

# International Economics Policy Briefs

## The Impact of Economic Sanctions on US Trade: Andrew Rose's Gravity Model

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*Andrew Rose kindly made available his gravity model with 14 control variables. For more information, see Rose (2002) and Rose and Glick (2001). Rose's gravity model database is available at <http://faculty.haas.berkeley.edu/arose>. The authors are grateful to Ben Goodrich for valuable assistance with the econometric calculations.*

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### Introduction

With the end of the Cold War, the focus of US foreign policy changed—and so did that of economic sanctions. Partly because of increased cooperation within the UN framework, economic sanctions were imposed so routinely in the early 1990s that scholars called that period the sanctions decade. This proliferation sparked intense debate about the effectiveness of sanctions as a policy tool and moved US sanctions policy to the center of public discourse.

Energized both by studies (notably *Economic Sanctions Reconsidered* by the Institute for International Economics) contending that economic sanctions seldom achieve their foreign policy goals and by intense lobbying on the part of multinational corporations (mainly under the umbrella of USA\*Engage), the Clinton administration and Congress attempted to reform US sanctions policy in the second half of the 1990s. Central to the reform effort were demands for more detailed cost analyses of economic sanctions, in particular US unilateral sanctions, prior to their imposition.

The Institute for International Economics first entered the cost debate in 1997 with a study measuring the impact of economic sanctions on bilateral merchandise trade flows between the United States and sanctioned countries. The 1997 study utilized common statistical techniques—the gravity model uses ordinary least square regression analysis—to calculate the loss of bilateral trade in 1995 due to economic sanctions (Hufbauer, et al. 1997).

Preliminary results from the third edition of *Economic Sanctions Reconsidered*<sup>1</sup> suggest that the proliferation of US unilateral sanctions episodes slowed markedly in the latter half of the 1990s. Several high-profile cases were launched (notably against India and Pakistan in the wake of their nuclear tests in 1998), while others were inherited from the past (for example, Cuba and North Korea). On balance, however, far fewer unilateral sanctions were initiated in the late 1990s, and some sanctions were even lifted during this period.<sup>2</sup>

Given these changes in US sanctions policy, we decided to take another look at the impact of economic sanctions on US trade flows. Professor Andrew Rose, at the University of California Berkeley, made available his gravity model for this exercise. Using Rose's gravity model with the addition of sanctions variables, we recalculated the impact of sanctions on US bilateral merchandise trade in 1995 and made new calculations for 1999. Further, we augmented the "mechanical" calculations of trade loss (based on regression coefficients) with our own "judgmental" calculations.

### Rose's Gravity Model

The case study approach adopted in *Economic Sanctions Reconsidered* looks at changes in trade or investment from the "bottom up" by estimating the impact of specific export or import restrictions, financial sanctions, or aid reductions. By contrast, the gravity model is a "top down" approach that estimates the impact of sanctions on bilateral trade flows by using a regression equation. In the analysis, a sanctions variable is only one of more than a dozen variables that explain bilateral trade.

Each approach has advantages and disadvantages. Case studies provide essential information about the direct cost of economic sanctions both to particular sectors of the targeted economy and to US firms, industries, and communities that trade or invest in the target country. The gravity model, however, purports to measure both direct and indirect merchandise trade effects, including the "reputation" and "after-life" effects of sanctions. Gravity model coefficients for the impact of sanctions represent deviations from statistical norms, however, and do not capture country-specific or case-specific nuances. Moreover, the gravity model database covers only bilateral merchandise trade and not trade in services. Since services trade often dwindles in

the face of sanctions, the gravity model coefficients may underestimate the impact of sanctions. For example, US sanctions against Cuba severely limit tourism, with a large impact that is not captured by a gravity model of merchandise trade. In addition, the gravity model does not capture the impact economic sanctions may have on capital flows to and investment in the targeted countries.

The standard gravity model predicts that bilateral trade increases with the size and wealth of two national economies (measured by GDP and GDP per capita) and decreases with the distance between them. Andrew Rose's gravity model also includes several other explanatory variables that can be expected to influence trade flows—such as common language, common border, and membership in regional trading blocs.

We have extended Rose's gravity model to include dummy variables for economic sanctions. Further, we have replaced Rose's bilateral trade, GDP, GDP per capita, and distance data for all country pairs with our own dataset and expanded the dataset to include data for countries subject to US sanctions during the years in question (1995 and 1999).<sup>3</sup> The following section briefly describes the gravity model variables.

The initial dependent variable is two-way merchandise trade for 1995 and 1999. We also ran separate regressions with US exports and US imports as dependent variables for each of the two years. Our dataset includes 175 countries (listed in appendix A). The regression equation form is logarithmic-linear, or log-linear, meaning that the equation has a linear form when all variables are expressed either in logarithmic form (for continuous variables) or as dummy variables (values of 0 or 1).<sup>4</sup> The following independent (explanatory) variables are included in Rose's model:<sup>5</sup>

$GDP_i * GDP_j$	Product of GDP of country pair measured in current dollars
$GDPPC_i * GDPPC_j$	Product of GDP per capita of country pair measured in current dollars

<sup>3</sup> Countries added were Afghanistan, Cuba, North Korea, and Yugoslavia. The source for trade data was IMF, *Direction of Trade Statistics*; for GDP and GDP per capita, we relied on IMF, *World Economic Outlook*; distance calculations are based on CIA *World Factbook*, the "great-circle" method was used.

<sup>4</sup> The regression equations use natural logarithms, i.e., logarithms to the base  $e$ .

<sup>5</sup> We replace Rose's database for bilateral trade and the first three independent variables with our own database.

<sup>1</sup> Hufbauer, et al. (forthcoming). Preliminary results are based on around 195 observations of economic sanctions imposed after World War I.

<sup>2</sup> Also see Carter (2002).

DIST	Distance between two countries
AREAP	Product of land areas in square miles
REGIONAL	Dummy for regional trade agreement
COMLANG	Dummy for common language
BORDER	Dummy for common border
CUSTRIC	Dummy for strict currency union
LANDL	Dummy for landlocked country
ISLAND	Dummy for island country
COMCOL	Dummy for countries that were colonies after 1945 with the same colonizer. (e.g. Angola and Mozambique, both colonies of Portugal)
CURCOL	Dummy for country pair currently in colonial relationship
COLONY	Dummy for country pair that was ever in a colonial relationship (e.g. United States and United Kingdom)
COMCTRY	Dummy for country pair that was part of the same nation during the year in question (e.g. United Kingdom and Bermuda)

### Dummy Variables for Sanctions

To capture the effect of economic sanctions, we added a series of dummy variables to Rose's basic model. We created a set of six dummy variables to indicate current or previous economic sanctions between two countries. Because sanctions take a variety of forms, we divided the cases into three categories according to the intensity of the sanctions—limited, moderate, or extensive. Variables LIM, MOD, and EXT indicate sanctions were in place during the years in question (1995 and 1999). To evaluate whether sanctions continue to adversely affect trade even after they have been lifted (an "after-life"), we included dummy variables LIM\*, MOD\*, and EXT\* representing cases where sanctions were not present in the year under analysis but had been in place at any time during the previous 10 years. The following section briefly describes the three categories of sanction intensity.

**LIM.** These are minor trade, financial, or travel sanctions. This category includes up to four of the following restrictions: reduction or suspension of economic aid; reduction or suspension of military aid; export restrictions on arms or limited dual-use technologies; prohibition of credits or credit guarantees by the US Export-Import Bank, Overseas Private Investment Corporation, Commodity Credit Corporation, or US Trade and Development Agency; objections to loans from international financial institutions (e.g. World Bank); travel bans or visa restrictions; bans on the export or import of one or two goods; and diplomatic rebuffs.

**MOD.** These are broader trade or financial sanctions, with five or more of the restrictions that would otherwise be classified as limited. Moderate sanctions also include more severe financial sanctions such as investment bans or asset freezes and export restrictions that go beyond defense items or selective goods.

**EXT.** The extensive category is reserved for comprehensive trade and financial sanctions such as those in place against Cuba, Iraq, Iran, and North Korea.

Because the severity of economic sanctions frequently changes, only restrictions actually in place during the year in question were taken into consideration. For example, while Vietnam was subject to comprehensive trade and financial sanctions for decades, by 1995 only very limited restrictions remained. With respect to past sanctions (LIM\*, MOD\*, and EXT\*), the most severe restrictions in place at any time during the past 10 years determined the classification.

When the sanctions dummy variables are added to Rose's gravity model, the augmented regression equation is as follows:<sup>6</sup>

$$\begin{aligned} \text{Log}(\text{TRADE}_{ij}) = & C + \beta_1 \text{log}(\text{GDP}_i \text{GDP}_j) + \\ & \beta_2 \text{log}(\text{GDPPC}_i \text{GDPPC}_j) + \beta_3 \text{log}(\text{DIST}) + \\ & \beta_4 \text{log}(\text{AREAP}) + \beta_5 (\text{REGIONAL}) + \beta_6 (\text{COMLANG}) + \\ & \beta_7 (\text{BORDER}) + \beta_8 (\text{CUSTRIC}) + \beta_9 (\text{LANDL}) + \\ & \beta_{10} (\text{ISLAND}) + \beta_{11} (\text{COMCOL}) + \beta_{12} (\text{CURCOL}) \\ & + \beta_{13} (\text{COLONY}) + \beta_{14} (\text{COMCTRY}) + \beta_{15} (\text{LIM}) + \\ & \beta_{16} (\text{MOD}) + \beta_{17} (\text{EXT}) + \beta_{18} (\text{LIM}^*) + \beta_{19} (\text{MOD}^*) + \\ & \beta_{20} (\text{EXT}^*) \end{aligned}$$

### General Results

The gravity model equation as specified, including the sanctions dummies, explains about 85 percent of the logarithmic variation in observed

<sup>6</sup> Natural logarithms (log) to the base *e* are used.

**Table 1 Mechanical estimates of bilateral merchandise trade lost due to extensive economic sanctions in place in 1995 (excluding nonsignificant coefficients)** (millions of dollars)

Target country	Total bilateral trade			US exports			US imports		
	Model-predicted bilateral trade	Counter-factual bilateral trade	Estimated reduction in bilateral trade	Model-predicted exports	Counter-factual exports	Estimated reduction in exports	Model-predicted imports	Counter-factual imports	Estimated reduction in imports
Cuba	40.8	3,870.0	-3,829.2	58.2	2,440.0	-2,381.8	0.2	1,640.0	-1,639.8
Iran	27.2	2,580.0	-2,552.8	23.8	998.0	-974.2	0.2	1,470.0	-1,469.8
Iraq	5.3	506.0	-500.7	4.9	205.0	-200.1	0.0	250.0	-250.0
Libya	15.7	1,490.0	-1,474.3	18.0	756.0	-738.0	0.1	734.0	-733.9
North Korea	2.2	208.0	-205.8	1.9	81.4	-79.5	0.0	98.4	-98.4
Yugoslavia, Federal Republic of	5.6	530.0	-524.4	5.5	229.0	-223.5	0.0	242.0	-242.0
<b>Total</b>	<b>96.8</b>	<b>9,184.0</b>	<b>-9,087.2</b>	<b>112.3</b>	<b>4,709.4</b>	<b>-4,597.1</b>	<b>0.6</b>	<b>4,434.4</b>	<b>-4,433.8</b>

**Table 2 Mechanical estimates of bilateral merchandise trade lost due to extensive economic sanctions in place in 1999 (excluding nonsignificant coefficients)** (millions of dollars)

Target country	Total bilateral trade			US exports			US imports		
	Model-predicted bilateral trade	Counter-factual bilateral trade	Estimated reduction in bilateral trade	Model-predicted exports	Counter-factual exports	Estimated reduction in exports	Model-predicted imports	Counter-factual exports	Estimated reduction in imports
Afghanistan	17.5	374.0	-356.5	6.3	113.0	-106.7	4.0	208.0	-204.0
Cuba	149.0	3,190.0	-3,041.0	107.0	1,920.0	-1,813.0	33.3	1,720.0	-1,686.7
Iran	149.0	3,190.0	-3,041.0	55.8	1,000.0	-944.2	36.0	1,860.0	-1,824.0
Iraq	98.3	2,100.0	-2,001.7	39.9	717.0	-677.1	20.7	1,070.0	-1,049.3
Libya	100.0	2,140.0	-2,040.0	55.1	991.0	-935.9	17.0	878.0	-861.0
North Korea	16.9	361.0	-344.1	6.4	115.0	-108.6	3.2	164.0	-160.8
Sudan	13.5	289.0	-275.5	4.9	87.8	-82.9	2.7	141.0	-138.3
Yugoslavia, Federal Republic of	19.6	419.0	-399.4	8.6	154.0	-145.4	3.4	175.0	-171.6
<b>Total</b>	<b>563.8</b>	<b>12,063.0</b>	<b>-11,499.2</b>	<b>284.0</b>	<b>5,097.8</b>	<b>-4,813.8</b>	<b>120.3</b>	<b>6,216.0</b>	<b>-6,095.7</b>

bilateral trade flows. This result indicates that the model fits the data well (see appendices D to I). The standard gravity model variables, such as economic size, distance, regional trade agreement, and common language, all have the anticipated signs and are statistically significant. Because we focus on US bilateral trade, variables related to contemporary colonial linkages dropped out.

### Impact of Current Sanctions

Our primary interest is the impact that current economic sanctions have on bilateral trade flows. As would be expected, extensive sanctions have a large depressing effect on bilateral trade flows, and the coefficients are highly significant. Extensive sanctions in place in 1995 reduce total bilateral trade flows by about 99 percent and US exports by about 98 percent (appendices D and E).<sup>7</sup> The impact of extensive sanctions was slightly less in 1999, reducing total bilateral trade by 95 percent and US exports by 94 percent (appendices G and H). The easing of some long-standing trade embargoes, such as those against North Korea, Cuba, and Iran, to permit US exports of food and medicine may explain the less draconian coefficients for 1999.

The estimated coefficients for limited and moderate sanctions, however, are not statistically significant at the usual levels of confidence. These counterintuitive results suggest that limited and moderate sanctions have little or no impact on bilateral trade flows. Ignoring statistical significance and just looking at the signs, the coefficients for limited and moderate sanctions in 1995 are negative (with a few exceptions). However, the coefficients for 1999 are positive, suggesting that trade actually increases in the presence of sanctions.<sup>8</sup>

<sup>7</sup> The percentage change in trade is calculated as follows. First find the value of the natural number  $e$  taken to the estimated coefficient as an exponent. Then subtract that value from 1.00. For example, the coefficient for extensive sanctions in 1995 (EXT95) is -4.554. The value of the natural number  $e$  taken to the exponent -4.554 is 0.01. Subtracting that value from 1.00 gives a change of 0.99. This indicates that bilateral trade was 99 percent lower between two countries owing to economic sanctions.

<sup>8</sup> Our results are confirmed by a similar gravity model study done at the George Washington University Center for the Study of Globalization. Using three different samples of economic sanctions across a time series of 19 years (1980–98), the authors find that in the case of two samples, the coefficients for limited or selective sanctions are mostly positive and statistically insignificant. The coefficients for Cold War export controls, however, are negative and statistically significant at the usual levels of confidence. Their estimates for severe sanctions are all negative and statistically significant, suggesting a reduction of trade between the United States and a targeted country of around 61 to 97 percent. See Askari, et al. (2003).

In our 1997 study, using a different gravity model, we concluded that limited sanctions had no impact on bilateral trade flows in 1995. However, we found that moderate sanctions had a significant negative impact. With the exception of China, the target countries confronted by moderate sanctions remained the same for both studies—Angola, Burma, Pakistan, Sudan, and Syria. One explanation for the different statistical estimates is that the number of bilateral country pair observations for countries *not* under US economic sanctions included in our current study is about double the number included in the 1997 study.<sup>9</sup>

### “After-life” of Sanctions

In addition to the direct and chilling impact on bilateral trade, the adverse effects of economic sanctions may linger after they have been lifted. Banning capital equipment exports today means lower exports in the future because markets for replacement parts and follow-up technologies are lost. Business ties are broken and may take time to reestablish. US firms may be regarded as unreliable suppliers and countries may avoid buying from them out of fear that, in the future, US suppliers might be caught up in another sanctions episode. To assess whether the effects of sanctions indeed linger, we included dummy variables—LIM85\*94, MOD85\*94, EXT85\*94 and LIM89\*98, MOD89\*98, EXT89\*98—representing cases where sanctions had been in place during the previous 10 years.

We find little evidence to support the argument that sanctions continue to suppress trade after they have been lifted. With the exception of limited sanctions in the 1985–94 period (LIM85\*94), the coefficients for past limited and moderate sanctions are not statistically significant. In fact, our results suggest that trade can significantly pick up after sanctions have been lifted. The extensive sanctions dummy variables (EXT85\*94, EXT89\*98) have positive signs and are statistically significant at the 95 percent confidence level. The cases in question are Haiti, Nicaragua, Panama, and Vietnam. For these countries, the “bungee-cord” results might be explained by catch-up purchases in the aftermath of a severe sanctions episode.

### Estimated Loss of Trade

To estimate the loss of US exports due to economic sanctions, we employed two methods—one model-based, the other judgmental.

<sup>9</sup> In addition, we used more control variables in the current study than the 1997 study. However, when we ran the current regression equation with the same control variables as the 1997 study, moderate sanctions still showed no effect.

**Table 3 Mechanical estimates of US merchandise exports lost due to economic sanctions in place in 1995** (millions of dollars)

Target country	Sanction level	Model-predicted exports	Counterfactual exports	Estimated reduction in US exports
Angola	Mod	49.1	55.9	-6.8
Azerbaijan	Lim	17.3	17.6	-0.3
Bulgaria	Lim	230.0	234.0	-4.0
Cambodia	Lim	34.3	34.8	-0.5
Cameroon	Lim	172.0	175.0	-3.0
China	Mod	6,860.0	6,970.0	-110.0
Cuba	Ext	58.2 <sup>a</sup>	2,440.0 <sup>a</sup>	-2,381.8 <sup>a</sup>
Czech Republic	Lim	482.0	490.0	-8.0
Ecuador	Lim	739.0	751.0	-12.0
Gambia, The	Lim	14.6	14.8	-0.2
Guatemala	Lim	1,460.0	1,480.0	-20.0
Indonesia	Lim	1,570.0	1,590.0	-20.0
Iran	Ext	23.8 <sup>a</sup>	998.0 <sup>a</sup>	-974.2 <sup>a</sup>
Iraq	Ext	4.9 <sup>a</sup>	205.0 <sup>a</sup>	-200.1 <sup>a</sup>
Lebanon	Lim	278.0	282.0	-4.0
Libya	Ext	18.0 <sup>a</sup>	756.0 <sup>a</sup>	-738.0 <sup>a</sup>
Myanmar (Burma)	Mod	51.1	58.3	-7.2
Nigeria	Lim	598.0	608.0	-10.0
North Korea	Ext	1.9 <sup>a</sup>	81.4 <sup>a</sup>	-79.5 <sup>a</sup>
Pakistan	Mod	955.0	1,090.0	-135.0
Peru	Lim	1,650.0	1,670.0	-20.0
Poland	Lim	2,330.0	2,370.0	-40.0
Romania	Lim	610.0	619.0	-9.0
Russia	Lim	4,990.0	5,070.0	-80.0
Rwanda	Lim	11.4	11.6	-0.2
Sudan	Mod	75.7	86.3	-10.6
Syria	Mod	210.0	239.0	-29.0
Vietnam	Lim	201.0	204.0	-3.0
Yemen	Lim	134.0	136.0	-2.0
Yugoslavia, Federal Republic of	Ext	5.5 <sup>a</sup>	229.0 <sup>a</sup>	-223.5 <sup>a</sup>
Zaire (Democratic Republic of Congo)	Lim	60.7	61.7	-1.0
<b>Total</b>		<b>23,895.5</b>	<b>29,028.4</b>	<b>-5,132.9</b>
<b>Total excluding non-significant coefficients</b>		<b>112.3</b>	<b>4,709.4</b>	<b>-4,597.1</b>

a. These coefficients are statistically significant at the 95 percent confidence level. The coefficients for limited (Lim) and moderate (Mod) sanctions are not statistically significant.

**Table 4 Mechanical estimate of US merchandise exports lost due to economic sanctions in place in 1999** (millions of dollars)

Target country	Sanction level	Model-predicted exports	Counterfactual exports	Estimated reduction in US exports
Afghanistan	Ext	6.3 <sup>a</sup>	113.0 <sup>a</sup>	-106.7 <sup>a</sup>
Angola	Mod	54.7	51.9	2.8
Azerbaijan	Lim	40.4	31.9	8.5
Cambodia	Lim	31.1	24.6	6.5
China	Mod	6,800.0	6,440.0	360.0
Cuba	Ext	107.0 <sup>a</sup>	1,920.0 <sup>a</sup>	-1,813.0 <sup>a</sup>
Guatemala	Lim	1,920.0	1,520.0	400.0
India	Lim	5,260.0	4,150.0	1,110.0
Indonesia	Lim	1,020.0	803.0	217.0
Iran	Ext	55.8 <sup>a</sup>	1,000.0 <sup>a</sup>	-944.2 <sup>a</sup>
Iraq	Ext	39.9 <sup>a</sup>	717.0 <sup>a</sup>	-677.1 <sup>a</sup>
Libya	Ext	55.1 <sup>a</sup>	991.0 <sup>a</sup>	-935.9 <sup>a</sup>
Myanmar (Burma)	Mod	44.0	41.7	2.3
Niger	Lim	15.6	12.3	3.3
North Korea	Ext	6.4 <sup>a</sup>	115.0 <sup>a</sup>	-108.6 <sup>a</sup>
Pakistan	Mod	848.0	804.0	44.0
Sierra Leone	Lim	21.2	16.7	4.5
Sudan	Ext	4.9 <sup>a</sup>	87.8 <sup>a</sup>	-82.9 <sup>a</sup>
Syria	Mod	222.0	211.0	11.0
Yugoslavia, Federal Republic of	Ext	8.6 <sup>a</sup>	154.0 <sup>a</sup>	-145.4 <sup>a</sup>
<b>Total</b>		<b>16,560.9</b>	<b>19,204.9</b>	<b>-2,644.0</b>
<b>Total excluding nonsignificant coefficients</b>		<b>284.0</b>	<b>5,097.8</b>	<b>-4,813.8</b>

a. These coefficients are statistically significant at the 95 percent confidence level. The coefficients for limited (Lim) and moderate (Mod) sanctions are not statistically significant, but positive in 1999, thus leading to the counterintuitive result that US exports increase to countries under limited and moderate sanctions.

The model-based or mechanical estimates are constructed by subtracting the gravity-model-predicted level of trade from the counterfactual level of trade in the absence of economic sanctions. For example, based on the size and wealth of the two economies (measured by GDP and GDP per capita), the distance between them and the fact that severe economic sanctions were in place, the gravity model predicts that the value of US exports to Cuba in 1999 would be \$107 million. By contrast, the model estimates that the 1999 value of US exports to Cuba, if no sanctions were in place (the counterfactual calculation), would have been \$1,920 million. Thus the estimated loss of US exports to Cuba on account of severe economic sanctions was \$1,813 million (\$1,920 million minus \$107 million, see table 4). Applying the model-based method to all sanctioned countries suggests that US bilateral merchandise trade flows (exports plus imports) with all sanctioned countries in 1995 were \$9.1 billion lower than they would have been without sanctions (table 1). In 1999, bilateral trade flows were reduced by an estimated \$11.5 billion (table 2). Expressed as a percentage of total US merchandise trade, these reductions amount to 0.7 percent for both years.

With respect to US exports, the impact of sanctions is similar. Our mechanical estimates suggest a reduction of \$4.6 billion in exports for 1995 and \$4.8 billion for 1999 (0.8 percent and 0.7 percent of total merchandise exports—see tables 3 and 4, respectively). If the statistically nonsignificant coefficients for limited and moderate sanctions were taken into account, the loss of exports in 1995 would increase to \$5.1 billion (table 3). If taken into account, the statistically nonsignificant coefficients for limited and moderate sanctions in 1999 would actually reduce the loss of exports in that year (table 4).

For a number of countries, US exports predicted by the gravity model are substantially different (in absolute terms) from actual exports to the country in question. For example, the gravity model predicted US exports to China in 1995 to be \$6,860 million, while actual US exports were \$11,478 million. Similarly, based strictly on the gravity model, the United States would have exported \$2,330 million worth of goods to Poland in 1995 but in fact only exported \$776.3 million. (See tables 3 and 5.) For this and other reasons, we also made judgmental calculations of the US trade loss. Our judgmental estimates are based on a mix of different methods. In some cases we have applied the statistical coefficients to actual US exports and imports to the sanctioned countries. In other cases, we have looked at US trade with similar countries to calculate what US exports and imports might be in the absence of sanctions.

Our judgmental figures are about twice as large as the mechanical calculations. Based on our judgmental estimates, total US bilateral merchandise trade flows (exports plus imports) with countries targeted by extensive sanctions were reduced by \$24.8 billion in 1995 and \$25 billion in 1999 (tables 5 and 6).<sup>10</sup>

The judgmental results suggest that extensive sanctions reduced US exports by around \$9.3 billion in 1995 and \$9.1 billion in 1999 (table 5).<sup>11</sup> Using these figures, lost US exports on account of extensive sanctions amounted to 1.6 percent of total merchandise exports in 1995. Lost US exports in 1999 amounted to 1.3 percent of total merchandise exports, suggesting that the relative cost of extensive sanctions has decreased slightly.

As mentioned earlier, because the gravity model only takes into account changes in merchandise trade and not trade in services, it may underestimate the total cost of economic sanctions to the US economy. In 1999, the United States exported around \$272 billion worth of services. Assuming economic sanctions would have a comparable impact on services trade as on trade in goods in terms of percentages of total bilateral trade, the United States may have lost \$6.6 billion in bilateral services trade (\$3 billion in services imports and \$3.6 billion in services exports) owing to sanctions (tables 5 and 6).

When sized against the vast US economy, or even total trade, sanctions seem to exert a small economic impact. If spread evenly, the costs of sanctions would be equivalent to a very low rate of tax. But the costs of sanctions are never spread evenly. The US trade embargo against Libya primarily affects the US oil services industry. Given that industry's geographic concentration, Texas is comparatively more burdened by the Libyan embargo. By the same token, while US trade with China has increased tremendously over the last decade, exports of high-technology and dual-use goods are still restricted. To cite just one more example, the long-standing US embargo on Cuba arguably has a much larger impact on Florida than on other states. Within the United States, specific firms and communities are disproportionately affected.

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<sup>10</sup> If limited and moderate sanctions are included in the calculations, the loss of bilateral trade might total \$40.6 billion in 1995 (tables 5 and 6). Based on the econometric coefficients, limited and moderate sanctions did not reduce bilateral trade flows in 1999.

<sup>11</sup> If limited and moderate sanctions are included in the calculations, the loss of exports in 1995 might be \$11.4 billion (table 5).

**Table 5 Judgmental estimates of US merchandise exports lost in 1995 and 1999** (millions of dollars)

<b>1995</b>	<b>Actual US exports in 1995</b>	<b>Estimated reduction in US exports<sup>f</sup></b>
Angola	259.9	-36.4
Azerbaijan	35.9	-0.6
Bulgaria	131.8	-2.1
Cambodia	26.9	-0.4
Cameroon	45.8	-0.7
China	11,748.5	-1,644.4
Cuba <sup>a</sup>	6.0	-2,381.8
Czech Republic	362.7	-5.8
Ecuador	1,538.4	-24.8
Gambia, The	6.1	-0.1
Guatemala	1,651.7	-26.6
Indonesia	3,395.2	-54.8
Iran <sup>b</sup>	238.0	-2,686.0
Iraq <sup>c</sup>	0.2	-1,996.0
Lebanon	589.5	-9.5
Libya <sup>c</sup>	n.a.	-1,411.0
Myanmar (Burma)	16.1	-2.3
Nigeria	602	-9.7
North Korea <sup>d</sup>	5.0	-153.0
Pakistan	934.5	-130.8
Peru	1775	-28.6
Poland	776.3	-12.5
Romania	256.2	-4.1
Russia	3,065.7	-49.4
Rwanda	38.4	-0.6
Sudan	43.5	-6.1
Syria	223.4	-31.3
Vietnam	252.9	-4.1
Yemen	185.3	-3.0
Yugoslavia, Federal Republic of <sup>e</sup>	n.a.	-675.0
Zaire (Democratic Republic of Congo)	76.9	-1.2
<b>Total merchandise</b>	<b>28,287.8</b>	<b>-11,392.7</b>
<b>Total merchandise excluding nonsignificant coefficients*</b>	<b>249.2</b>	<b>-9,302.8</b>
<b>Estimated loss of services exports<sup>g</sup></b>	<b>--</b>	<b>-3,550.9</b>

\* Countries included in this estimate are Cuba, Iran, Iraq, Libya, North Korea, and the Federal Republic of Yugoslavia.  
n.a. = not available

**Table 5** (Continued)

<b>1999</b>	<b>Actual US exports in 1999</b>	<b>Estimated reduction in US exports<sup>f</sup></b>
Afghanistan	18.0	-305.8
Cuba <sup>a</sup>	5.0	-1,813.0
Iran <sup>b</sup>	47.9	-1,947.0
Iraq <sup>c</sup>	19.6	-2,227.0
Libya <sup>c</sup>	n.a.	-1,574.0
North Korea <sup>d</sup>	11.3	-106.0
Sudan	7.2	-122.3
Yugoslavia, Fed. Rep	58.2	-988.8
<b>Total merchandise</b>	<b>167.2</b>	<b>-9,084.0</b>
<b>Estimated loss of services exports<sup>g</sup></b>	<b>--</b>	<b>-3,620.0</b>

<sup>a</sup> Estimated exports to Cuba based on model-predicted reduction of exports.

<sup>b</sup> Estimated exports to Iran calculated as US share of industrial-countries exports to Saudi Arabia (28 percent for 1995, 35 percent for 1999) multiplied by industrial-countries exports to Iran.

<sup>c</sup> Estimated exports to Iraq and Libya calculated as (US exports in the last year before sanctions) multiplied by (world exports in 1995 or 1999) divided by (world exports in the last year before sanctions).

<sup>d</sup> Estimated exports to North Korea calculated as US share of industrial-countries exports to South Korea (31 percent for 1995, 35 percent for 1999) multiplied by industrial-countries exports to North Korea.

<sup>e</sup> Estimated 1995 exports to the Federal Republic of Yugoslavia calculated as estimated 1995 US exports to all of Yugoslavia less observed exports to Croatia and Bosnia Herzegovina.

<sup>f</sup> For countries other than those specifically noted, the reduction in US exports is estimated as (actual 1995 or 1999 exports) divided by (the econometric estimate of percentage decrease in exports) minus (actual 1995 or 1999 exports).

<sup>g</sup> Loss of services exports calculated as US total exports of services in 1995 or 1999 multiplied by (estimated reductions of US merchandise exports in 1995 or 1999) divided by (total US merchandise exports in 1995 or 1999).

**Table 6 Judgmental estimates of US merchandise imports lost in 1995 and 1999**  
(millions of dollars)

<b>1995</b>	<b>Actual US imports in 1995</b>	<b>Estimated reduction in US imports<sup>f</sup></b>
Angola	2,390.2	157.1
Azerbaijan	0.8	-0.6
Bulgaria	200.5	-141.2
Cambodia	5.6	-3.9
Cameroon	52.6	-37.0
China	48,520.7	3,189.7
Cuba <sup>a</sup>	n.a.	-1,639.8
Czech Republic	439.3	-309.3
Ecuador	2,158.0	-1,519.3
Gambia, The	2.2	-1.5
Guatemala	1,632.4	-1,149.3
Indonesia	7,954.8	-5,600.5
Iran <sup>b</sup>	0.2	-2,879.0
Iraq <sup>c</sup>	n.a.	-4,224.1
Lebanon	36.4	-25.6
Libyac	0.0	-6,002.0
Myanmar (Burma)	86.9	5.7
Nigeria	5,054.9	-3,558.8
North Korea <sup>d</sup>	n.a.	-171.8
Pakistan	1,278.2	84.0
Peru	1,092.2	-768.9
Poland	711.1	-500.6
Romania	240.6	-169.4
Russia	4,270.0	-3,006.2
Rwanda	1.8	-1.3
Sudan	23.5	1.5
Syria	65.0	4.3
Vietnam	210.1	-147.9
Yemen	44.4	-31.3
Yugoslavia, Federal Republic of <sup>e</sup>	n.a.	-602.5
Zaire (Democratic Republic of Congo)	273.4	-192.5
<b>Total merchandise</b>	<b>76,745.8</b>	<b>-29,242.0</b>
<b>Total merchandise excluding non-significant coefficients*</b>	<b>0.2</b>	<b>-15,519.2</b>
<b>Estimated loss of services imports<sup>i</sup></b>	<b>--</b>	<b>-3,022.0</b>

\* Countries included in this estimate are Cuba, Iran, Iraq, Libya, North Korea, and the Federal Republic of Yugoslavia.  
n.a. = not available

**Table 6** (Continued)

<b>1999</b>	<b>Actual US imports in 1999</b>	<b>Estimated reduction in US imports<sup>h</sup></b>
Afghanistan	9.2	-465.7
Cuba <sup>a</sup>	0.6	-1,686.7
Iran <sup>b</sup>	2.4	-2,684.8
Iraq <sup>c</sup>	4,266.3	-4,782.7
Libya <sup>f</sup>	n.a.	-5,721.3
North Korea <sup>d</sup>	n.a.	-115.1
Sudan <sup>g</sup>	3.4	-172.1
Yugoslavia, Federal Republic of	6.0	-303.7
<b>Total</b>	<b>4,287.9</b>	<b>-15,932.1</b>
<b>Estimated loss of services imports<sup>i</sup></b>	<b>--</b>	<b>-2,926.7</b>

<sup>a</sup> Estimated imports from Cuba based on model-predicted reduction of imports.

<sup>b</sup> Estimated imports from Iran calculated as US share of industrial-countries imports from Saudi Arabia (28 percent for 1995, 32 percent for 1999) multiplied by industrial-countries imports from Iran.

<sup>c</sup> Estimated imports to Iraq calculated as (US imports in the last year before sanctions) multiplied by (world imports in 1995 or 1999) divided by (world imports in the last year before sanctions).

<sup>d</sup> Estimated imports from North Korea calculated as US share of industrial-countries imports from South Korea (40 percent for 1995, 43 percent for 1999) multiplied by industrial-countries imports from North Korea.

<sup>e</sup> Estimated 1995 imports from the Federal Republic of Yugoslavia. Calculated as estimated 1995 US imports to all of Yugoslavia less observed exports to Croatia and Bosnia Herzegovina.

<sup>f</sup> Estimated imports from Libya calculated as (ratio of US imports to other industrial-countries imports from Libya in the last year before sanctions) multiplied by (1995 or 1999 industrial-countries imports from Libya).

<sup>g</sup> US imports for 1998 used as estimate of 1999 US imports from Sudan. Reduction in US imports is estimated as (actual 1998 imports) divided by (the econometric estimate of percentage decrease in imports) minus (actual 1998 imports)

<sup>h</sup> For countries other than those specifically noted, the reduction in US imports is estimated as (actual 1995 or 1999 imports) divided by (the econometric estimate of percentage decrease in imports) minus (actual 1995 or 1999 imports).

<sup>i</sup> Loss of services imports calculated as US total imports of services in 1995 or 1999 multiplied by (estimated reductions of US merchandise imports in 1995 or 1999) divided by (total US merchandise imports in 1995 or 1999).

Some firms and communities may experience severe economic dislocation in the wake of sanctions that are intended to target foreign countries. Such important realities are not captured in aggregate measures of economic loss.

Finally, it should be recognized that the longer sanctions are in place, the greater the opportunity for both exports and imports to carve new channels. The extensive sanctions listed in our tables have

been in place against the target countries for decades. It is reasonable to suppose that much of the "lost trade," as calculated in this policy brief, now takes place through less efficient channels. When sanctions are removed, the old channels will be restored, diverting commerce from the replacement channels. Total US trade will increase but not by the full amount of calculated lost trade.

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*The views expressed in this publication are those of the authors. This publication is part of the overall program of the Institute, as endorsed by its Board of Directors, but does not necessarily reflect the views of individual members of the Board or the Advisory Committee.*

**Appendix A Country List**

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Afghanistan	Ethiopia
Albania	Fiji
Algeria	Finland
Angola	France
Antigua and Barbuda	Gabon
Argentina	Gambia, The
Armenia	Georgia
Australia	Germany
Austria	Ghana
Azerbaijan	Greece
Bahamas, The	Grenada
Bahrain	Guatemala
Bangladesh	Guinea
Barbados	Guinea-Bissau
Belarus	Guyana
Belgium	Haiti
Belize	Honduras
Benin	Hungary
Bhutan	Iceland
Bolivia	India
Botswana	Indonesia
Brazil	Iran
Bulgaria	Iraq
Burkina Faso	Ireland
Burundi	Israel
Cambodia	Italy
Cameroon	Jamaica
Canada	Japan
Cape Verde	Jordan
Central African Republic	Kazakhstan
Chad	Kenya
Chile	Kiribati
China, People's Republic of	Korea, South
China, Hong Kong Special Administrative Region	Kuwait
Colombia	Kyrgyz Republic
Comoros	Laos
Congo, Democratic Republic of	Latvia
Congo, Republic of	Lebanon
Costa Rica	Lesotho
Cote d'Ivoire	Libya
Croatia	Lithuania
Cuba	Luxembourg
Cyprus	Macedonia, Former Yugoslav Republic of
Czech Republic	Madagascar
Denmark	Malawi
Djibouti	Malaysia
Dominica	Maldives
Dominican Republic	Mali
Ecuador	Malta
Egypt	Mauritania
El Salvador	Mauritius
Equatorial Guinea	Mexico
Estonia	Moldova

Mongolia	Solomon Islands
Morocco	South Africa
Mozambique	Spain
Myanmar (Burma)	Sri Lanka
Namibia	St. Kitts and Nevis
Nepal	St. Lucia
Netherlands	St. Vincent and the Grenadines.
New Zealand	Sudan
Nicaragua	Suriname
Niger	Swaziland
Nigeria	Sweden
North Korea	Switzerland
Norway	Syria
Oman	Tajikistan
Pakistan	Tanzania
Panama	Thailand
Papua New Guinea	Togo
Paraguay	Tonga
Peru	Trinidad and Tobago
Philippines	Tunisia
Poland	Turkey
Portugal	Uganda
Qatar	Ukraine
Romania	United Arab Emirates
Russia	United Kingdom
Rwanda	Uruguay
Samoa	Uzbekistan
São Tomé & Príncipe	Vanuatu
Saudi Arabia	Venezuela
Senegal	Vietnam
Seychelles	Yemen
Sierra Leone	Yugoslavia, Federal Republic of
Singapore	Zambia
Slovak Republic	Zimbabwe
Slovenia	

## Appendix B Sanctions dummy variables–1995

### Sender country: United States

Target country	LIM95	MOD95	EXT95	LIM85*94	MOD85*94	EXT85*94
Angola	0	1	0	0	0	0
Azerbaijan	1	0	0	0	0	0
Bulgaria	1	0	0	0	0	0
Cambodia	1	0	0	0	0	0
Cameroon	1	0	0	0	0	0
Chile	0	0	0	0	1	0
China	0	1	0	0	0	0
Cuba	0	0	1	0	0	0
Czech Republic	1	0	0	0	0	0

**Appendix B** (Continued)

<b>Target country</b>	<b>LIM95</b>	<b>MOD95</b>	<b>EXT95</b>	<b>LIM85*94</b>	<b>MOD85*94</b>	<b>EXT85*94</b>
Ecuador	1	0	0	0	0	0
El Salvador	0	0	0	1	0	0
Ethiopia	0	0	0	1	0	0
Gambia, The	1	0	0	0	0	0
Guatemala	1	0	0	0	0	0
Haiti	0	0	0	0	0	1
Hungary	0	0	0	0	1	0
India	0	0	0	1	0	0
Indonesia	1	0	0	0	0	0
Iran	0	0	1	0	0	0
Iraq	0	0	1	0	0	0
Jordan	0	0	0	1	0	0
Kenya	0	0	0	1	0	0
Lebanon	1	0	0	0	0	0
Liberia	1	0	0	0	0	0
Libya	0	0	1	0	0	0
Malawi	0	0	0	1	0	0
Myanmar (Burma)	0	1	0	0	0	0
Nicaragua	0	0	0	0	0	1
Nigeria	1	0	0	0	0	0
North Korea	0	0	1	0	0	0
Pakistan	0	1	0	0	0	0
Panama	0	0	0	0	0	1
Peru	1	0	0	0	0	0
Poland	1	0	0	0	0	0
Romania	1	0	0	0	0	0
Russia	1	0	0	0	0	0
Rwanda	1	0	0	0	0	0
South Africa	0	0	0	0	1	0
Sudan	0	1	0	0	0	0
Suriname	0	0	0	1	0	0
Syria	0	1	0	0	0	0
Thailand	0	0	0	1	0	0
Vietnam	1	0	0	0	0	0
Yemen	1	0	0	0	0	0
Yugoslavia, Federal Republic of	0	0	1	0	0	0
Zaire (Democratic Republic of Congo)	1	0	0	0	0	0
Zimbabwe	0	0	0	1	0	0

**Appendix C Sanctions dummy variables–1999****Sender country: United States**

<b>Target country</b>	<b>LIM99</b>	<b>MOD99</b>	<b>MOD99</b>	<b>LIM89*98</b>	<b>MOD89*98</b>	<b>EXT89*98</b>
Afghanistan	0	0	1	0	0	0
Angola (UNITA)	0	1	0	0	0	0
Azerbaijan	1	0	0	0	0	0
Bulgaria	0	0	0	0	1	0
Cambodia (Khmer Rouge)	1	0	0	0	0	0
Cameroon	0	0	0	1	0	0
Chile	0	0	0	0	1	0
China	0	1	0	0	0	0
Colombia	0	0	0	1	0	0
Cuba	0	0	1	0	0	0
Czech Republic	0	0	0	0	1	0
Ecuador	0	0	0	1	0	0
El Salvador	0	0	0	1	0	0
Ethiopia	0	0	0	1	0	0
Gambia, The	0	0	0	1	0	0
Guatemala	1	0	0	0	0	0
Haiti	0	0	0	0	0	1
Hungary	0	0	0	0	1	0
India	1	0	0	0	0	0
Indonesia	1	0	0	0	0	0
Iran	0	0	1	0	0	0
Iraq	0	0	1	0	0	0
Jordan	0	0	0	1	0	0
Kenya	0	0	0	1	0	0
Lebanon	0	0	0	1	0	0
Liberia	1	0	0	0	0	0
Libya	0	0	1	0	0	0
Malawi	0	0	0	1	0	0
Myanmar (Burma)	0	1	0	0	0	0
Nicaragua	0	0	0	0	0	1
Niger	1	0	0	0	0	0
Nigeria	0	0	0	0	1	0
North Korea	0	0	1	0	0	0
Pakistan	0	1	0	0	0	0
Pananma	0	0	0	0	0	1
Paraguay	0	0	0	1	0	0
Peru	0	0	0	1	0	0
Poland	0	0	0	0	1	0
Romania	0	0	0	0	1	0
Russia	0	0	0	0	1	0
Rwanda	0	0	0	1	0	0
Sierra Leone	1	0	0	0	0	0

**Appendix C** (Continued)

Target country	LIM99	MOD99	MOD99	LIM89*98	MOD89*98	EXT89*98
Somalia	1	0	0	0	0	0
South Africa	0	0	0	0	1	0
Sudan	0	0	1	0	0	0
Syria	0	1	0	0	0	0
Thailand	0	0	0	1	0	0
Vietnam	0	0	0	0	0	1
Yemem	0	0	0	1	0	0
Yugoslavia, Federal Republic of	0	0	1	0	0	0
Zaire (Democratic Republic of Congo)	0	0	0	1	0	0
Zambia	0	0	0	1	0	0

**Appendix D 1995 econometric results, total bilateral trade**

Variables	Estimated coefficient	Standard error	t-statistic	Estimated percentage change when dummy variable is 1
<b>Sanctions dummy variables**</b>				
LIM95	-0.159	0.223	-0.71	-14.7
MOD95	0.077	0.736	0.10	8.0
EXT95	-4.554	1.077	-4.23	-98.9
LIM85*94	0.348	0.248	1.40	41.6
MOD85*94	0.156	0.250	0.62	16.9
EXT85*94	0.656	0.258	2.54	92.7
<b>Gravity model continuous variables*</b>				
log of GDP <sub>i</sub> *GDP <sub>j</sub>	1.036	0.084	12.35	
log of GDPPC <sub>i</sub> *GDPPC <sub>j</sub>	-0.065	0.099	-0.66	
log of DIST	-1.060	0.223	-4.76	
log of AREAP	-0.056	0.057	-0.97	
<b>Gravity model dummy variables</b>				
REGIONAL	0.808	0.232	3.48	124.3
COMLANG	0.481	0.169	2.85	61.8
BORDER	-0.121	0.489	-0.25	-11.4

**Appendix D** (Continued)

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CUSTRIC	-0.010	0.196	-0.05	-1.0
LANDL	-0.703	0.227	-3.10	-50.5
ISLAND	0.057	0.270	0.21	5.9
COMCOL	(dropped)			
CURCOL	(dropped)			
COLONY	0.345	0.708	0.49	41.2
COMCTRY	(dropped)			
<b>Constant</b>				
CON	20.056	3.162	6.34	
Regression with robust standard errors				
Number of observations	173			
R-squared	0.8667			
Root MSE	1.0518			

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\*The regression coefficient on a continuous logarithmic variable can be interpreted as an elasticity, namely the percentage change in the dependent variable for each 1 percent change in the independent variable. For example, if the estimated coefficient on log (GDP) is 0.9, a 10 percent increase in a country's GDP is estimated to increase the dependent variable (trade) by 9 percent.

\*\* The regression coefficient on a positive dummy variable (variable =1) can be interpreted as a step increase in the independent variable. For example, if the estimated coefficient for limited sanctions (lim) is -0.159, the percentage change in trade is calculated as follows. The value of the natural number e taken to the exponent -0.159 is 0.852. Subtracting that value from 1.000 gives a change of 14.8 percent. This means that bilateral trade was 14.8 percent lower between the two countries owing to limited sanctions than it would have been if the sanctions were not in place.

**Appendix E 1995 econometric results, US exports**

<b>Variables</b>	<b>Estimated coefficient</b>	<b>Standard error</b>	<b>t-statistic</b>	<b>Estimated percentage change when dummy variable is 1</b>
<b><i>Sanctions dummy variables**</i></b>				
LIM95	-0.016	0.208	-0.08	-1.6
MOD95	-0.131	0.471	-0.28	-12.3
EXT95	-3.735	1.109	-3.37	-97.6
LIM85*94	0.583	0.259	2.25	79.1
MOD85*94	0.303	0.329	0.92	35.4
EXT85*94	0.724	0.276	2.63	106.2
<b><i>Gravity model continuous variables*</i></b>				
log of GDPi*GDPj	0.948	0.070	13.56	
log of GDPPCi*GDPPCj	0.026	0.083	0.32	
log of DIST	-1.367	0.221	-6.18	
log of AREAP	-0.011	0.063	-0.18	
<b><i>Gravity model dummy variables</i></b>				
REGIONAL	0.990	0.278	3.56	169.1
COMLANG	0.485	0.166	2.92	62.3
BORDER	-0.768	0.550	-1.40	-53.6
CUSTRIC	0.067	0.245	0.28	7.0
LANDL	-0.767	0.231	-3.32	-53.6
ISLAND	0.044	0.275	0.16	4.5
COMCOL	(dropped)			
CURCOL	(dropped)			
COLONY	0.543	0.708	0.77	72.1
COMCTRY	(dropped)			
<b><i>Constant</i></b>				
CON	20.064	2.724	7.37	
Regression with robust standard errors				
Number of observations	173			
R-squared	0.8709			
Root MSE	1.0196			

\* See appendix D note.

\*\* See appendix D note.

**Appendix F 1995 econometric results, US imports**

<b>Variables</b>	<b>Estimated coefficient</b>	<b>Standard error</b>	<b>t-statistic</b>	<b>Estimated percentage change when dummy variable is 1</b>
<b><i>Sanctions dummy variables**</i></b>				
LIM95	-0.533	0.348	-1.53	-41.3
MOD95	0.068	0.947	0.07	7.0
EXT95	-8.904	0.217	-41.04	-100.0
LIM85*94	0.163	0.410	0.40	17.7
MOD85*94	0.185	0.300	0.62	20.3
EXT85*94	0.458	0.454	1.01	58.1
<b><i>Gravity model continuous variables*</i></b>				
log of GDPi*GDPj	1.141	0.109	10.44	
log of GDPPCi*GDPPCj	-0.139	0.138	-1.01	
log of DIST	-0.995	0.278	-3.57	
log of AREAP	-0.051	0.071	-0.72	
<b><i>Gravity model dummy variables</i></b>				
REGIONAL	0.817	0.292	2.80	126.4
COMLANG	0.565	0.252	2.25	76.0
BORDER	-0.122	0.598	-0.20	-11.5
CUSTRIC	-0.484	0.299	-1.62	-38.4
LANDL	-1.024	0.311	-3.29	-64.1
ISLAND	0.038	0.355	0.11	3.9
COMCOL	(dropped)			
CURCOL	(dropped)			
COLONY	0.188	0.818	0.23	20.6
COMCTRY	(dropped)			
<b><i>Constant</i></b>				
CON	18.664	4.133	4.52	
Regression with robust standard errors				
Number of observations	166			
R-squared	0.8186			
Root MSE	1.3497			

\* See appendix D note.

\*\* See appendix D note.

**Appendix G 1999 econometric results, total bilateral trade**

<b>Variables</b>	<b>Estimated coefficient</b>	<b>Standard error</b>	<b>t-statistic</b>	<b>Estimated percentage change when dummy variable is 1</b>
<b><i>Sanctions dummy variables</i></b>				
LIM99	0.383	0.397	0.96	46.6
MOD99	0.734	0.658	1.12	108.3
EXT99	-3.062	0.810	-3.78	-95.3
LIM89*98	0.086	0.251	0.34	9.0
MOD89*98	-0.055	0.279	-0.20	-5.4
EXT89*98	0.822	0.329	2.50	127.5
<b><i>Gravity model continuous variables*</i></b>				
log of GDP <sub>i</sub> *GDP <sub>j</sub>	0.964	0.081	11.90	
log of GDPPC <sub>i</sub> *GDPPC <sub>j</sub>	0.107	0.105	1.02	
log of DIST	-0.845	0.274	-3.08	
log of AREAP	-0.025	0.053	-0.47	
<b><i>Gravity model dummy variables</i></b>				
REGIONAL	0.749	0.238	3.14	111.4
COMLANG	0.529	0.171	3.10	69.8
BORDER	0.137	0.570	0.24	14.7
CUSTRIC	-0.189	0.277	-0.68	-17.2
LANDL	-0.542	0.200	-2.71	-41.8
ISLAND	-0.008	0.309	-0.03	-0.8
COMCOL	(dropped)			
CURCOL	(dropped)			
COLONY	0.520	0.915	0.57	68.3
COMCTRY	(dropped)			
<b><i>Constant</i></b>				
CON	14.973	3.560	4.21	
Regression with robust standard errors				
Number of observations	174			
R-squared	0.8697			
Root MSE	1.0172			

\* See appendix D note.

\*\* See appendix D note.

**Appendix H 1999 econometric results, US exports**

<b>Variables</b>	<b>Estimated coefficient</b>	<b>Standard error</b>	<b>t-statistic</b>	<b>Estimated percentage change when dummy variable is 1</b>
<b><i>Sanctions dummy variables**</i></b>				
LIM99	0.236	0.220	1.07	26.6
MOD99	0.054	0.497	0.11	5.5
EXT99	-2.890	0.582	-4.97	-94.4
LIM89*98	0.288	0.240	1.20	33.3
MOD89*98	-0.188	0.232	-0.81	-17.1
EXT89*98	0.858	0.235	3.66	135.9
<b><i>Gravity model continuous variables*</i></b>				
log of GDPi*GDPj	0.895	0.071	12.55	
log of GDPPCi*GDPPCj	0.227	0.090	2.51	
log of DIST	-1.298	0.251	-5.16	
log of AREAP	-0.006	0.053	-0.12	
<b><i>Gravity model dummy variables</i></b>				
REGIONAL	0.749	0.255	2.93	111.5
COMLANG	0.625	0.180	3.47	86.8
BORDER	-0.467	0.562	-0.83	-37.3
CUSTRIC	-0.141	0.302	-0.47	-13.1
LANDL	-0.575	0.203	-2.84	-43.7
ISLAND	-0.146	0.303	-0.48	-13.6
COMCOL	(dropped)			
CURCOL	(dropped)			
COLONY	0.676	1.015	0.67	96.5
COMCTRY	(dropped)			
<b><i>Constant</i></b>				
CON	16.077	2.942	5.46	
Regression with robust standard errors				
Number of observations	174			
R-squared	0.8881			
Root MSE	0.9507			

\* See appendix D note.

\*\* See appendix D note.

**Appendix I 1999 econometric results, US imports**

<b>Variables</b>	<b>Estimated coefficient</b>	<b>Standard error</b>	<b>t-statistic</b>	<b>Estimated percentage change when dummy variable is 1</b>
<b><i>Sanctions dummy variables**</i></b>				
LIM99	0.419	0.604	0.69	52.0
MOD99	1.027	0.812	1.26	179.2
EXT99	-3.944	1.538	-2.56	-98.1
LIM89*98	-0.291	0.433	-0.67	-25.2
MOD89*98	0.156	0.330	0.47	16.8
EXT89*98	1.050	0.472	2.22	185.8
<b><i>Gravity model continuous variables*</i></b>				
log of GDPi*GDPj	1.105	0.114	9.71	
log of GDPPCi*GDPPCj	0.017	0.142	0.12	
log of DIST	-0.719	0.371	-1.94	
log of AREAP	-0.017	0.079	-0.22	
<b><i>Gravity model dummy variables</i></b>				
REGIONAL	1.020	0.299	3.41	177.2
COMLANG	0.478	0.244	1.96	61.3
BORDER	-0.023	0.769	-0.03	-2.3
CUSTRIC	-0.869	0.403	-2.16	-58.1
LANDL	-0.422	0.319	-1.32	-34.4
ISLAND	0.361	0.420	0.86	43.5
COMCOL	(dropped)			
CURCOL	(dropped)			
COLONY	0.340	0.914	0.37	40.5
COMCTRY	(dropped)			
Constant				
CON	12.751	4.946	2.58	
Regression with robust standard errors				
Number of observations	171			
R-squared	0.7855			
Root MSE	1.4789			

\* See appendix D note.

\*\* See appendix D note.