

**IS IT ALL ABOUT SANCTIONS BUSTING:
THE EFFECTS OF UN SANCTIONS ON NEIGHBOR COUNTRIES
(EVIDENCE FROM THE GRAVITY MODEL OF INTERNATIONAL TRADE)**

(preliminary and incomplete)

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Abstract

This paper examines three theories about the effects of UN sanctions on trade flows between land neighbors of the target country and the rest of the world. First, Curovic (1997) has claimed that a neighbor would benefit from sanctions, due to improved world terms of trade, if it had the same pattern of trade as the target before the embargo. Given that most targets and their neighbors are small economies and cannot affect equilibrium world prices, this claim is not plausible. Second, there have been claims that sanctions hurt neighbor countries by cutting off trading routes, increasing transportation costs, and disrupting established trading ties. This paper builds a simple dynamic model which shows that a neighbor's trade with the rest of the world would *fall*, as a result. However, I employ simple regression analysis to show that, empirically, a neighbor's trade with the rest of the world tends to *rise* during sanctions episodes. This is consistent with a third claim: that land neighbors have been heavily involved in sanctions-busting activities.

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1. Introduction

With the end of the Cold War, we have witnessed a proliferation in the use of international economic sanctions under Article 41 of Chapter VII of the UN Charter. During the Cold War the UN imposed only two sanctions regimes—against Rhodesia (1966-1979) and against South Africa (1977-1994). In the 1990s the UN created sanctions regimes against nine countries: Iraq (1990-??), former Yugoslavia (1991-95, 1998-2001), Liberia (1992-??), Libya (1992-??), Somalia (1992-??), Haiti (1993-94), Angola (1993-??), Rwanda (1994-??), and Sierra Leone (1997-??).¹

Economic sanctions are an admittedly blunt policy tool. They often hurt those people in the target country who are least responsible for the policies that prompted imposition of sanctions and who are also least likely to be able to change these policies: children, the elderly, the poor. Allegedly, sanctions also hurt third countries, neighbors or major trading partners. Under Article 50 of Chapter VII of the UN Charter, they have the right to “consult the Security Council with regard to a solution of [the special economic problems arising from the carrying out of those measures].” 21 states claimed injuries from sanctions against Iraq (Stremlau (1996)).² Losses stemmed from disrupted trade flows, increased transportation costs, dependence on oil imports from Iraq or Kuwait, suspension of payments of sovereign debt by Iraq. Eight states consulted the Security Council about losses incurred as a result of the embargo against former Yugoslavia (Burci (1994)).³ In both cases, no compensation was granted by the UN, in spite of the historical precedent with Zambia and Mozambique who received UN-mandated aid during sanctions against Rhodesia in the 1960s and 1970s. Third countries’ failure to get compensation has been attributed to coordination problems within the UN and to their extensive involvement in sanctions-busting and smuggling.

A lively literature has sprung up discussing the economics of sanctions. Most studies have focused on the strategic interaction between targets and senders of sanctions, on quantifying the costs to both parties, and on finding correlates of the success or failure of sanctions regimes. However, the literature has largely neglected the impact of UN-mandated sanctions on land neighbors or major trading partners of the target country. Compliance with UN sanctions is mandatory for all member states. However, trading partners and especially land neighbors of the target often face special costs

¹ See Table 1 for a summary of the most important facts about the ten sanctions regimes that occurred in the 1990s. This includes sanctions against South Africa which were imposed in 1977.

² Bangladesh, Bulgaria, Czechoslovakia, Djibouti, India, Jordan, Lebanon, Mauritania, Pakistan, the Philippines, Poland, Romania, the Seychelles, Sri Lanka, Sudan, Syria, Tunisia, Uruguay, Vietnam, Yemen, and Yugoslavia.

³ Albania, Bulgaria, Hungary, Macedonia, Romania, Slovakia, Uganda, Ukraine. Uganda’s losses stemmed from an abandoned large road construction project.

and opportunities. There exist three sets of claims on how economic sanctions affect the target's land neighbors:

First, using a neoclassical model of trade with 2 goods and 3 countries, Curovic (1997) has shown that sanctions *benefit* third countries if they exported and imported the same types of goods as the target country in free-trade equilibrium. Assuming that most targets are similar to their neighbors in terms of trade patterns, it is logical to expect that sanctions will benefit third countries by both increasing the demand for their exports and by making more imports available to them at lower prices, as there is excess world supply of what the target used to import from the rest of the world under free trade. However, most targets and their neighbors happen to be small countries with hardly any influence on the world terms of trade. Therefore, this channel appears implausible, with the notable exception of sanctions against Iraq and their significant impact on world oil prices.

Second, sanctions allegedly *hurt* neighbor countries by cutting off trading routes, increasing transportation costs, and disrupting established trading ties with suppliers of imports or buyers of exports. Governments of neighbor countries have repeatedly made this argument the cornerstone of their demands for compensation from the UN. On the basis of this claim we would expect to see a drop in neighbors' trade with the rest of the world following the imposition of sanctions. Section 3 of this paper builds a simple dynamic model of a small open economy buffeted by terms of trade shocks in order to illustrate this point theoretically.

Third, sanctions allegedly *benefit* neighbors by enabling them to engage in sanctions-busting activities. Evidence on the involvement of neighbor countries in smuggling is overwhelming. This story would lead one to expect that neighbors will import and export more during sanctions because they trade on behalf of the target (who is officially confined to autarky) and smuggle output back and forth across the border. Using a modified gravity equation with data on 75 countries and 9 sanctions episodes for the years 1989-2000, this paper finds that neighbors' imports and exports with the rest of the world increase significantly during sanctions episodes, thus lending support to the smuggling story.

The rest of the paper is organized as follows: Section 2 briefly reviews existing work on the effects of sanctions on third countries and on the use of gravity models in analyzing economic sanctions. Section 3 presents a dynamic model to illustrate the presumption that sanctions would reduce neighbors' trade flows through increased transportation costs. Section 4 discusses the gravity

model, the data, and my choice of variables and estimation procedure. Section 5 presents the results and Section 6 concludes.

2. The literature

Perhaps the most monumental treatment of the economics of sanctions is Hufbauer *et al* (2000) which catalogs 170 sanctions episodes (unilateral as well as multilateral) since World War I, of which 50 occurred in the last 10 years. Its main focus is on finding correlates of the success or failure of sanctions. Earlier editions of this book (1985, 1990) have inspired a large literature. Bonetti (1997) provides a critical summary.

Existing work on the impact of sanctions on third countries is scarce. Hayes (1987) contains a chapter dealing with the impact of sanctions against South Africa on its neighbors. The chapter's case study approach is illustrative of the bulk of studies on the topic. While case studies are an important first step in identifying the impact of international economic sanctions, they have significant drawbacks. Case studies often rely on the assessment of injuries by "competent observers," such as affected companies or government agencies. These rarely happen to be "disinterested observers" as well. Solicitation of handouts from the government or from the international community often biases their analysis. Even when objective, anecdotal evidence and eye witness reports tend to neglect less visible secondary effects of sanctions and to confuse causality with correlation. This approach provides a partial coverage of the issue, at best.

A chapter in Curovic (1997) provides the only available theoretical analysis of the effect of economic sanctions on third countries. The chapter does not distinguish between neighbors and major trading partners because location does not matter in the chapter's framework. Sanctions are analyzed in a Heckscher-Ohlin model of trade. In an endowment economy with 2 goods and 3 countries, sanctions are modeled as a restriction on the exchange of endowments for the target country. The severity of sanctions is measured by a parameter between 0 and 1, the fraction of endowments that can be exchanged. The model formalizes the intuitively plausible result that sanctions hurt third countries if they were net importers of the good exported by the target in free-trade equilibrium. Sanctions would benefit the third country if it exported the same good as the target country under free trade.

A different chapter in Curovic (1997) is also of interest because it applies a modified gravity equation to the issue of economic sanctions. The author's focus this time is not on third countries but

on the target: whether there was a structural change in Italy's pattern of trade following the short-lived and disastrous League of Nations sanctions in 1935-36, which were prompted by Italy's takeover of Abyssinia. Curovic estimates pre-sanctions, post-sanctions, and combined versions of the gravity equation for Italy's exports to 15 European countries over 15 years. The data test positive for a structural break in 1935-36, with Italian exports being diverted from participants to non-participants in the sanctions regime. Interestingly, the structural change was found to be persistent: Italy's pattern of trade did not revert to "normal" once the sanctions were lifted.

Hufbauer *et al.* (1997) is another study of the effects of economic sanctions using a gravity model but, once again, the focus of the study is not on third countries. The authors' primary concern is with the costs unilateral sanctions impose on sender countries in terms of lost trade. The intensity of economic sanctions is modeled by introducing 3 dummies corresponding to 3 intensity levels. Almost invariably, the signs on these dummies were found to be significantly negative for the three sample years (1985, 1990, 1995). Of course, that result is vulnerable to the criticism (made by many but most forcefully in Srinivasan (1998)) that these dummies do not really measure the effect of sanctions but rather the researcher's own ignorance about what determines the remaining variation in trade flows for a subset of the trading pairs. A significant change in the dummy coefficients in years with sanctions relative to years without is what would have really established the authors' claim.

Hufbauer *et al.* (1997) further analyzes the "echo effects" of economic sanctions: whether they continue to pull trade away from the sender even after they are lifted, perhaps because firms in the sender country earn a reputation for being "unreliable suppliers". Two more sets of dummies are added to measure the impact of sanctions 1-2 and 3-4 years after they are lifted. In contrast to the high persistence result in Curovic (1997), the results here are inconclusive. They are, in any case, subject to the criticism outlined in the previous paragraph.⁴

Montenegro and Soto (1996) is another study linking the issue of economic sanctions to the gravity equation but once again the focus is on the target. Their objective is to illustrate and quantify Cuba's distorted pattern of trade, due to decades of US sanctions and CMEA membership, and also to predict Cuba's pattern of trade in a post-Castro world. Their econometric approach together with that in Soloaga and Winters (1999) is closest to the one adopted in this paper.

3. The model

In this section I build a dynamic model of a small open economy in order to show the theoretical impact of increased transportation costs due to UN sanctions on a neighbor country and its trade flows with the rest of the world. The results from this model will be matched against the empirical results of Section 5, in order to prove that increased transportation costs do not appear to be an empirically important part of the story.

The model's structure is reasonably rich and realistic. It has three types of goods: imports, exports, and non-traded goods. The model features money as well as sticky prices in the non-traded sector. The *only* source of uncertainty is the domestic terms of trade P^X . A temporary negative shock to P^X will be the device for modeling the imposition of UN sanctions on a neighbor country.

In Home, there are households, firms producing non-traded goods and exports, and a government. I discuss each sector in turn.

3.1 Households

Infinitely-lived representative households consume imports and non-traded goods, but not exports. They hold money balances and supply labor to firms. Their utility function over consumption, real money balances, and effort is:

$$U_t = \sum_{s=t}^{\infty} \beta^{s-t} \left[\frac{C_s^{1-\rho}}{1-\rho} + \chi \log\left(\frac{M_s}{P_s}\right) - \frac{\kappa}{2} L_s^2 \right]$$

Households have access to two assets: money M_t and nominal bonds B_t . Their budget constraint is given by:

$$P_t C_t = W_t L_t + \Pi_t + T_t - (M_t - M_{t-1}) - \left(\frac{B_t}{1+i_t} - B_{t-1} \right), \quad (1)$$

where W_t is the nominal wage, Π_t denotes lump-sum dividends from producers of non-traded goods, and T_t denotes nominal transfers from the government. C_t is a Cobb-Douglas aggregator for the consumption of non-traded and imported goods:

$$C_t = \frac{(C_t^N)^\gamma (C_t^M)^{1-\gamma}}{\gamma^\gamma (1-\gamma)^{1-\gamma}} \quad (2)$$

⁴ One should further note that the paper drops all observations where trade was zero. This reduced sample size by 29 to 35 percent in different years. The authors claim, however, that their results are not sensitive to that omission of information. CBO (1999) provides a detailed critical assessment of Hufbauer *et al.* (1997).

The consumer price index (CPI) is then defined by:

$$P_t = (P_t^N)^\gamma (P_t^M)^{1-\gamma} \quad (3)$$

Expenditure allocation between non-traded goods and imports is guided by the intratemporal first-order condition:

$$\frac{1-\gamma}{\gamma} \frac{C_t^N}{C_t^M} = \frac{P_t^M}{P_t^N} \quad (4)$$

The following three first-order conditions describe exhaustively households' optimal choices for consumption, real money balances, and labor supply:

$$C_t^{-\rho} = \beta(1+i_t) \frac{P_t}{P_{t+1}} C_{t+1}^{-\rho} \quad (5)$$

$$C_t^{-\rho} \frac{W_t}{P_t} = \kappa L_t \quad (6)$$

$$C_t^{-\rho} = \beta \frac{P_t}{P_{t+1}} C_{t+1}^{-\rho} + \chi \left(\frac{M_t}{P_t} \right)^{-1} \quad (7)$$

3.2 Firms

Exporting firms hire labor and buy imported goods for use as capital in order to produce a good, according to the following simple production function:

$$Y_t^X = (L_t^X)^{1-\alpha} (K_t^X)^\alpha \quad (8)$$

Capital depreciates completely each period. Domestic exporting firms are competitive price-takers in world markets. All output leaves the country and none is consumed domestically. An exporting firm solves the following standard problem:

$$\max_{L_t^X, K_t^X} (P_t^X Y_t^X - W_t L_t^X - P_t^M K_t^X)$$

The first-order conditions are well-known:

$$(1-\alpha) \frac{P_t^X Y_t^X}{L_t^X} = W_t \quad (9)$$

$$\alpha \frac{P_t^X Y_t^X}{K_t^X} = P_t^M \quad (10)$$

Monopolistically competitive producers of non-traded goods are indexed by z on the continuous interval $[0,1]$. Each firm z produces its own brand of a differentiated good out of labor and imports, using the following technology:

$$C_t^N(z) = (L_t^N(z))^{1-\delta} (K_t^N(z))^\delta \quad (11)$$

I assume that $\delta < \alpha$, in other words, non-traded goods are labor-intensive, while exports are capital-intensive. C_t^N is an index of differentiated goods given by:

$$C_t^N = \left[\int_0^1 C_t^N(z)^{\frac{\nu}{\nu-1}} dz \right]^{\frac{\nu-1}{\nu}}, \quad \nu > 1$$

The elasticity of substitution between brands is given by ν . Following standard Dixit-Stiglitz math, demand for each individual brand z is given by:

$$C_t^N(z) = \left(\frac{P_t^N(z)}{P_t^N} \right)^{-\nu} C_t^N,$$

where the index P_t^N is defined as:

$$P_t^N = \left[\int_0^1 P_t^N(z)^{1-\nu} dz \right]^{\frac{1}{1-\nu}}$$

By solving a standard expenditure minimization problem, we can derive the nominal marginal cost:

$$MC_t = \frac{(W_t)^{1-\delta} (P_t^M)^\delta}{(1-\delta)^{1-\delta} \delta^\delta}, \quad (12)$$

Note that the nominal marginal cost is identical across firms. Input choice for each firm z will be driven by the following first-order condition:

$$\frac{1-\delta}{\delta} \frac{K_t^N(z)}{L_t^N(z)} = \frac{W_t}{P_t^M} \quad (13)$$

In modeling non-traded producers' price-setting decisions, I follow the tradition of Calvo (1983) and Yun (1996). Firms update their prices infrequently. Independently of past history, each period a fraction $(1-\varphi)$ of them gets a chance to adjust prices. Due to the law of large numbers, there is no aggregate uncertainty or income uncertainty for the representative household. The index P_t^N will evolve according to:

$$P_t^N = \left[\varphi (P_t^N)^{1-\nu} + (1-\varphi) (P_t^{N,new})^{1-\nu} \right]^{\frac{1}{1-\nu}}$$

In log-linear terms, the equation becomes:

$$\hat{P}_t^N = \varphi \hat{P}_{t-1}^N + (1 - \varphi) \hat{P}_t^{N,new}, \quad (14)$$

where $\hat{Z}_t \equiv dZ_t/Z$ denotes percentage deviation from the steady state (computed later in this section).

A profit-maximizing producer of non-traded goods can be shown to follow a log-linear price-setting equation whose derivation is standard (see, for example, Monacelli (2001)):

$$\hat{P}_t^{N,new} = (1 - \beta\varphi) \sum_{s=t}^{\infty} \left((\beta\varphi)^{s-t} (\hat{MC}_s) \right), \quad (15)$$

If prices are completely flexible ($\varphi=0$), firms will set prices according to the standard static monopolistic pricing condition:

$$P_t^N = \frac{\nu}{\nu-1} MC_t \quad (16)$$

Combining equations (14) and (15), we get the following dynamic price-setting equation:

$$\hat{P}_t^N = \varphi \hat{P}_{t-1}^N + (1 - \varphi) (1 - \beta\varphi) \sum_{s=t}^{\infty} \left((\beta\varphi)^{s-t} (\hat{MC}_s) \right) \quad (17)$$

Firm profits in the non-traded sector are given by the equation:

$$\Pi_t = (P_t^N - MC_t) C_t \quad (18)$$

3.3 Government

The government rebates to households, in a lump-sum fashion, the proceeds from money creation:

$$M_t - M_{t-1} = T_t$$

3.4 Market clearing and flex-price equilibrium

Market clearing in the labor market requires that:

$$L_t^X + L_t^N = L_t \quad (19)$$

Also, I will normalize the domestic currency price of imports to 1, without loss of any generality:

$$P_t^M \equiv 1, \quad \forall t$$

I assume that in steady state $T = 0$ and $B = 0$. To compute the perfect-foresight, flexible-price, constant steady state of the model, we need to solve equations (1)-(13), (16), (18)-(19) for C_b , C_t^N ,

$C_t^M, Y_t^X, L_t^X, L_t^N, L_t, K_t^X, K_t^N, \Pi_t, M_t, MC_t, W_t, i_t, P_t^N, P_t$. The *only* source of uncertainty in the model is the terms of trade P^X .

3.5 The log-linear model

Next, together with (17), I log-linearize equations (1)-(13), (18)-(19) around the constant steady state:

$$\begin{aligned}
\hat{C}_t &= \gamma \hat{C}_t^N + (1-\gamma) \hat{C}_t^M & \hat{P}_t &= \gamma \hat{P}_t^N \\
\hat{C}_t^N - \hat{C}_t^M &= -\hat{P}_t^N & \left(1 - \frac{\gamma}{\nu}\right) (\hat{W}_t + \hat{L}_t) + \frac{\gamma}{\nu} \hat{\Pi}_t &= \hat{P}_t + \hat{C}_t \\
-\rho \hat{C}_t &= (1 + \hat{i}_t) + \hat{P}_t - \hat{P}_{t+1} - \rho \hat{C}_{t+1} & -\rho \hat{C}_t + \hat{W}_t - \hat{P}_t &= \hat{L}_t \\
\hat{M}_t - \hat{P}_t &= \rho \hat{C}_t - \beta(1 + \hat{i}_t) & \hat{Y}_t^X &= (1-\alpha) \hat{L}_t^X + \alpha \hat{K}_t^X \\
\hat{W}_t + \hat{L}_t^X &= \hat{P}_t^X + \hat{Y}_t^X & \hat{K}_t^X &= \hat{P}_t^X + \hat{Y}_t^X \\
\hat{C}_t^N &= (1-\delta) \hat{L}_t^N + \delta \hat{K}_t^N & MC_t &= (1-\delta) \hat{W}_t \\
\hat{K}_t^N - \hat{L}_t^N &= \hat{W}_t & \hat{P}_t^N &= \varphi \hat{P}_{t-1}^N + (1-\varphi)(1-\beta\varphi) \sum_{s=t}^{\infty} \left((\beta\varphi)^{s-t} (MC_s^N) \right) \\
\frac{1}{\nu} \hat{\Pi}_t &= \hat{P}_t^N + \hat{C}_t^N - \frac{\nu-1}{\nu} (MC_t^N + \hat{C}_t^N) & (1-a_1) \hat{L}_t^X + a_1 \hat{L}_t^N &= \hat{L}_t,
\end{aligned}$$

where $a_1 = \frac{\gamma(1-\delta)(\nu-1)}{\nu-\gamma}$

In general, $\hat{Z}_t = dZ_t/Z_t$, with the exception of $(1 + \hat{i}_t) \equiv \log(1 + i_t) - \log(1 + i)$. In the above system, \hat{P}_t^X is the only exogenous shock. The table below summarizes the numerical values I adopt for the numerical simulations of the model.

Parameter	Value
α	0.65
δ	0.35
γ	0.55
ν	6
φ	0.75
β	0.99

Figure 1 presents the impulse response functions of the system in response to a 10% temporary negative shock in the domestic terms of trade P^X . Such a shock may be thought of as a way to model the sudden imposition of UN-mandated economic sanctions on a neighbor country. The immediate effect of sanctions on a land neighbor could be a sharp increase in transportation costs. In turn, that will drive a wedge between the world terms of trade and the domestic ones. Transportation costs distort relative prices the same way tariffs and export taxes do: they reduce the price of exports and increase the price of imports faced by domestic firms and consumers, respectively. The world terms of trade will presumably stay unchanged, while the domestic ones will deteriorate.

As a result, both exports and imports fall. In Figure 1, we can see that both physical output (Y^X) and total revenue ($P^X Y^X$) fall in the export sector. Furthermore, all three components of import demand decline: consumption C^M , capital investment in the non-traded sector K^N , and capital investment in the export sector K^X . Therefore, if transportation costs were an important part of the story, I would expect to find a reduction of trade following the imposition of UN trade sanctions on a neighbor country.

The shock to transportation costs is modeled as being temporary. Intuitively, the initial disruption might be large but economic agents learn their way and find cheaper ways to ship goods around the sealed off target country. Thus, the disruption is not as large in the long run.

Now I proceed to estimate empirically the actual effect of sanctions on exports and imports using the gravity model of international trade.

4. The gravity equation

The gravity model of international trade turns out to be the weapon of choice for signing and measuring the effects of sanctions on land neighbors of target countries. The gravity model produces a benchmark for trade flows which enables us to investigate if and how departures from "normal" volumes of trade between pairs of countries are correlated with the imposition of a UN embargo. Over the past 40 years, the gravity model of international trade has provided a remarkably good fit to empirical data, especially if one considers its somewhat suspect theoretical and econometric pedigree. In its most basic specification, the model relates trade flows between two countries to their size (as measured by national incomes) and the distance between them. The "full" version of the gravity model adds per capita incomes, as well as more measures of proximity, such as a dummy for a

common land border and another one for a common language. More recently, the gravity model has been used to analyze the effects of preferential trade agreements (PTAs) on the world trading system.

Tinbergen (1962), Pöyhönen (1963), and Linnemann (1966) are universally cited as the pioneering works in the field. Aitken (1973) was perhaps the first to apply the gravity equation to PTAs. Jeffrey Frankel has written prolifically on the issue in the 1990s.⁵ Leading references on the theoretical underpinnings of the gravity model are Anderson (1979), Bergstrand (1985, 1989), Helpman (1987), Helpman and Krugman (1985), and Deardorff (1998). A quick and safe way to summarize their work is to claim that the gravity model is atheoretical and broadly consistent with most leading theories of international trade: starting with the Heckscher-Ohlin model, and including recent theories of trade based on imperfect competition and product differentiation. Deardorff (p. 21, 1998) summarizes what the gravity equation should not be used for: ". . . because the gravity equation appears to characterize a large class of models, its use for empirical tests of any of them is suspect." However, the gravity model is very useful in providing a benchmark for trade flows between countries. Then we can search for departures from "normal" levels of trade and for correlates of these departures.

The log-form specification of the gravity model I adopt is as follows:

$$X_{ij} = C + \beta_1 GDP_i + \beta_2 GDP_j + \beta_3 PerCapGDP_i + \beta_4 PerCapGDP_j + \beta_5 Distance + \beta_6 Contiguity + \beta_7 Language + \beta_8 RTA \quad (20)$$

X_{ij} denotes the log of exports from country i to country j in constant 1997 US dollars. I will discuss variations on the exact specification of this variable shortly. GDP_i and GDP_j are the logs of national incomes of countries i and j measured in constant 1997 US dollars. $PerCapGDP_i$ and $PerCapGDP_j$ are defined similarly. Coefficients on incomes and per capita incomes are expected to be positive, reflecting the fact that trade is increasing in the size of the countries involved and in the level of their economic development. $Distance$ is the logged great-circle distance between the national capitals or major economic centers of the two countries, in miles.⁶ It is expected to have a negative coefficient since it proxies for transportation costs. $Contiguity$, $Language$, and RTA are dummy variables, each taking the value of 1 if the two countries share a common land border, or

⁵ Frankel (1997) is probably the most comprehensive summary.

⁶ See Appendix 1 for a list of the cities I used for each country. Note that, for example, Chicago was chosen for the US over Washington, New York, or Los Angeles, because of its central location. Sensitivity studies by other authors have confirmed that the distance variable is quite robust to the choice of cities.

share a common language,⁷ or belong to the same regional trading agreement, respectively. The coefficients on *Contiguity* and *Language* are expected to be positive. They are included in order to refine the concept of *distance* between two countries. The RTA dummy proxies for tariff rates since comprehensive tariff data were not available. The expected sign on *RTA* is positive. I allowed for 7 RTAs: the EU,⁸ EFTA,⁹ NAFTA, MERCOSUR,¹⁰ the Andean Community,¹¹ ASEAN,¹² and the Closer Economic Relations agreement (CER) between Australia and New Zealand. In order to maintain comparability of coefficient estimates, I have kept the membership lists for all RTAs constant at their 1997 level even though their actual membership fluctuated over the years and some did not even exist in 1989.

My data set includes 75 countries. The country list appears in Appendix 1. These are the 63 countries used in Frankel (1997) plus neighbors of targets of UN sanctions in the 1990s.¹³ I had to exclude countries without country pages in IMF's International Financial Statistics (my data source for incomes, exchange rates, and populations). I also excluded the targets of UN sanctions from the data set. That determined the final number of countries. 75 countries give a maximum of $75 \times 74 = 5,550$ observations in each year. The data span 12 years, from 1989 to 2000. The maximum total number of observations is $9 \times 5,550 = 66,600$. Data on trade came from Statistics Canada's World Trade Analyzer. To convert all numbers into constant 1997 US dollars I used line *rf* or *wf* (exchange rates, period averages) in the IMF's International Financial Statistics, and the US Producer Price Index available through the US Bureau of Labor Statistics.¹⁴ For languages, national capitals, and contiguity I used the online edition of CIA's World Factbook 1998. Finally, distances were calculated using the web site www.indo.com/distance.

As a test of my choice of variables, I first ran a pooled equation for all 12 years *without* bringing in the issue of economic sanctions. Because of the pooled nature of the data, I added time-fixed effects – dummies for the years from 1990 to 2000 (the dummy for 1989 is figured into the

⁷ I allowed for English, Spanish, Chinese, Arabic, French, German, Japanese, Dutch, or Portuguese.

⁸ 14 countries: most data sources lump Luxembourg together with Belgium.

⁹ 3 countries: Iceland, Norway, and Switzerland.

¹⁰ 4 countries: Argentina, Brazil, Paraguay, and Uruguay.

¹¹ 5 countries: Bolivia, Colombia, Ecuador, Peru, and Venezuela.

¹² 5 countries: Indonesia, Malaysia, the Philippines, Singapore, and Thailand.

¹³ See Table 1.

¹⁴ It remains to be checked how sensitive the results are to the use of these particular series. Alternatively, one could use PPP-adjusted incomes.

constant term). Furthermore, I also added a variable *RTAtrend* which is simply *RTA* interacted with the number of years elapsed since 1989.

Table 2 reports results from two estimations of equation (20). The dependent variable in both is non-oil exports (total exports minus SITC category 33). Montenegro and Soto (1996) and Soloaga and Winters (1999) are other recent papers that exclude fuel exports. Oil trade fits awkwardly with theories of intra-industry trade, often used to justify the gravity model. We rarely observe two oil-exporting countries buying each other's oil "for love of variety".

The first equation is estimated using OLS with the dependent variable in the form $\log(\text{exports})$ while the second one is estimated using Tobit with the dependent variable entering in the form $\log(1+\text{exports})$. The first specification obviously has to drop all observations in which trade was 0 while the second one incorporates the left-censored nature of the data in a way suggested by Eichengreen and Irwin (1998).¹⁵

Most of the variables enter with the expected sign and are highly statistically significant. Coefficients on GDPs in the OLS equation are close to 1, in line with previous estimates. The coefficient on distance in the OLS regression is somewhat larger than what many previous studies have found but is broadly in line with them. Turning to the Tobit estimate, the basic gravity variables enter with the right sign and are highly significant. The coefficient estimates differ markedly in magnitude from the OLS case, but now they have a different interpretation. We can no longer interpret them as "elasticities." These coefficients capture not only the effect of a marginal change in a regressor on the mean of the dependent variable given that it is positive but also the effect of that change on the probability that the dependent variable is censored. Both estimators provide a reasonably good fit to the data: the OLS estimates have an adjusted R-squared of 0.71 while the Tobit estimates have a *pseudo* adjusted R-squared of 0.57.

The only surprising difference between the OLS and Tobit estimates comes with the sign of *RTAtrend*. *RTAtrend* is strongly positive in the OLS equation but switches to strongly negative with Tobit. All results reported in the remainder of this paper use the Tobit estimator.

¹⁵ An alternative would have been to run OLS with $\log(1+\text{exports})$ as the dependent variable, and then divide the coefficient estimates by the fraction of non-limit observations in our sample (p. 966, Greene (1997)).

5. Results

Table 1 summarizes the most important facts about the ten sanctions episodes that took place in the 1990s. Sanctions against Sierra Leone are not analyzed in this paper since its two land neighbors were dropped from the sample. No data on Guinea are available in the International Financial Statistics and Liberia is itself a target of UN sanctions. Since I only have annual data, I decided to consider sanctions to be "on" for the entire year, even if they were in place for only a part of it. Thus, 1992 is considered to be a sanctions year for Liberia even though UN sanctions were imposed in November 1992. 1994 is a sanctions year for South Africa in this analysis, even though sanctions were lifted in May 1994. I defer discussion of a few more minor technicalities to the notes for that table.

As a first step in analyzing the effect of economic sanctions on neighboring countries, I added one dummy to the gravity model outlined in the previous section. Results are reported in column 1 of Table 3. The variable *Total_sanctions* is set to 1 whenever the trading pair involves a neighbor of a target country, only for the years during which there were UN sanctions in place. For example, *Total_sanctions* equals 0 for trade between Iraq and the US in 1989, and 1 for trade between the same pair of countries for the years after and including 1990.

Furthermore, I added what Srinivasan (1998) calls "dumb" dummy variables – fixed effects for the land neighbors of the nine target countries, for all years in the sample. For example, one such dummy variable equals 1 every time the *exporting* country is a land neighbor of Iraq. Another dummy equals 1 every time the *importing* country is a land neighbor of Iraq. There is a total of $9 \times 2 = 18$ such dummies. These 18 dummies simply measure the researcher's ignorance. They control for what we do not know about trade flows among countries in a particular subset in our sample. Both regressions in Table 3 include these dummies. I do not report the coefficients on them since they are neither meaningful nor interesting. All they tell us is that, for reasons we do not understand, trade among a subset of the countries in the sample tends to be lower or higher than what the gravity model would predict, both in years with sanctions and in years without.

Once we have controlled for our ignorance, *Total_sanctions* allows us to focus on the effect of economic sanctions on trade flows involving a neighbor of a sanctioned country. The coefficient on *Total_sanctions* (column 1, Table 3) is strongly positive (0.44 with a t-statistic of 6.04). It is an empirical validation of the involvement of neighbor countries in sanctions-busting activities.

As a logical next step, I allowed for different coefficients when the target's neighbor is the exporter or the importer in the trading pair. The basic model was run with 2 dummies. *Exports_sanctions* was set to 1 for all trading pairs where the exporting country was a target's neighbor, only for years with economic sanctions. *Imports_sanctions* is defined symmetrically. Column 2 in Table 3 presents the results. Once again, the coefficients are positive, with t-statistics of 4.46 for *Imports_sanctions* and 5.73 for *Exports_sanctions*.

Based on Table 3, we can conclude that there is strong evidence that increased transportation costs do not play an important role. Neighbors seem to trade *more* with the rest of the world during sanctions episodes, not *less*, as the model in Section 3 predicts. This result suggests that neighbors are heavily involved in smuggling – they trade with the rest of the world on behalf of the target as well.

The empirical results allow us to assign a rough quantitative measure for the amount of smuggling during sanctions episodes, and for the benefits neighbor countries derive from their participation in sanctions-busting activities. There is a large literature on the principle-agent problem in public law enforcement (see Polinsky and Shavell (1999)). Benefits from smuggling affect the cost-benefit trade-off from enforcing sanctions for land neighbors of target countries. In designing the optimal incentives for land neighbors to refrain from smuggling and to enforce the sanctions regime, the international community should take into consideration land neighbors' temptation to "cheat" and participate in smuggling.

6. Conclusion

Using simple regression analysis, this paper has taken a step forward in sorting out the sign and magnitude of the effect of international economic sanctions on neighboring countries. The general impact of sanctions on trade flows was shown to be positive.

It is important to discuss the limitations of this study. First, it considers only UN-imposed sanctions and leaves out unilateral sanctions. There have been relatively few UN sanctions regimes over the last ten years. UN sanctions are binding for all member states and thus compliance with them is universal, at least on paper. Data on UN sanctions regimes are widely available. Thus, UN sanctions are a good starting point for analyzing the effect of sanctions on third countries. Unilateral sanctions are harder to analyze, primarily because of their sheer number. Hufbauer (1990) catalogs more than one hundred such cases, but the list is not meant to be exhaustive. There is much more variability in the intensity and weaponry of unilateral sanctions regimes. Some of these are redundant

or never enforced. A final problem is that compliance with unilateral sanctions in the rest of the world is dramatically lower.

Second, the paper chooses to focus on land neighbors of target countries and leaves "major trading partners" out of the analysis. Such a choice makes sense given that smuggling across the border plays a central role in the analysis. Furthermore, a "land neighbor" can be defined objectively. On the other hand, it is hard to decide who counts as a "major trading partner." To avoid having to make arbitrary decisions, this paper focuses on land neighbors.

Third, the empirical analysis excludes target countries themselves. The paper's only econometric weapon is the gravity equation. Its performance depends on, among other things, the reliability of trade flow data. It is reasonable to suppose that data on trade flows between targets' neighbors and the rest of the world are no less reliable than trade data in general. Neighbors might have an incentive to conceal the origin or final destination of the traded goods (if smuggled to or from the target) but they don't have an incentive to distort the magnitude of trade flows. On the other hand, it is hard to take seriously data on trade flows between targets and anybody else in the world for obvious reasons.

Fourth, I do not address the vexing issue of causality: maybe changes in trade flows are caused by the imposition of UN sanctions on a neighbor, or maybe both are outcomes of a third event, perhaps the general political and economic instability in the region.

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Appendix 1: List of the 75 countries included in the dataset
(with names of the cities used in calculating great-circle distances in brackets)

Algeria (Algiers)	Mexico (Mexico City)
Argentina (Buenos Aires)	Morocco (Casablanca)
Australia (Sydney)	Mozambique (Maputo)
Austria (Vienna)	Netherlands (Amsterdam)
Belgium-Luxembourg (Brussels)	New Zealand (Wellington)
Bolivia (La Paz)	Niger (Niamey)
Brazil (Sao Paulo)	Nigeria (Lagos)
Bulgaria (Sofia)	Norway (Oslo)
Burundi (Bujumbura)	Pakistan (Karachi)
Canada (Ottawa)	Paraguay (Asuncion)
Chad (N'djamina)	Peru (Lima)
Chile (Santiago)	Philippines (Manila)
China (Shanghai)	Poland (Warsaw)
Colombia (Bogota)	Portugal (Lisbon)
Democratic Republic of Congo (Kinshasa)	Romania (Bucharest)
Republic of Congo (Brazzaville)	Saudi Arabia (Riyadh)
Cote D'Ivoire (Yamoussoukro)	Singapore (Singapore)
Denmark (Copenhagen)	Spain (Madrid)
Dominican Republic (Santo Domingo)	Sudan (Khartoum)
Ecuador (Quito)	Sweden (Stockholm)
Egypt (Cairo)	Switzerland (Geneva)
Ethiopia (Addis Ababa)	Syria (Damascus)
Finland (Helsinki)	Tanzania (Dar es Salaam)
France (Paris)	Thailand (Bangkok)
Germany (Bonn)	Tunisia (Tunis)
Ghana (Accra)	Turkey (Ankara)
Greece (Athens)	Uganda (Entebbe)
Hong Kong (Hong Kong)	UK (London)
Hungary (Budapest)	Uruguay (Montevideo)
Iceland (Reykjavik)	USA (Chicago)
India (New Delhi)	Venezuela (Caracas)
Indonesia (Jakarta)	Zambia (Lusaka)
Iran (Tehran)	Zimbabwe (Harare)
Ireland (Dublin)	
Israel (Jerusalem)	
Italy (Rome)	
Japan (Tokyo)	
Jordan (Amman)	
Kenya (Nairobi)	
Republic of Korea (Seoul)	
Kuwait (Kuwait City)	
Malaysia (Kuala Lumpur)	

Figure 1: Impulse response functions for a negative shock to the terms of trade P^X

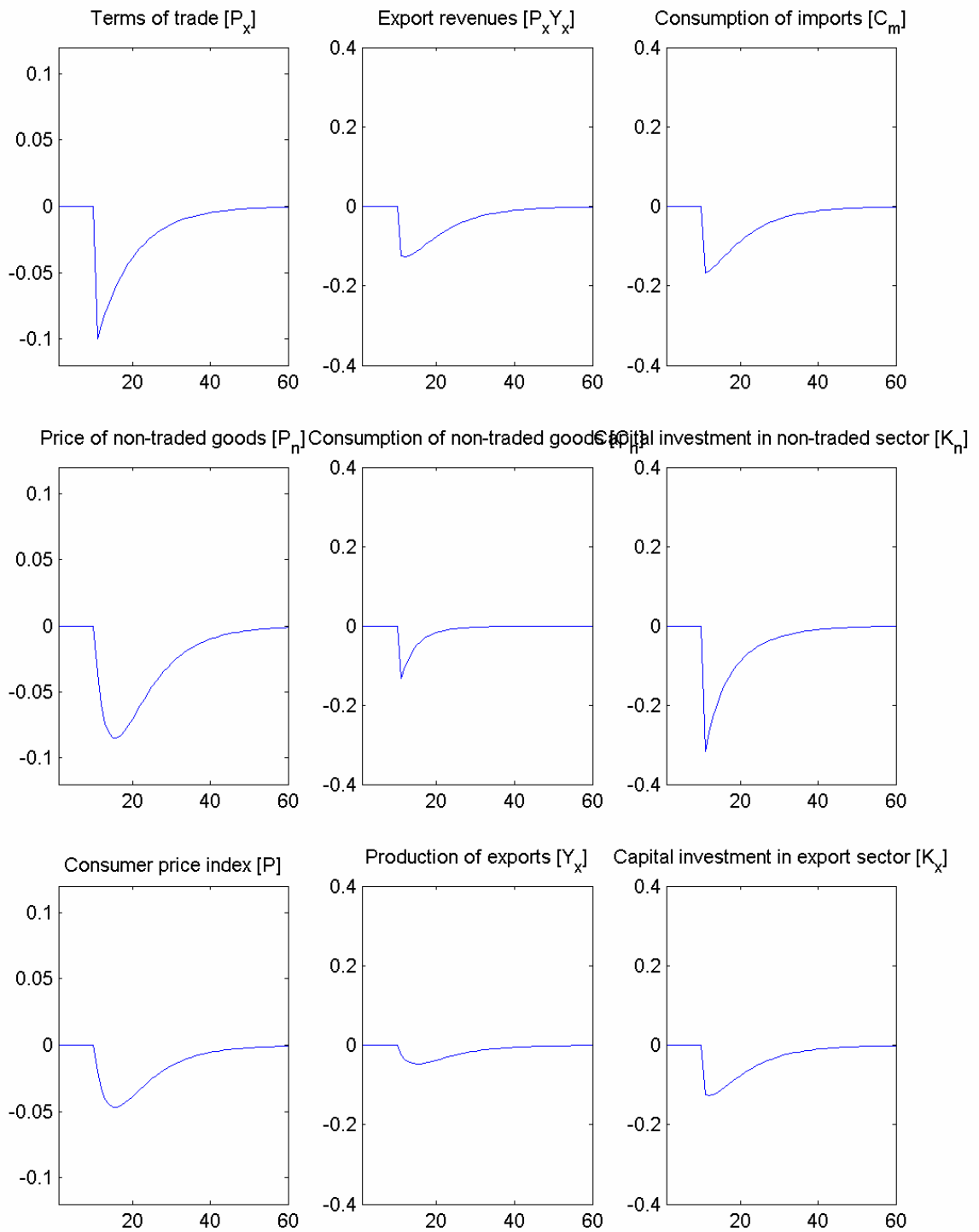


Table 1: List of UN sanctions regimes with target countries, relevant dates and Security Council resolutions, and neighboring countries (1989-2000)

Target Country	Date of imposition and lifting (if any) of UN sanctions and most relevant Security Council resolutions	Years considered to be “sanctions years” for the purposes of the gravity model analysis	Land neighbors included in the dataset	Land neighbors not included in the dataset ¹
Angola	<u>Imposed</u> : 15 September 1993, #864 <u>Expanded</u> : 28 August 1997, #1127	1993 – 2000	Democratic Republic of Congo, Republic of Congo, Zambia	Namibia
Haiti	<u>Imposed</u> : 16 June 1993, #841 <u>Expanded</u> : 6 May 1994, #917 <u>Lifted</u> : 29 September 1994, #944	1993 – 1994	Dominican Republic	n.a.
Iraq	<u>Imposed</u> : 6 August 1990, #661	1990 – 2000	Iran, Jordan, Kuwait, ² Saudi Arabia, Syria, Turkey	n.a.
Liberia	<u>Imposed</u> : 19 November 1992, #788 <u>Extended</u> : 7 March 2001, #1343	1992 – 2000	Cote D'Ivoire	Guinea, Sierra Leone
Libya	<u>Imposed</u> : 31 March 1992, #748 <u>Expanded</u> : 11 November 1993, #883	1992 – 2000	Algeria, Chad, Egypt, Niger, Sudan, Tunisia	n.a.
Rwanda	<u>Imposed</u> : 17 May 1994, #918 <u>Expanded</u> : 9 June 1995, #997 <u>Partially lifted</u> : 16 August 1995, #1011	1994 – 2000 ³	Burundi, Democratic Republic of Congo, Tanzania, Uganda	n.a.
Federal Republic of Yugoslavia (Serbia and Montenegro)	<u>Imposed</u> : 25 September 1991, #713 <u>Expanded</u> : 30 May 1992, #757 <u>Expanded</u> : 16 November 1992, #787 <u>Expanded</u> : 17 April 1993, #820 <u>Lifted or suspended</u> : 22 November 1995, #1021, #1022 <u>Lifted</u> : 1 October 1996, #1074 <u>Imposed</u> : 31 March 1998, #1160 <u>Lifted</u> : 10 September 2001, #1367	1991 – 1995, 1998-2000 ⁴	Austria, Bulgaria, Greece, Hungary, Italy, Romania ⁵	Albania
Sierra Leone	<u>Imposed</u> : 8 October 1997, #1132	n.a. ⁶	n.a.	Guinea, Liberia
Somalia	<u>Imposed</u> : 23 January 1992, #733	1992 – 2000	Ethiopia, Kenya	Djibouti
South Africa	<u>Imposed</u> : 4 November 1977, #418 <u>Lifted</u> : 26 May 1994, #919	1989 – 1994	Mozambique, Zimbabwe	Namibia, Botswana, Lesotho, Swaziland

Sources: Stremlau (1996), van Bergeijk (1995), and the United Nations via www.un.org/Docs/scinfo.htm.

- Notes:**
1. Certain land neighbors were excluded either because there were no country pages for them in IMF's *International Financial Statistics*, or because they were, at some point, targets of UN sanctions themselves.
 2. Kuwait was included as Iraq's neighbor despite the fact that between August 1990 and February 1991 it was a part of Iraq and, technically, a target of the UN sanctions as well.
 3. UN sanctions against Rwanda were considerably relaxed in 1995 but the arms embargo remained in force against non-government forces. That is why I considered these sanctions to span the whole period between 1994 and 2000, incl.
 4. Sanctions against former FRY were either lifted or suspended in November 1995. Thus, I consider them to span the years 1991-1995, even though most were formally lifted in October 1996.
 5. For the former FRY, I included as neighbors all the 6 neighboring countries of the old, pre-1989 SFRY which consisted of six republics.
 6. My dataset does not consider UN sanctions against Sierra Leone because they were imposed toward the very end of 1997, the last year in my sample. Also, both of its neighbors are in the list of countries I dropped for the reasons outlined in note 1 above.

Table 2: Two tests of the adopted specification of the pooled gravity equation

Variable	1		2	
	OLS, non-oil exports		Tobit, non-oil exports	
	coefficients	<i>t-statistics</i>	coefficients	<i>t-statistics</i>
Constant	-27.04		-77.00	
		-146.78		-138.80
GDP _i	1.02		1.98	
		184.68		125.97
GDP _j	0.90		1.63	
		159.97		102.79
Per capita GDP _i	0.19		0.54	
		30.23		30.36
Per capita GDP _j	0.08		0.39	
		11.95		20.61
Distance	-0.83		-0.91	
		-81.62		-29.50
Contiguity	0.63		0.15	
		14.93		1.06
Language	0.99		2.64	
		46.01		43.97
RTA	0.47		0.58	
		11.62		4.80
RTA trend	0.02		-0.10	
		3.30		-6.25
Number of observations	51418		61440	
(Pseudo-)Adjusted R-squared	0.71		0.57	
S.E. of regression	1.72		4.56	

Notes: The OLS regression reports White's heteroscedasticity-consistent standard errors and covariances. The Tobit regression reports QML (Huber-White) standard errors and covariances to account for possible heteroscedasticity. Regression 1 defines the dependent variable as $\log(exports)$ and excludes all observations where exports were zero. Regression 2 defines the dependent variable as $\log(1+exports)$ and includes all observations where exports were zero. Both regressions include a correction for first-order autocorrelation in the disturbances, as well as yearly fixed effects (coefficients not reported).

Table 3: The effect of UN sanctions on trade flows between land neighbors of target countries and the rest of the world

Variable	1	2
	Tobit, non-oil exports	Tobit, non-oil exports
	coefficients	coefficients
	<i>t-statistics</i>	<i>t-statistics</i>
Total_sanctions	0.44	
Imports_sanctions	6.04	0.43
Exports_sanctions		4.46
		5.73

Notes: The regressions report QML (Huber-White) standard errors and covariances to account for possible heteroscedasticity. The dependent variable is $\log(1+exports)$. Both regressions include all variables from the pooled gravity equation (see Table 2 above). They also include country fixed effects (coefficients not reported above) as defined in the main text. See page 15.