.15%	-$0.62
$Tack\_ice^2_{D,t-1}$	Tackle and ice price index squared	19,378.96	21,414.66	-0.001		
Dsl_D	Diesel price index	93.27	79.90	0.298	-4.51%	-$0.11
$Sbr_{D,t-1}$	Ship building and repairing price index	138.00	144.00	4.401	20.62%	$0.49
$Cpue_D$	Catch per unit effort	658.00	458.49	-0.623	25.24%	$0.60