Did Iraq Cheat the United Nations?
Underpricing, Bribes, and the Oil for Food Program

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Abstract: From 1997 through early 2003, the United Nations Oil for Food Program allowed Iraq to export oil in exchange for humanitarian supplies. We measure the extent to which this program was corrupted by Iraq's attempts to deliberately set the price of its oil below market prices in an effort to solicit bribes, both in the form of direct cash bribes and in the form of political favors, from the buyers of the underpriced oil. We infer the magnitude of the potential bribe by comparing the gap between the official selling price of Iraq's two crude oils (Basrah Light and Kirkuk) and the market price of several comparison crude oils during the Program to the gap observed prior to the Program. We find consistent evidence that underpricing of Basrah Light averaged $1 per barrel from 1997 through 1999 and reaches a peak (almost $3 per barrel) from May 2000 through September 2001. The estimated underpricing quickly declines after the UN introduced a retroactive pricing scheme that reduced Iraq's ability to set the price of its oil. The evidence on whether Kirkuk was underpriced is less clear. Notably, we find that episodes of underpricing of Basrah Light are associated with a decline in the share of major oil multinationals among the oil buyers, and an increase in the share of obscure individual traders. The observed underpricing of Iraqi oil suggests that Iraq generated $5 billion in rents through its strategic underpricing. Of this amount, we estimate that Iraq collected $0.7 to $2 billion in bribes (depending on Iraq's share of the rents implied by the price gap), which is roughly 1 to 3 percent of the total value of oil sales under the Program. Finally, we find little evidence that underpricing was associated with increases in the relative supply or declines in the relative demand of Iraqi oil.

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1 Introduction

In response to Iraq's invasion of Kuwait in 1990, the United Nations Security Council imposed an embargo on exports of Iraqi oil. To alleviate the economic hardship caused by the embargo, the UN Security Council created the Oil for Food program in 1995 that allowed Iraq to export oil in exchange for humanitarian goods, largely food and medicine. The proceeds from the oil exports had to be deposited in an escrow account controlled by the UN that could only be used to purchase humanitarian supplies.

By some measures, the Oil for Food program was the largest humanitarian relief program in world history. By the time the program ended in March 2003, the Oil for Food program had provided $46 billion in humanitarian supplies to Iraq.[1] This makes the Oil for Food program more than half the size of the Marshall Plan in absolute terms, and almost six times larger than the Marshall Plan on a per capita basis.[2]

While an important goal of the Oil for Food program was to provide humanitarian assistance to Iraq, the UN Security Council was also keen to prevent the Iraqi regime from obtaining resources that might be used to purchase weapons or luxury goods. However, despite the safeguards built into the Oil for Food program, there are widespread reports that Iraq was able to extract cash bribes and political favors from the oil buyers in the Oil for Food program.[3] Two key features of the Oil for Food program made this potentially feasible. First, Iraq could freely choose the buyers of Iraqi oil. Second, until September 2001, Iraq had some discretion to set the selling price of its oil. These two features of the program potentially allowed Iraq to deliberately set the price of its oil below market prices and then choose buyers that were willing to pay bribes to obtain the underpriced oil.

The objective of this paper is to measure these bribes. Clearly, due to its illicit nature, finding direct evidence of the alleged cash payments and political favors – a paper trail, for example – is difficult. A commission headed by Paul Volcker is currently investigating mismanagement and fraud in the Oil for Food program, but has not provided evidence on the magnitude of the alleged bribes.[4] The General Accounting Office (2004) estimates that Iraq

[1] Iraq exported $64 billion worth of oil under the Oil for Food program. Of this amount, $46 billion was earmarked for humanitarian supplies.

[2] The Marshall Plan disbursed $11.8 billion ($84 billion in 2000 dollars) in aid to 16 countries with a combined population of 270 million. Iraq's population is 22 million.

[3] Hereafter, unless otherwise stated, we define the term "bribe" broadly to include cash bribes and political favors.

[4] The Volcker commission's interim report (IIC, 2005) focuses on possible conflict of interests on the part of UN personnel, mismanagement of UN contracts, and problems with the audits carried out by the UN Office of Internal Oversight Services. The report presents documentary evidence of underpricing in the case of one firm with alleged ties to the head of the UN Oil for Food program, but has so far not documented the magnitude of the underpricing over the life of the program. There were more than 1,300 oil contracts over the life the program. In Section 3, we compare our estimates of underpricing with the documentary evidence of underpricing in the specific case analyzed in the Volcker commission's report.

received $859 million in cash bribes by underpricing its oil, but this estimate is not based on any evidence on the bribes. Rather, the GAO simply *assumes* that Iraq collected a 50 cent bribe on every barrel of oil. Alternative estimates, based on documents provided by Iraq's state owned oil company to the CIA, suggest that Iraq received $230-$240 million in cash bribes through the strategic underpricing of its oil (CIA, 2004). However, the CIA's estimate does not capture the monetary value of the political favors provided by the oil traders (or their associates) in exchange for the underpriced oil. Moreover, it does not include bribes that might have been paid to Iraqi officials outside the oil company. Therefore, the CIA's figure is likely to be an underestimate of the illegal resources Iraq was able to obtain through its strategic underpricing. [5]

We take a different approach. Instead of looking for documentary evidence of the alleged bribes, we use publicly available data to uncover patterns suggestive of bribery. Specifically, we measure the magnitude of the potential bribe by the gap between the official selling price of Iraqi oil (i.e. the price paid to the UN's Oil for Food Program) and our estimates of the "market" price of Iraqi oil (i.e. the price of Iraqi oil at the destination port, typically in Europe and the US, after subtracting shipping and insurance costs). We then compare this gap to that observed before the program. If Iraqi oil was underpriced in an effort to collect bribes, we expect to see two features in the data. First, we expect to see a larger gap between the "market" price and the official price of Iraqi oil during the Oil for Food program years than before the Program. In the years before the Oil for Food program, Iraq had full control over its oil revenues and thus did not have any incentive to underprice. Second, we expect the price difference to become smaller and return to its historical levels after September 2001. The reason is that in September 2001, the UN changed the way in which Iraq could price its oil. Specifically, the UN adopted a "retroactive pricing" scheme under which Iraq was forced to set its selling price retroactively based on the price actually observed in the markets.

To illustrate our evidence, consider the gap between the official selling price of Basrah Light–one of the two Iraqi oils–and the price of Arabian Light in the top panel of Figure 1. Arabian Light and Basrah Light are chemically very similar and are considered close substitutes. The price gap averages zero in the 1980s and early 1990s, but is clearly higher during the Oil for Food program years: the gap averages $2 in 1997 and 1998, climbs above $5 between 2000 and 2001, and falls after that. This evidence suggests that underpricing of Basrah Light was modest in the first few years of the program, reached a peak in the 2000-2001 period, and declined after the adoption of retroactive pricing in the fall of 2001.

Notably, we find a qualitatively similar pattern when we measure the gap between official

[5] A third reason for why the CIA's figure may be an underestimate is that, like all self-reported data on illegal activities, the source of the data has an obvious incentive to minimize the extent of the bribes.

selling price of Iraqi oil and the spot market price of Iraqi oil (after deducting shipping costs). This gap reflects the difference between the price of Iraqi oil when the oil is first sold at the Iraqi port under UN supervision and the spot price of the *same* oil when it reaches its destination and is sold to a refiner in Europe or the US. The price paid to oil traders in these spot market transactions presumably includes the cost of the bribe paid to the Iraqi regime. The gap between this spot market price and the official selling price is our most direct measure of underpricing. Unlike the evidence based on competitors, this gap can not be explained by unobserved shocks to the relative demand or supply of Iraqi oil.

We provide corroborating evidence of our interpretation of the price gaps from changes in the composition of Iraqi oil buyers. Specifically, for the underpricing scheme to work, Iraq has to choose oil buyers willing to pay bribes. While a major multinational oil company might be reluctant to pay bribes, a small oil trader operating in Russia or Switzerland might be more pliant. Therefore, if underpricing was a deliberate attempt to extract bribes, we should see a larger fraction of oil sold to obscure oil traders during periods when underpricing was more prevalent. Using the CIA's data (CIA 2004) on the buyers of Iraqi oil, we find a correlation between the degree of underpricing and the fraction of oil sold to oil individual traders (rather than to large oil multinationals.) In particular, during the peak underpricing period of the spring of 2001, there were *no* major oil company on the list of buyers.

We also test the prediction that underpricing was positively correlated with price volatility in world oil markets. Under the Oil for Food Program, Iraq set its price at least a month in advance, and the UN had to ascertain that the price set was as close as possible to the *expected* market price for the following month. It was therefore easier for the UN to prevent Iraq from underpricing when the price of oil on the world markets was stable than when the price of oil was very volatile. Furthermore, this relation between underpricing and volatility presumably changed after the introduction of retroactive pricing, since retroactive pricing effectively forced Iraq to set prices equal to the realized market price. The data support these predictions remarkably well. In the period before retroactive pricing, we find that underpricing is strongly correlated with price volatility in world oil markets. By contrast, in the period after the introduction of retroactive pricing, we find no relationship between underpricing and price volatility.

Based on this evidence, we interpret the product of the increase in the price gap (relative to the price gap prior to the program) and the quantity of oil sold as an estimate of rents generated by the strategic underpricing scheme. Our best estimate is that Iraq generated $5 billion in rents by underpricing its oil. This estimate captures both the cash bribes and the monetary value of the favors provided by the oil traders in exchange for the underpriced oil. Since these rents were presumably shared between the oil buyers and the Iraqi government (in the form of favors and cash bribes), we estimate the amount of bribes collected by Iraqi

under different assumptions on the split. If bribes were indeed paid only by individual traders, and not by reputable oil companies, our estimates suggest that Iraq collected 0.7 to 2 billion dollars in bribes over the course of the Oil for Food Program, depending on the relative bargaining power of individual traders and Iraq.[6] The estimated bribes collected by Iraq amount to 1 to 3 percent of the total value of oil sold during this period. While this estimate is higher than the existing estimates, presumably because it also captures the value of the non-monetary favors provided by the oil buyers, it is not very large when compared to the typical amount of corruption that we observe in many projects in developing countries.[7]

Clearly, our evidence of bribery is only indirect, and alternative interpretations are in theory possible. First, it is possible that the documented price gaps simply reflects an increase in the *relative supply* of Iraqi oil. For example, Iraq may have actually valued the humanitarian aid provided by the Oil for Food Program and thus chose to underprice its oil to maximize the revenues of the Program. However, empirically we find that episodes of underpricing were not associated with increases in the quantity of oil sold. Since the price elasticity of demand for Iraqi oil is likely to be fairly high, the failure to find significant effects of the price gap on the quantity of oil sold suggests that this hypothesis is not valid.

Alternatively, the underpricing could be due to a decrease in the *relative demand* of Iraqi oil. For example, this decrease could reflect a deterioration of the quality of Iraqi oil, a deterioration of Iraq's shipping facilities, or an increase in the risk of dealing with the Iraqi regime. Again, the empirical evidence does not seem to support this possibility. If the underpricing was due to lower quality, we would expect to see the lower quality reflected in the *market* price of Iraqi oil (which we don't). In addition, the hypothesis that underpricing was due to the lower quality of Iraqi oil is difficult to reconcile with the quick decline in underpricing after the adoption of retroactive pricing and with the documented relationship between underpricing and the type of buyer.

There are several reasons why the question investigated in this paper is important. First, the Oil for Food program was both the largest and the most high profile humanitarian aid program ever implemented by the UN. As mentioned, there are allegations that Iraq managed to exploit the program to obtain illegal revenues. Clearly, given the seriousness of the allegations and the implications for the UN if the allegations were true, it is important

[6] To be clear, this estimate assumes that bribes were only paid by oil traders and not by large oil companies. Under this scenario, some of the rent was appropriated by the large oil companies in the form of low oil prices. Obviously Iraq would prefer to deal only with individual traders willing to pay bribes. However, it is possible that, in some periods, the supply of Iraqi oil exceeded the demand from individual traders or that Iraq had to deal at least in part with reputable oil companies to minimize international scrutiny.

[7] Existing estimates of corruption range from 15%-18% for hospital procurements in Argentina (Di Tella and Schargrodsky, 2003) and anti-poverty programs in Indonesia (Olken, 2004b) to 80% for Ugandan schools (Reinikka and Svensson, 2004).

that we provide quantitative evidence on the extent to which the program may have been corrupted.

Second, the experience of the Oil for Food program may hold important lessons for other humanitarian assistance programs. For example, Chad recently reached an agreement with a consortium of oil companies led by ExxonMobil to develop its oil industry. To prevent the oil revenues from being misused, Chad pledged that its revenues from the project were to be deposited into an escrow account controlled by international monitors.[8] The experience of the Oil for Food program highlights the importance of institutional design in preventing initiatives such as the ExxonMobil-Chad program from resulting in other types of rent-seeking behavior. For example, in the case of the Oil for Food Program, a relatively minor change in design (the introduction of retroactive pricing) appears to have dramatically curtailed the scope for bribes.

Finally, there is growing interest among economists on rent-seeking and corruption. Our analysis of corruption in the Oil for Food program follows the approach taken by Di Tella and Schargrodsky (2003) (on procurement fraud in public hospitals in Argentina), Fisman and Wei (2004) (on tax evasion in China), and Reinikka and Svensson (2004) (on theft of public education funds in Uganda) in using patterns in prices and quantities to make inferences about corruption.[9] The specific rent-seeking mechanism we examine in this paper, in which distortions are deliberately created to extract rents, is something we see in other contexts. For example, Banerjee et. al. (2001) describe how wealthy members of sugar cooperatives in Maharashtra (India) set abnormally low prices for sugarcane to extract rents from the poorer members of cooperatives, and then use the "excess" profits of the cooperatives to finance their political activities.

There are a number of important questions we do not address in this paper. First, we only focus on the bribes that Iraq might have been able to obtain through underpricing its oil, and not on other mechanisms by which Iraq could have obtained illegal resources (for example, over-invoicing the purchases of humanitarian goods). Second, there have been allegations–currently under investigation by the Volcker Commission–that some UN employees personally gained from the program (e.g., by intervening with the Iraqis to obtain underpriced oil for their associates). Our evidence does not speak to this issue, although our estimates can be used to measure the rents associated with a particular oil contract. Finally, our paper does not measure the benefits provided by the humanitarian assistance provided by the Oil for Food Program. Despite the corruption we document in this paper, it is entirely possible that the humanitarian supplies provided by the program significantly improved the standards of

[8] See www.essochad.com for additional information on this project.

[9] In the same spirit, Fisman (2001) quantifies the value of political connections in Indonesia, Duggan and Levitt (2002) document match-fixing in sumo wrestling, Jacob and Levitt (2003) document patterns consistent with teacher cheating, and Olken (2004b) measures theft of subsidized rice in Indonesia.

living of Iraq's civilian population during a period of severe need.

The paper proceeds as follows. We begin by describing the Oil for Food program and its loopholes. We then turn to our empirical evidence in Section 3. Section 4 discusses alternative explanations. Section 6 concludes.

2 The Oil for Food Program

The UN Security Council imposed an embargo on exports of Iraqi oil after Iraq invaded Kuwait in 1990. To alleviate the economic hardship experienced by the Iraqi population, the Security Council created the Oil for Food program in 1995. The first oil sale took place in March 1997. The revenues from the oil sales had to be deposited into an escrow account controlled by the UN and could only be used for purposes authorized by the UN. Most of the funds were to be used to purchase food and medicine for the Iraqi population.[10] The Oil for Food program was controlled by the members of the Security Council, meeting as the "Sanctions Committee." The Sanctions Committee was assisted by a committee of four technical experts, known as the oil overseers, with substantial experience in the oil industry.[11]

For our purposes, there are two important features of the oil for food program. First, Iraq set the selling price for its two crude oils. The price had to be approved by the UN oil overseers and sanctions committee. Until September 2001, the sanctions committee approved the official selling price of Iraqi oil at the beginning of each month, which would apply to all oil purchases over the month. Given the uncertainty on future market prices, it was not always easy for the Council to determine in advance what the right price for the following month should be. Second, Iraq was completely free to choose the buyers of its oil. As we'll discuss later in the paper, there is some evidence that the bulk of the contracts went to oil traders rather than to the major oil refiners.

Although the intention was that the overseers would ascertain that the official price of oil set by the Iraqis was set as close as possible to the market price this was not an easy task, especially in periods when world oil markets were volatile.[12] The overseers were facing two

[10] Specifically, 72 percent were dedicated for food and medicine, 25 percent for a compensation fund for victims of the first gulf war, 2.2 percent for the Oil for Food program's administrative costs, and 0.8 percent for the UN's weapons inspection program. The Oil for Food program initially placed some limits on how much oil Iraq could export, but the export cap was completely lifted by December 1999. Iraq was initially allowed to export $1 billion worth of oil every 3 months. The cap was raised to $5.2 billion every 6 months in May 1998 and completely removed in December 1999.

[11] Four overseers, from Russia, France, US, and Norway, were appointed on August 1996. However, by June 1999, the Russian overseer was the only one of the four overseers that remained in the position after the French, American, and Norwegian overseers resigned. The members of the Security Council did not agree on the replacements of the three departed overseers until August 2000. Therefore, from July 1999 to August 2000, the Russian overseer was the only oil "expert" advising the Sanctions Committee.

[12] There are no future prices for Iraq oil.

types of uncertainty: uncertainty on future world oil prices and uncertainty on idiosyncratic factors that might affect the relative demand of Iraqi oil (for example, changes in perceived risks of dealing with Iraq or changes in quality of Iraqi oil). Political considerations were also at play. According to many accounts, the Russian overseer was often inclined to approve the price set by the Iraqi government.[13]

The incentive for Iraq to underprice is that when the official price is set below the price of competing crude oils, this creates a windfall gain for the buyers of Iraqi oil. By underpricing, Iraq could then demand "unofficial" payments (in addition to the official price) from the oil buyers. Iraq rulers could then use the "unofficial" revenues to purchase weapons and palaces, while the official revenues were spent on items (such as food and medicine) that were presumably of less value to the Iraqi regime.

For this scheme to work, the buyers of underpriced Iraqi oil have to be willing to make these illegal payments. This is where the second important feature of the oil for food program comes in – namely, that Iraq could freely choose the buyers of its oil. This is important because while the major oil companies might be unwilling to make these illegal payments, a small oil trader operating in an environment with little restrictions on bribes might be more willing to pay the bribe to obtain the oil contract. In turn, the oil trader could, after an appropriate markup to account for the bribe paid, sell the oil contract to a major oil refiner. The refiner would then send a tanker to Iraq to load the oil. The oil refiner, who did not directly pay the bribe, is happy to do this as long as the price paid to the oil trader is no higher than the price of competing crude oils.

The way Iraqi oil was priced changed after September 2001, after rumors about possible bribes became more widespread. In September 2001, a "retroactive" pricing scheme was introduced, in which the buyers of Iraqi oil would know the price only after the oil had been loaded onto the tankers. This retroactive pricing scheme made it much easier for the UN to approve prices that were close to the actual market price. In addition, the retroactive pricing system made it much more transparent when the UN approved prices that were below market prices. It is reasonable to expect that this new pricing mechanism curtailed dramatically the scope of the bribes from the oil buyers.

[13] Maurice Lorenz, a former Exxon executive and the American overseer for the Oil for Food program in 1997 and 1998, has publicly stated that the Russian overseer constantly attempted to allow Iraqi to underprice its oil. In a 2002 interview with the Wall Street Journal, Lorenz stated that "[he] recalls 'continually fighting' with the Russian counterpart Alexander Kramer over the price of Iraqi oil." (Wall Street Journal, "Secret Pipeline: How Iraq Reaps Illegal Oil Profits," by Alix Freedman and Steve Stecklow, A1, May 2, 2002.) In 2004, Mr. Lorenz indicated that "until mid-1998 Iraq occasionally proposed somewhat low prices but increased them under pressure from the American overseer, despite the Russian overseer's resistance but under the threat of throwing the issue to the Sanctions Committee. The American overseer departed in 1998 and the next month Iraq's proposed prices were much further below market than any until that time. The ex-overseer alerted the U.S. representatives on the Sanctions Committee, and these prices were increased upon their intervention." (Wall Street Journal, "Letter to the Editor," May 6, 2004, p. A19.)

3 Empirical Evidence

In this section, we document the extent to which Iraqi oil was underpriced when compared to the market price of several comparison crude oils. We present four pieces of evidence. First, in section 3.1 we compare the official selling price of Iraqi crude oils to the price of its closest substitutes: Arabian Light, Arabian Medium, and Urals. Second, in Section 3.2 we compare the official selling price of Iraqi crude oils with the spot market price of Iraqi crude oil itself. Third, in section 3.3 we show that the timing and the amount of the underpricing is associated with changes in the composition of the buyers of Iraqi oil. Fourth, in Section 3.4, we show that underpricing was higher in periods of high price volatility, and lower in periods of price stability, at least before retroactive pricing. Finally, in section 3.5 we present estimates of the bribes that the Iraqi regime may have obtained under different assumptions on the split of the rent between buyers and Iraq. The data used are described in the Data Appendix.

3.1 Close Competitors

We begin by comparing the price of Iraqi oils with the market prices of crude oils that are closest substitutes to Iraqi oil. Iraq produces two types of crude oil, known as Basrah Light and Kirkuk.[14] Both crude oils are considered "light" and "sour" crudes.[15] The closest substitute of the two Iraqi oils are Arabian Light, a crude oil produced in Saudi Arabia, and Urals, an oil produced in Russia. The physical characteristics of Arabian Light is virtually identical to that of Basrah while Urals is considered the closest competitor to Kirkuk. The volume of Arabian Light and Urals traded on the world oil markets are quite large and the available data on their prices are not noisy.

The top panel in Figure 1 plots the difference between the price of Arabian Light and the official selling price of Basrah. The bottom panel shows the difference between the market price of Urals and the official selling price of Kirkuk. The first vertical line marks the beginning of trading under the Oil for Food Program (tenth week of 1997). The second vertical line indicates the beginning of retroactive pricing. The horizontal line is the average difference for the years before the Oil for Food Program.[16]

[14] Basrah Light is produced from the Rumaila oil fields (around Basrah) in southern Iraq and Kirkuk is extracted from the Kirkuk oil fields in northern Iraq. Basrah Light is typically exported from ports in the Persian Gulf (mainly Mina-ak-Bahr) while Kirkuk is sent via pipeline to the Turkish port of Ceyhan (on the Mediterranean) from where it is loaded onto oil tankers.

[15] "Light" crudes are easier to refine and thus command a premium over "heavier" crudes. On the other hand, "sour" crudes have high amounts of sulfur that need to be removed during the refining process. Therefore, sour crudes are typically sold at a discount to crude oils with lower sulfur content (called "sweet" crudes).

[16] No data are available between 1991 and 1993 because Iraqi oil was not traded due to the oil embargo, the first Gulf War and its aftermath; and in 1995-1996 due to delays in the implementation of the Oil for

As can be seen, the price gap between Basrah and Arabian Light averages zero in the years prior to the Oil for Food program. The price gap between Kirkuk and Urals in the 1980s is also zero. This provides some reassurance that Arabian Light and Urals are reasonably close substitutes for the Iraqi oils. Although the difference is by no means constant in the years prior to the Oil for Food program, it bounces around its mean and does not show any particular trend.

After the Oil for Food Program is introduced, this difference is clearly larger for Basrah: the gap averages $2 in 1997 and 1998, and climbs above $5 between 2000 and 2001. Notably, after retroactive pricing is introduced in September 2001, the difference drops quickly to its historical level.[17] There is also some evidence that Kirkuk was underpriced from 2000-2001, albeit not as much as Basrah, but little evidence that it was underpriced during the first three years of the Oil for Food program.

We can quantify the average price gap by estimating the following regression:

$$\Delta P_t = \alpha + \beta Program_t + \epsilon_t \tag{1}$$

where t indexes weeks, ΔP_t is the difference between the market price of the comparison crude and the official selling price of the relevant Iraqi crude, and $Program_t$ is an indicator variable for periods of the Oil for Food Program in which sales of Iraqi oil took place (March 1997-December 2002). The excluded category, captured by the intercept, is the period before the Oil for Food Program (in most cases it includes years 1980-1996). The coefficient β measures the average change in the price difference during the Program relative to the historical baseline before the program. Because the figures indicate that the price gaps vary significantly between 1997 and 2002, we also estimate model that allow the gap to differ in different periods:

$$\Delta P_t = \alpha + \beta_1 Program_{1t} + \beta_2 Program_{2t} + \beta_3 Program_{3t} + \epsilon_t \tag{2}$$

where $Program_{jt}$ is an indicator variable for the jth sub-period of the Oil for Food Program (for example: j = 1997-1999, 2000-2001, 2002).

One concern is that the error term ϵ_t might be autocorrelated. The residual is the *difference* between shocks to Iraqi oil and shocks to its competitors. Serial correlation might occur if the shocks to the demand and supply of Iraqi oil relative to its competitors are serially correlated. To account for possible serial correlation we have tried two different strategies. First, we cluster the standard errors at the trimester-year level. This is not ideal, because it assumes no correlation between shocks in different trimesters. Second, we estimate models

Food Program.

[17] We postpone the discussion of why the price gap peaks between 2000 and 2001 to Section 3.4.

where the error structure is assumed to be autocorrelated up to five lags and heteroskedastic (Newey and West, 1987). In the Tables we report estimates based on this second strategy. The clustered standard errors model are generally similar to the one in the tables.[18]

Table 1 quantifies the visual impression one gets from Figure 1 by presenting estimates of β (from equation 1). The first column presents the estimates of the change in the gap between Arabian Light and Basrah. The estimate in the top panel indicates that the underpricing averaged \$2.44 dollars a barrel during the Oil for Food Program years (relative to the years before the program).[19] Because the price gaps appear to vary over time, in the bottom panel we show separate estimates for three sub-periods (equation 2). These estimates indicate that the price gap was significantly different from zero in the 1997-1999 period, reaches a peak in the 2000-2001 period, and declines in 2002.

An alternative competitor to Basrah Light is the Saudi crude oil Arabian Medium. While the Arabian Light has historically been the closest substitute of Basrah light, the quality of Basrah Light became much closer to that of Arabian Medium by the end of the program.[20] For this reason, in column 2 we present a comparison based on the price of Arabian Medium. We find that the estimated underpricing averaged \$1.24 dollars a barrel during the Oil for Food Program years (relative to the years before the program). This estimate is smaller than the comparison based on Arabian Light (column 1), which suggests that part of the increase in the price gap between Arabian Light and the official selling price of Basrah Light after 1997 may be due to the deteriorating quality of the Iraqi oil.

The estimate based on the comparison between Urals and Kirkuk (column 3) suggests an average underpricing of only \$0.69 dollars a barrel. This point estimate is only marginally significant.[21]

Based on the estimates of these price gaps, we can calculate the rents created by the underpricing of Iraqi oil. Specifically, we estimate these rents as the product of quantity sold in each week and the difference between that week's price gap and the baseline price gap:

$$I = \sum_t [(\Delta P_t - \hat{\alpha}) * Q_t] \tag{3}$$

where ΔP_t is the actual price gap in a given week, $\hat{\alpha}$ is the estimate of the average price

[18] Because of the gaps in our series, we have also experimented with the Baltagi and Wu (1999) estimator for cases where the observations that are unequally spaced over time and the residual follows an AR(1) process. Results are similar.

[19] Specifically, this is the gap from the 10th week of 1997 through the last week of 2002 relative to the 15 years prior to the program.

[20] Authors' personal communication with Mr. Maurice Lorenz (American oil overseer for the Oil for Food program from 1997-1998).

[21] Estimates for models in columns 1 and 3 where the residual follows an AR(1) process based on Baltagi and Wu (1999) are, respectively, 2.56 (0.31) and 0.70 (0.16). The estimated AR(1) parameters are 0.88 and 0.62.

gap in the years before the Program (the intercept in equation 1), and Q_t is the quantity of the relevant Iraqi oil sold that week. This estimate indicates that the underpricing of Iraqi oil created $3.75 billion to $6.7 billion in rents for buyers of Basrah Light (depending on whether Arabian Light or Medium is used a comparison) and $1.8 billion in rents for buyers of Kirkuk. These rents were presumably split between the Iraqi regime and oil buyers. Below, we try to quantify how much of these illegal revenues went to Iraq in the form of bribes.

For completeness, we have also investigated the gap between the official price of the Iraqi oils and the market price of West-Texas Intermediate (WTI) and Brent. WTI and Brent are two crude oils widely used as benchmarks for the world price of oil. The patterns of the price gap are shown in Appendix figure A1 and are generally similar to the patterns in figure 1. Finally, we obtain similar results when we examine the price gap between Iraqi oils and four other sour crude oils: Iranian Light, Oman, Dubai, and Venezuelan Tijuana (not shown).

3.2 Market Price of Iraqi Oil

In the previous subsection we have compared the price of Iraqi oils with the prices of its closest substitutes. This comparison controls for changes in price of Iraqi oil that may be driven by changes in the market's valuation of the physical quality of Iraqi oil. However, there may be other factors (other than physical quality) that could lower the relative demand for Iraqi oil. For example, the decline in the relative price of Iraqi oil could reflect an increased perceived risk of buying oil from Iraq or a higher political cost of dealing with the Hussein regime.

To address this possibility, we turn to our second measure of the market value of Iraqi oil: the spot market price of Iraqi oil itself. That is, we compare the official selling price of Iraqi oil to the spot market price of the same oil. As explained in Section 2, oil traders that received Iraqi oil contracts sold these contracts in spot markets in Europe and the US. The price paid to oil traders in these spot market transactions presumably includes the cost of the bribe paid to the Iraqi regime.

After an adjustment for transportation costs, the gap between the spot market price and the official selling price should be the best measure of underpricing. Unlike the evidence based on the other comparison oils, this price gap can not be explained by changes in the relative demand or supply of Iraqi oil. However, the spot market data of Iraqi oil is of lower quality than the data on the spot market prices of the other four comparison crude oils. In particular we have data on the spot market price of Kirkuk and Basrah from three independent sources.[22] But no data source covers the entire period. To construct a series for the spot market price of the two Iraqi crude oils over the entire time period, we simply

[22] Our three sources are ICISLOR, Platts, and Petroleum Argus. See the Data Appendix for more details.

take the average of the price gaps from the data sources available in each week.

Figure 2 shows the price difference between the market price of Iraqi crude and its own official selling price. The top panel is for Basrah. As can be seen, the overall picture is qualitatively similar to Figure 1. The figure suggests that underpricing was somewhat limited from 1997-1999, large from 2000-2001, and declined after September 2001. The bottom panel is for Kirkuk. The graph is noisier than the previous figures, and the evidence for underpricing for Kirkuk appears therefore weaker than that for Basrah. We do not know exactly why the documented price gap appears to be larger for Basrah than for Kirkuk.[23]

Table 2 quantifies the magnitude of the price gap. Looking at the overall estimates, the point estimates are 1.64 and 0.29 for Basrah and Kirkuk, respectively. The estimate for Basrah is remarkably close to the estimate based on the comparison between Arabian Medium and Basrah (column 2 Table 1), while the estimate for Kirkuk is lower than the previous estimate.[24]

Estimates by period show a pattern similar to the one shown in Table 1, with the peak of the underpricing reached in the 2000-2001 period. Although the patterns over time are generally similar, it appears that the findings in column 1 and 3 of Table 1 may be an overestimate of the true magnitude of the price gap. However, the estimate of underpricing based on the comparison of Basrah Light with Arabian Medium is remarkably similar to the estimate obtained from the spot market price of Basrah Light. Estimates of the illegal revenues are $4.96 billion and $1.14 billion, respectively.

Our estimates of underpricing match fairly well the only existing piece of documentary evidence of underpricing. This documentary evidence is from a report by the commission headed by Paul Volcker, and refers to five purchases of Kirkuk crude oil (for a total of 7.3 million barrels) by an oil trading company called the Africa Middle East Petroleum Company (AMEP). Based on written documentation on the price paid by AMEP to Iraq and on the price received by AMEP on the spot market by refiners (mostly by Shell), the Volcker commission calculates that Kirkuk was underpriced by an average of $.25 in these five cases (IIC, 2005). Our estimates based on the comparison between the OSP price for Kirkuk and the market price for Kirkuk in the five three-week windows centered around the date of the AMEP sales is $.27, which is remarkably consistent with the evidence provided by the Volcker commission.

It is worth noting that the estimated underpricing in the AMEP contracts appears to be low. There are two reasons for this. First, the underpricing involves Kirkuk, and we have

[23] We note, however, that the traded quantity of Basrah is larger than the traded quantity of Kirkuk. This difference may explain, at least in part, the fact that the series for Kirkuk is noisier.

[24] Clustered standard errors are respectively .28 and .15. Estimates for models where the residual follows an AR(1) process are, respectively, 1.79 (.27) and .27 (.14). The estimated AR(1) parameters are .78 and .54.

shown that underpricing was much less prevalent with Kirkuk than with Basrah. Second, three of the sales are from the 1998-1999 period, where underpricing was generally low. For this reason, the specific case examined in detail by the Volcker commission does not appear to be representative of the underpricing during the life of the Program. More generally, there were 1,300 oil contracts during the Oil for Food program, and it would seem to be prohibitively costly to compile the same type of documentary evidence provided by the Volcker commission for the AMEP oil sales for all 1,300 contracts. In this context, our estimates can be used to focus valuable investigative resources. Specifically, our estimates of underpricing suggest that the bulk of the underpriced contracts involved Basrah between May 2000 and September 2001, and it is these contracts that investigators should focus on.

3.3 Underpricing and the Composition of Oil Buyers

So far we have found consistent evidence that Basrah Light was modestly underpriced from 1997-1999 and significantly underpriced from 2000-2001. Here we show that the peak of illegal revenues happens at the time when the importance of major oil companies as a fraction of Iraqi oil buyers is the lowest. Although this evidence is clearly only suggestive, it is consistent with the rest of the evidence presented so far.

If the underpricing of Basrah Light was a deliberate attempt to extract bribes from the oil buyers, it obviously must be the case that the buyers are willing to pay these bribes. It is possible, and indeed likely, that not all the buyers are willing to pay bribes. There were three types of buyers of Iraqi oil. First, there were major multinational oil companies that operate in Iraq as well as in many other oil markets. Examples include Shell, BP, Total, Eni, and Gasprom. On the other extreme, there were many individual dealers with no connection to reputable companies. These dealers were typically from countries such as Russia, Ukraine, or Switzerland, that are not major oil importers. Third, there were small but legitimate oil companies (not major multinationals).[25]

We expect that, while a major multinational oil company might find it difficult to pay bribes, a small oil trader operating in Russia or Switzerland might be more willing to do so. Therefore, if greater underpricing was in fact associated with greater bribes, we should see a larger fraction of oil sold to obscure oil traders during periods when underpricing was more prevalent.[26] Finding that during periods of high underpricing most of Iraqi oil was in fact bought by reputable multinational companies like Shell or BP would cast doubt on the proposed link between underpricing and bribes.

Table 3 presents some descriptive statistics for the composition of buyers of Iraqi oil. The

[25] This group also include few cases where the buyer was a government organization.

[26] The likelihood that the third type of buyers was willing to pay bribes is probably in between the likelihood for the first and the second type.

evidence on buyers is based on data provided in the publicly released report of the CIA's Iraq Survey Group, also known as the Duelfer's report (CIA 2004), which lists the buyers of Iraqi oil in each 3-6 months period.[27] The number of buyers tend to increases over time, while the average size of a each contract declines after 1998. The number of major oil companies reaches a nadir in 2001, while the number of individual buyers generally increases. The bottom part of the table shows the top five countries of origin of the buyers. As can be seen, the largest number of contracts went to Russian traders.

Figure 3 presents the evidence on the relation between the composition of buyers of Iraqi oil and the extent of underpricing. The top panel shows the estimated total amount of illegal revenues, by period. The total amount of illegal revenues is obtained using estimates of equation 3 based on the comparison of the official selling price of Iraqi oil and its market price. The figure indicates that most of the illegal revenues were obtained between 2000 and 2001.

The middle panel presents the fraction of buyers of Iraqi oil that are individual traders (as opposed to corporations, both major and minor). This fraction is low in the years before 2000, and grows with time. It reaches a peak in the first trimester of 2001, and declines after that. A comparison with the top panel indicates that the first trimester of 2001 is exactly the time when underpricing of Basrah reached its peak. The correlation between the degree of underpricing and the fraction of buyers that are individuals is .48.

The bottom panel presents similar evidence based on an alternative classification of Iraqi oil buyers. Specifically, it shows what fraction of buyers of Iraqi oil that are *major* oil companies. We define major oil companies as the ones listed among the top 200 oil companies in the world.[28] (Not all the companies are major oil companies, so that the fraction of major oil companies is not 1 minus the fraction of individual traders.) Again, there appears to be a relationship between underpricing and the share of major oil companies among the oil buyers. A large fraction of buyers are major oil companies in the earlier years of the program when underpricing was less prevalent. The share of major oil companies decline over time. Notably, there are no major oil companies among the oil buyers in the first trimester of 2001, which is exactly when underpricing reached its peak. The correlation between underpricing and the fraction of buyers that are major oil corporations is -.42.

3.4 The Relationship Between Underpricing and Price Volatility

In this subsection, we propose a second specification check based on the relationship between underpricing and price volatility in the crude oil world markets. Until the adoption

[27] The Oil for Food program had to be renewed by the Security Council every 3-6 months.
[28] As defined by Forbes. (http://www.forbes.com/2004/03/24/04f2000land.html)

of retroactive pricing, Iraq could set the price of its oil, but the price had to be approved by the UN (see Section 2). In particular, each month, Iraq set the price of its oil for transactions that would take place the *following* month and the UN ascertained that the price set was as close as possible to the *expected* market price for the following month. Since there are no future prices for Iraq oil, this was not an easy task for the UN overseers, especially in periods when world oil markets were volatile. When the price of oil on the world markets was stable, predicting the future price of oil was relatively easy. However, in periods when the price of oil was very volatile, predicting the future price of oil became much harder. This suggests that it should have been easier for Iraq to get away with a low price in periods characterized by high volatility in world oil prices. It was harder for the UN overseers to object to a low price in periods were the future price of oil was very uncertain. This relation between underpricing and volatility presumably changed after the introduction of retroactive pricing, since retroactive pricing effectively forced Iraq to set prices equal to the actual market price, irrespective of volatility.

If this is true, we should observed two features in the data. First, in the period before the introduction of retroactive pricing, we should see that our estimates of underpricing are higher in weeks of high oil price volatility. Second, in the period after the introduction of retroactive pricing, we should see that our estimates of underpricing are not correlated with volatility. Finding a correlation between underpricing and volatility after the adoption of retroactive pricing would cast doubt on the validity of the interpretation of this specification test.

Table 4 shows estimate from four regressions of underpricing on market volatility. Because the UN overseers used the price of Brent (a widely used international benchmark price) as a reference points for shipments going to Europe, we measure volatility on the world oil market as the standard deviation of the price of Brent in the ten weeks preceding the observed transaction.[29] (Note that the dependent variable is of course a price difference, while the dependent variable is volatility in the price level.)

The table shows a pattern that matches remarkably well our predictions. In the period before retroactive pricing (September 2001), there is a positive association between our estimates of underpricing and volatility, both for Basrah and Kirkuk. To have a sense of the magnitude of the coefficient, consider that a move from the 25th percentile of the standard deviation distribution to the 75th percentile (i.e. from a standard deviation of 0.89 to one of 1.77) would be associated with an increase in underpricing equal to \$0.80 for Basrah and \$0.26 for Kirkuk. Such an effect seems quantitatively large, especially for Basrah. Notably, after retroactive pricing is introduced, the correlation between underpricing and volatility disappears. The coefficients in the second row for both Basrah and Kirkuk are not

[29] Using 5 weeks does not significantly change the results.

statistically different from zero.

Overall, it appears that it was easier for Iraq to underprice its oil in period of high price volatility than in periods of price stability. This finding is interesting for two reasons. First, it lends further credibility to the interpretation of our results. Second, it is useful in explaining the *timing* of the documented underpricing. Our evidence suggests that the peak underpricing period began in the spring of 2000 and ended by September 2001. It seems clear that the end of underpricing was due to the adoption of the retroactive pricing scheme in September 2001 by the British and American representatives on the Security Council. The question that remains, however, is why was Iraq able to dramatically expand its underpricing in the spring of 2000? The evidence on the link between volatility and underpricing suggests that part of the answer may lie with the increased volatility of the price of oil in world markets. The months of peak underpricing (2000 and the first half of 2001) are month characterized by high volatility in the price of oil markets. By contrast, volatility was much lower in 1997, 1998 and 1999.

3.5 Estimating the Total Amount of Bribes to Iraq

We have presented evidence that there seems to have been significant underpricing of Iraqi oil (especially of Basrah) and that this underpricing increases when the fraction of contracts awarded to major oil companies is small. Here we aim to quantify the amount of bribes that the Iraqi government may have received from this underpricing mechanism.

In the top panel of Figure 3 we have shown the total amount of illegal revenues based on our estimates, by period. Of course, not all this revenue ends up in Iraqi coffers. Presumably, the buyers (at least some of them) demand a share of the illegal revenues. If one knew that share, the amount of bribes obtained by Iraq could be estimated as

$$B = \sum_t [(\Delta P_t - \hat{\alpha}) * (Q_t * \gamma_t)] * (1 - \rho) \tag{4}$$

where γ_t is the fraction of the relevant oil in week t that was bought by buyers willing to pay bribes and ρ is the intermediaries' cut. We obviously have no information on the intermediary's cut. Because of this, we simply provide alternative estimates of B under different assumption on the size of ρ. We want to stress that these assumptions are arbitrary and are intended only to show how sensitive our estimates of B are as we change ρ. We have relatively more information on γ_t, because we know who the buyers are.

In Table 5 we present estimates of equation 4. Entries in column 1 are obtained by taking a fraction of the product of the amount of the relevant Iraqi oil sold in each week between 1997 and 2002 by the difference between the price difference observed in each week between 1997 and 2002 and the average price difference for the period 1980-1995. The price

differences are between the market price of Iraqi oil and the official selling price of Iraqi oil (Table 2). For example, the first entry in column 1 is obtained by taking 75% of the sum of the two entries in the bottom row in Table 2. In terms of equation 4, the entry in the first column and first row assumes that $\rho = .25$ and $\gamma = 1$. The second and third entry in column 1 are obtained by taking 50% and 25% of the sum of the two entries in the bottom row in Table 2, respectively ($\rho = .5$ and $\rho = .75$).

Based on the entries in columns 1, if the dealers' cut was 25%, the total amount of bribes obtained by Iraq would be $4.5 billion. If the dealers' cut was 50%, the bribes would amount to $3.0 billion. If the dealers' cut was 75%, the total amount of bribes would be $1.5 billion.

However, not all buyers may have been willing to pay bribes. As we argue above, major oil companies may be concerned about their reputation and may find it difficult to pay bribes. Entries in column 2 show estimates of the amount of bribes obtained by Iraq under the assumption that only individual traders not affiliated with oil companies are willing to pay bribes. Those entries are obtained by applying equation 4, where γ_t is estimated as 1 minus the fraction of buyers who are individual traders in the relevant period of the Oil for Food Program.[30] Note that under this scenario, the major oil companies that were allocated contracts for underpriced Iraqi oil get to keep the entire rent. Individual traders, on the other hand, would buy Iraqi oil below market price, resell it at market price, but would have to split the rent with the Iraqi regime. Obviously the Iraqi regime would prefer to deal only with individual traders. But it is possible that, in some periods, the supply of Iraqi oil exceeded the demand from traders that were willing to pay bribes to purchase underpriced oil. Alternatively, it is possible that Iraq felt compelled to deal at least in part with reputable oil companies to minimize international scrutiny.

Based on the estimates in columns 2, the total amount of bribes obtained by Iraq would be between $0.7 billion and $2.1 billion, depending on the dealers' cut.

Column 2 provides our best estimate of the bribes obtained by Iraq. The estimated bribes amount to 1 to 3% of the total value of oil sales during the Oil for Food Program. Compared to the amount of corruption typically observed in projects in some developing countries, a 1 to 3% of funds lost to corruption does not appear to be particularly large.[31] However, it is possible that there were other irregularities in the Oil for Food Program that allowed Iraq to siphon funds from the program. For example, it is possible that over-billing took place in the purchase of humanitarian goods. We do not measure this in this paper, as we do not

[30] Our proxy for γ_t does not vary at the weekly level, but for each six month interval.

[31] For example, Olken (2004a) finds that 29% of funds allocated to to a road building project in Indonesia were stolen. In another program in Indonesia, Olken (2004b) finds that 18% of subsidized rice in a large anti-poverty program in Indonesia is stolen. A study of hospital procurement in Argentina finds a 15% overcharging for inputs (Di Tella and Schargrodsky, 2003). A study of Uganda schools finds that 80% of the funds allocated by the Ministry of Education for schools never reached the schools (Reinikka and Svensson, 2004).

have a tractable way of measuring its magnitude.

How do our estimates of the total amount of bribes in column 2 compare with the two existing estimates? The GAO (2004) estimates that Iraq obtained almost $900 million in bribes while the CIA's (2004) estimates are smaller, ranging from $230 to $240 million. As we've mentioned, the GAO's estimate is not based on any evidence, but simply assumes that Iraq collected a 50 cent bribe on every barrel of oil. On the other hand, the CIA's estimates are presumably more reliable, as they are based on documentation provided by Iraq's state owned oil company on the cash bribes paid by the oil buyers. However, there are two reasons to believe that the CIA's data might understate the amount of the illegal cash payments. First, the source of the CIA's data – Iraq's oil company – has an obvious incentive to minimize the extent of the bribes. This is a common problem with all self-reported data on illegal activities. Second, bribes may have also been paid to other branches of the Iraqi government (other than the oil company) and to Iraqi officials on a personal basis. The CIA estimate would miss these bribes.

More importantly, it is possible that some of recipients of the oil contracts (or their associates) compensated Iraq with political favors instead of monetary bribes. For example, a central accusation of the Volcker commission (IIC, 2005) is that head of the Oil for Food program, Mr. Benon Sevan, intervened with the Iraqis to obtain oil allocations for Africa Middle East Petroleum Company (AMEP). In exchange, the Iraqis wanted Mr. Sevan's assistance in getting permission to use the Oil for Food program funds to purchase oil-industry equipment. If Iraq was compensated by some buyers in the form of political favors (rather than by monetary bribes), the CIA's estimate would understate the degree by which Iraqi oil was underpriced and, by extension, the illegal resources that Iraq might have been able to obtain through this scheme.

In fact, the Volcker commission reports that of the five transactions involving AMEP, a cash bribe (about 18 cents a barrel) was paid in only one of the five transactions. Thus, the documentary evidence indicates that AMEP paid an average cash bribe of 2.5 cents a barrel for the 7.3 million barrels of Kirkuk crude oil purchased from Iraq, which is roughly a tenth of the extent by which Kirkuk was underpriced in the AMEP transactions (25 cents a barrel).[32] In contrast, we remind the reader that our estimates are remarkably consistent with the Volcker commission's documentary evidence of underpricing in the AMEP oil sales. Therefore, our estimates based on the price gap are arguably an accurate measure of the *sum* of the monetary bribes and the monetary value of the political favors that Iraq obtained through the deliberate underpricing of its oil.

[32] The illegal cash payment of 18 cents a barrel involved the sale of 1 million barrels of oil, or 13.6 percent of the total Iraqi sales to AMEP.

4 Alternative Explanations

We have interpreted the documented underpricing as a deliberate attempt by Iraq to extract bribes from the oil buyers. It is useful to visualize this argument in terms of the supply and demand for Iraqi oil. Specifically, suppose that S represent the supply of Iraqi oil, D the demand for Iraqi oil from the end-users (e.g., oil refiners), and the equilibrium price and quantity of Iraqi oil is given by $P1$ and $Q1$ (Figure 4). Now, suppose that, in exchange for a bribe, Iraq sells the oil to traders at a below-market price ($P2$). In turn, the trader resells the oil to refiners in spot markets at the market price $P1$. Since the underpricing does not affect the final price paid by the end users of Iraqi oil, there is no change in the equilibrium quantity of Iraqi oil. The underpricing creates a rent, given by the shaded area in Figure 4, which is presumably split between Iraq (in the form of bribes) and the oil traders.

This interpretation of the price gap assumes that there were no contemporaneous changes in the relative supply or relative demand for Iraqi oils. In this section, we discuss the validity of this assumption. Specifically, we discuss the possibility that underpricing of Iraqi oil was driven by an increase in *relative supply* or a decrease in *relative demand*.

Increase in Supply: An alternative interpretation of the evidence on underpricing is that the underpricing was a deliberate effort by the Iraqi regime to sell more oil. Why might Iraq want to do this? One possible explanation is that the UN oil embargo decreased standards of living in Iraq. Assuming that this decline affected the Iraqi elite as well as the average Iraqi, this can be interpreted as an increase in the marginal utility of consumption. If Iraq is trying to decide how much oil to produce today and how much to save for future consumption, an increase in the marginal utility of consumption should generate an increase in current production and therefore, assuming that Iraq faces a downward sloping demand curve for its oil, a decline in price.[33] Of course, the magnitude of the price decline would depend on the elasticity of demand for Iraqi oil. The higher the elasticity, the smaller is the price change.

This hypothesis is illustrated in Figure 4 by a shift in the supply curve from S to S' (assuming that the demand and supply of Iraqi competitors remain unchanged.) The equilibrium shifts from point 1 to point 2. The increase in supply lowers the market price from $P1$ to $P2$ and increases the quantity of oil sold from $Q1$ to $Q2$. Note that if one can not

[33] We have in mind a stylized two-period model of optimal oil extraction. Suppose that Iraq has to decide how much of its finite oil reserves it wants to extract today. The marginal benefit of extracting oil today is the product of the marginal utility of consumption today and the gap between marginal revenues and marginal costs. In turn, the marginal loss from extracting oil today is the cost of forgone future consumption, which is the product of the discounted marginal utility of consumption tomorrow and the difference between marginal revenue and costs tomorrow. The equilibrium quantity of Iraqi oil is where marginal benefit equals marginal loss. A more formal treatment is available on request.

observe the exact location of the supply curve, one could attribute the price drop $P1$ to $P2$ to illegal underpricing, while in fact it is caused by a standard increase in supply.

Several pieces of evidence argue against this hypothesis. First, if the only explanation for the documented underpricing was an increase in the supply of Iraqi oil relative to its competitors, we should not see underpricing when we compare the market price of Iraqi oil to its own official selling price. However, we find evidence of underpricing even when we measure the gap between the market price of Iraqi oil and its official selling price.

Second, although it is probably less than infinite, the demand faced by Iraq is likely to be very elastic. After all, even if crude oil is not perfectly homogeneous, it is a commodity.[34] If the demand curve for Iraqi oil is elastic, the large price differences documented in the previous section (more than $1 on average, with peaks of up to $4) would imply enormous increases in quantity sold. However, we simply do not observe such large variations in quantity sold. Figure 5 presents a scatter-plot of the price gap and the quantity sold of Basrah (top panel) and Kirkuk (bottom panel). If the episodes of underpricing were triggered by an outward shift in the relative supply of Iraqi oil, we should see a *positive* relationship between the price gap and the quantity. However, the relationship between the price difference and quantity is either not statistically different from zero or negative. [35]

In sum, this evidence is not consistent with a story where the Iraqi government was trying to sell a lot of oil, especially if the elasticity of demand for Iraqi oil is high. How elastic is the price elasticity of demand for Iraqi oil? To answer this question, we need an exogenous change in the supply of Iraqi oil. One such exogenous supply shift is the doubling of the export cap of Iraqi oil in mid 1998. Specifically, starting in Phase 4 of the Oil for Food Program (May 30, 1998), the cap on Iraq's exports of oil was doubled from $1 billion every 3 months to $5.2 billion every six months. As a consequence, the volume of oil exports increased from 182 million barrels in phase 3 (December 5, 1997 to May 29, 1998) to 308 million barrels in phase 4 (May 30, 1998 to November 25, 1998).[36]

The top panel of Figure 6 shows the amount of oil produced by Iraq and its price before and after the increase in production allowed by the UN. [37] The vertical line denotes the exogenous change in quantity sold between phase 3 and phase 4. The top panel indicates that the large supply increase resulted in a modest price decline in official selling price in

[34] While different types of oils have different chemical characteristics, and different refiners have preferences for some types of oil over others, these differences are second order, and refiners can adjust their refining processes to deal with different crudes.

[35] A regression of quantity sold on the price gap yields a coefficient (std error) of -2.17 (4.00) for Basrah and -8.61 (4.34) for Kirkuk. It is in theory possible that these coefficients are biased, if unobserved shocks to the demand of Iraqi oil are systematically correlated with changes in its supply.

[36] The quantity cap was completely lifted in 1999.

[37] The level of observation here is each six month phase of the Oil for Food Program. For this period, separate data on the production of Basrah and Kirkuk are not separately available. The amount of oil sold is therefore the sum of Basrah and Kirkuk and the price is the average of the two Iraqi oils.

the period that immediately followed the supply increase. This decline was reversed in the following period. The lack of substantial decrease in price is consistent with a demand curve that is very elastic but not perfectly horizontal. Because many other things may have changed in the oil market in that period, the bottom panel reports the price difference between Iraqi competitors and Iraqi oils, instead of the price of Iraqi oil.[38] In the period that immediately follows the supply increase, the price of Iraqi oil declines somewhat relative to the price of its competitors. This effect is short lived, and in the next period this relative decline is reversed. Overall, the evidence is consistent with the notion that the price elasticity of demand for Iraqi oil is relatively high. This evidence, combined with the absence of a positive relationship between quantity and the price gap, suggests that the underpricing was not driven by an increase in the relative supply of Iraqi oil.

Quality Differences and Relative Demand Shifts A second alternative explanation is that the price gap reflects a shift in the relative demand for Iraqi oil. Recall that our econometric models in Table 1 control for a baseline difference in the demand of Iraqi oil and the relevant comparison oil. This baseline difference accounts for permanent differences in demand, but this obviously leaves open the possibility that the relative demand for Iraqi oil fell during the Oil for Food program years.

Why would the relative demand for Iraqi oil fall? First, it might be possible that the quality of Iraqi oil (relative to the quality of its close substitutes) fell in the years after the first Gulf War.[39] Alternatively, it is possible that the physical quality of Iraqi oil may not have changed, but that the quality of Iraq's shipping facilities may have declined. A related explanation is that the political costs of buying Iraqi oil may have increased after the first Gulf War.

All three factors would represent a fall in the demand for Iraqi oil. This can be viewed as a leftward shift in the demand curve for Iraqi oil from D to D' in Figure 4, and a fall in the equilibrium price and quantity to $P2$ and $Q3$, respectively. As we mentioned before, if we can not observe the exact location of the demand curve, we could attribute the decline in price to illegal underpricing, while in fact it is caused by a simple decline in demand.

However, this story is not consistent with three pieces of evidence. First, the price gap between Iraqi oil and other oils drops to zero after the introduction of retroactive pricing. There is no reason to believe that quality differences or risk differences–if they ever existed–

[38] The price difference is the difference between a weighted average of the price of Arabian Light and Urals minus the price of Iraqi oil, with weights reflecting the average share of production of Basrah and Kirkuk in the period where separate information on the quantity sold of Basrah and Kirkuk is separately available.

[39] As we mention above, we suspect that this possibility is not very likely, since Arabian Light and Arabian Medium have chemical characteristics very similar to Basrah and the physical quality of Urals is almost identical to that of Kirkuk.

ended abruptly in September 2001. Second, and most importantly, the change in relative demand story is not consistent with Figure 2 and Table 2, which show a gap between the market price of Iraqi oil and its *own* official selling price. Third, this hypothesis would not explain the relationship between underpricing and fraction of buyers who are not major oil companies.

Overall, we conclude that in most of the period under consideration, changes in the relative demand, if they took place, were not driving the price gaps documented.[40]

5 Conclusion

In this paper, we find modest evidence that the official selling price of Iraqi oil was below its market value from 1997 through 1999, but clear evidence of underpricing from May 2000 through September 2001. In addition, there is little evidence of underpricing after September 2001, when the UN introduced a retroactive pricing scheme that made it more difficult for Iraq to underprice. Moreover, we find a suggestive relationship between the degree of underpricing and the composition of the buyers of Iraqi oil. Specifically, we find that periods of underpricing were periods in which a larger share of the oil was purchased by obscure oil traders rather than by multinational oil companies. The peak of the underpricing occurred at a time when *no* major multinational companies appear among the buyers. We also find that it was easier for Iraq to underprice its oil in periods of high price volatility in world oil markets. This is expected, as detection of underpricing by the UN is more difficult in periods of high volatility. As expected, the relationship between underpricing and volatility disappears after the adoption of retroactive pricing.

Why did Iraq sell its oil below market price? We hypothesize that underpricing was a way for the Iraq regime to obtain illegal kickbacks or political favors from the oil buyers. Because all the legal oil revenues were controlled by the UN, the Iraq regime had an incentive to sell its oil below its market price in exchange for a bribe from the buyer. Our estimates suggest that Iraq created 5 billion dollars in rents by underpricing the oil. Depending on the assumptions one makes about the split of this rent between Iraq and the oil traders, we estimate that Iraqi illegally received 0.7 to 2 billion dollars in bribes between 1997 and

[40] A third possible explanation is represented by technological differences. While there are no reasons to think that Iraqi oil extraction and shipping technologies were different from its competitors in 1991 just before the first Gulf War, it is likely that such difference existed after 1997. Years of embargo are likely to have affected Iraqi access to new technologies and to spare parts necessary to keep its production facilities up to date. Could this technological gap explain the underpricing documented in the previous section? It seems unlikely. Two scenario are possible, depending on the elasticity of demand. If elasticity of demand is infinite, we should see a decline in oil production but no change in prices. The reason is that at a given world price, some marginal fields become not profitable. In this scenario, prices are not affected, while quantity declines. If elasticity of demand is not infinite, both quantity and prices are affected. But a decline in extraction technology will result in an *increase* in Iraqi prices, not a decrease.

2002.[41] This estimate should be interpreted as the sum of the direct cash payments and the monetary value of the political favors provided by the oil buyers.

We want to be clear on two points. First, in addition to underpricing its oil, there are other mechanisms that Iraq could have employed to obtain illegal resources. For example, it could very well be the case that Iraq was also obtaining illegal revenue by over-invoicing the humanitarian goods it purchased through the Oil for Food program. We focus on illicit income from oil sales, rather than on illegal revenue from other sources, because we have a tractable way of measuring the the bribes Iraq might have been able to extract from the oil buyers.

Second, we clearly can not say that the Oil for Food program was a failure. Although we find suggestive evidence that during certain periods of time, particularly from 2000-2001, the Oil for Food program was corrupted by Iraq's efforts to extract bribes, it is entirely possible that the program provided valuable aid that significantly alleviated the humanitarian crisis in Iraq. Furthermore, underpricing declined after a retroactive pricing scheme was put in place by the UN in 2001. Therefore, it appears that incentives do matter, and careful institutional design on the part of international development agencies is crucial to minimize the amount of theft and waste in humanitarian programs.

[41] We reminder the reader that 0.7 to 2 billion dollars is roughly 1 to 3 percent of the oil sales under the Oil for Food program.

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Data Appendix

Every month, Iraq (with the approval of the UN's oil overseers) sets the official selling price of Basrah Light and Kirkuk. The quoted prices are "free on board" (fob) prices for loadings in Ceyhan in Turkey (Kirkuk) or at Mina-ak-Bahr in the Persian Gulf (Basrah Light). The official selling price also differs according to the intended destination of the oil (US, Europe, or Asia). [42] Starting in September 1998, the UN reports the it average official selling price of Iraqi crude oil each week.[43] However, the UN does not provide information on the individual prices of the two Iraqi crude oils, nor does it provide the fob prices for the different markets. For this reason, we obtained the official selling price of the two Iraqi crude oils (Basrah Light and Kirkuk) from Platts.[44] Because Basrah Light is typically exported to the US, we take the official selling price for Basrah Light destined for the US. In turn, Kirkuk is largely exported to Europe, so we take the official selling price of Kirkuk destined for European markets.

We compare the official selling price of Iraqi oil with the market price of Arabian Light and Arabian Medium (Saudi Arabia) and Urals (Russia). The oil industry press frequently cites "Arab Light", a crude oil produced by Saudi Arabia, as the closest substitute for Basrah Light[45] In turn, a Russian crude oil known as "Urals" is widely viewed as a close substitute of Kirkuk. We define the price of the two Saudi crude oils as the fob price in the Persian Gulf (from ICIS-LOR, obtained from Datastream's database). In turn, the market price of Urals is typically quoted as a delivered (or cif) price in Italy (also from ICIS-LOR, provided through Datastream). We convert the delivered price of Urals in Italy to a fob price by subtracting oil tanker rates from the Black Sea to Italy[46]

Turning to the market price of the Iraqi oils, we combine data from three sources to obtain the spot market price of Basrah Light and Kirkuk. These three sources are ICIS-LOR, Platts, and Petroleum Argus.[47] For Kirkuk, the data provided by all three sources are spot fob prices for loadings at the port of Ceyhan (in Turkey.) For Basrah Light, ICIS-LOR and Petroleum Argus reports the cif price at the US Gulf Coast. We convert the cif price to a fob price by subtracting the shipping rates for crude oil from the Persian Gulf to the US Gulf Coast.[48] Platts also reports the cif price of Basrah Light in the US Gulf Coast, but

[42] Specifically, the official price is quoted as a discount to the benchmark crude oil in each region (Brent in Europe, West-Texas Intermediate in the US, and Oman and Dubai in Asia). Specifically, the Iraq's official selling price is quoted as a discount to dated Brent for oil shipped to European markets, as a discount to West Texas Intermediate for shipments to the US, and as a discount to an average of Oman and Dubai for exports to Asia.

[43] Available from http://www.un.org/Depts/oip .

[44] We purchased this data from Platts. There are no price data is 1995 and 1996, because no trading took place. The data from the UN match reasonably well the properly weighted data from Platts for the years when both sources are available (mid 1998-2002).

[45] The technical characteristics of Basrah Light and Arab Light are very similar. The two crude oils have identical weights (at 33 percent API), while Arab Light has a slightly lower sulfur content (1.8 percent) than Basrah Light (2 percent.)

[46] For the years 1991-2002, we weekly shipping data from Bloomberg. Unfortunately the Bloomberg series is not available prior to 1991. For the years 1987-1990, we use the monthly series from the annual issues of OPEC's Statistical Bulletin (OPEC). We could not find monthly level data for 1985 and 1986. We impute transportation costs in 1985 and 1986 based on the mean transportation cost observed between 1987 and 1990.

[47] The data from Petroleum Argus is obtained from weekly issues of "Petroleum Argus Weekly Global Markets." We obtained Platts data on spot prices of the Iraqi crudes from OPEC's annual statistical bulletin and weekly issues of the Energy Information Administration's "Weekly Petroleum Status Report." Finally, we purchased data on the spot prices of the two Iraqi oils from ICIS-LOR.

[48] We obtained weekly series on shipping costs from the Persian Gulf to the US Gulf Coast from Bloomberg.

our sources that report Platts' data already adjust the cif price for shipping costs from the Persian Gulf. Unfortunately, no individual source for spot prices covers the entire period. To construct a series for the spot market price of the two Iraqi crude oils over the entire time period, we take the average of the price gaps from the data sources available in each week. We choose a simple average as the most transparent way of combining the three alternative series.

Finally, the website of the UN Oil for Food program reports the weekly quantity of oil sold. Starting in mid-1998, this data is reported separately for exports through Ceyhan (Turkey) and Mina-ak-Bahr (on the Persian Gulf) for most weeks, but there are many weeks in which this breakdown is not provided publicly.

Table 1: Difference Between the Market Price of Close Competitors and the official selling Price of Iraqi Oils

	Arabian Light - Basrah (1)	Arabian Medium - Basrah (2)	Urals - Kirkuk (3)
Model 1: Overall Estimates			
Difference for 1997-2002 - Difference for 1980-1995	2.44**	1.24**	0.69**
	(0.25)	(0.34)	(0.18)
Model 2: Estimates by Period			
Difference for 1997-1999 - Difference for 1980-1995	2.07**	0.84**	0.53**
	(0.18)	(0.24)	(0.15)
Difference for 2000-2001 - Difference for 1980-1995	3.91**	2.67**	1.07**
	(0.41)	(0.61)	(0.40)
Difference for 2002 - Difference for 1980-1995	0.68	-0.40	0.45
	(0.36)	(0.49)	(0.29)
Total Revenue from Underpricing (billion)	6.78	3.75	1.88

Notes: Standard errors in parenthesis. The dependent variable is the difference between the price of the closest competitor and the official selling price of the relevant Iraqi crude oil, in dollars per barrel. The entry in row 1 is the coefficient on a dummy equal 1 for observations during the Oil for Food Program (between the 10th week of 1997 and the last week of 2002). The excluded category includes observations before the Oil for Food Program (between 1980 and 1996). The level of observation is a week. Entries in rows 2 to 4 are from one regression, and are coefficients on dummies equal 1 for observations during the stated period. The error structure is assumed to be autocorrelated up to five lags and heteroskedastic. The entry in the bottom row is obtained by multiplying the amount of the relevant Iraqi oil sold in each week between 1997 and 2002 by the difference between the price difference observed in each week between 1997 and 2002 and the average price difference for the period 1980-1995. (See Equation 3).

Table 2: Difference Between the Market Price of Iraqi Olis and the official selling Price of Iraqi Oils

	Basrah Market Price - Basrah Official Selling Price (1)	Kirkuk Market Price - Kirkuk Official Selling Price (2)
Model 1: Overall Estimates		
Difference for 1997-2002 - Difference for 1980-1995	1.64**	0.29**
	(0.20)	(0.12)
Model 2: Estimates by Period		
Difference for 1997-1999 - Difference for 1980-1995	0.85**	0.33**
	(0.15)	(0.13)
Difference for 2000-2001 - Difference for 1980-1995	2.82**	0.40*
	(0.24)	(0.21)
Difference for 2002 - Difference for 1980-1995	1.46**	-0.03
	(0.22)	(0.21)
Total Revenue from Underpricing (billion)	4.96	1.14

Notes: Standard errors in parenthesis. The dependent variable is the difference between the market price of an Iraqi crude oil and the official selling price of the same Iraqi crude, in dollars per barrel. The entry in row 1 is the coefficient on a dummy equal 1 for observations during the Oil for Food Program (between the 10th week of 1997 and the last week of 2002). The excluded category includes observations before the Oil for Food Program (between 1980 and 1996). The level of observation is a week. Entries in rows 2 to 4 are from one regression, and are coefficients on dummies equal 1 for observations during the stated period. The error structure is assumed to be autocorrelated up to five lags and heteroskedastic. The entry in the bottom row is obtained by multiplying the amount of the relevant Iraqi oil sold in each week between 1997 and 2002 by the difference between the price difference observed in each week between 1997 and 2002 and the average price difference for the period 1980-1995. (See Equation 3).

Table 3: Type of Buyers of Iraqui Oil during the Oil for Food Program, by Year

	1997	1998	1999	2000	2001	2002
Total number of contracts	67	143	80	219	194	361
Average amount per contract	3.69	5.20	4.86	3.26	2.68	1.66
Number of major companies	23	28	14	25	5	14
Number of individual buyers	0	20	31	71	122	195
Number of other buyers	44	95	35	123	67	152
Top 5 countries	Russia	Russia	Russia	Russia	Russia	Russia
	US	France	France	China	Iraq	China
	Turkey	China	China	France	Jordan	Liechtenst.
	France	Italy	Turkey	Turkey	Syria	Syria
	Spain	Turkey	Italy	Vietnam	Switzer.	UAE

Notes: Other buyers include companies that are not in the list of the world top 200 oil companies and government organizations.

Table 4: The Relationship Between Underpricing and the Volatility of World Oil Prices

	Basrah	Kirkuk
	(1)	(2)
Before Retroactive Pricing		
Coeff. on Std. Dev. of Price of Brent	0.916**	0.306**
	(0.094)	(0.084)
After Retroactive Pricing		
Coeff. on Std. Dev. of Price of Brent	0.190	-0.067
	(0.176)	(0.191)

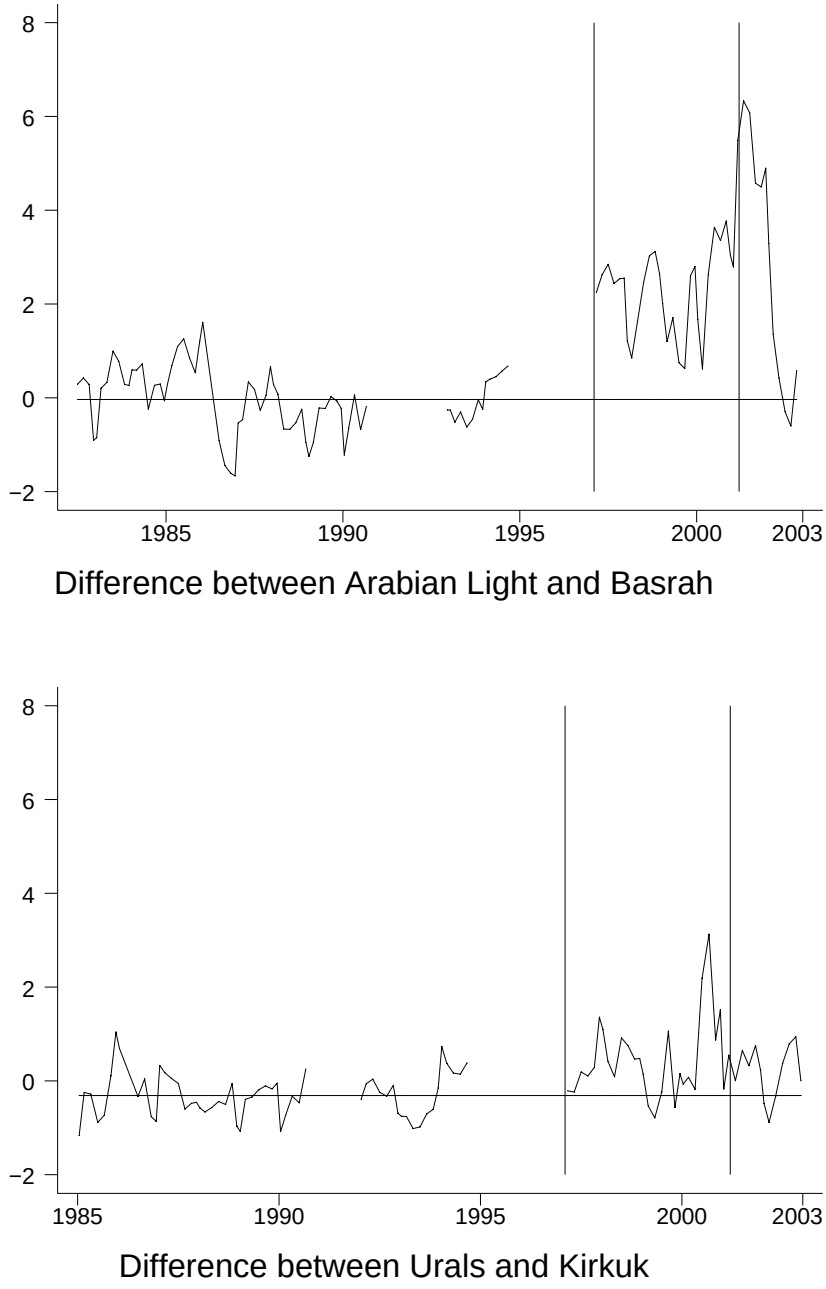
Notes: Standard errors in parenthesis. Each entry is from a separate regression. The dependent variable is the estimated underpricing by week. The independent variable is the standard deviation of the price of Brent in the 10 weeks preceding the relevant week. Estimates in row 1 are based on a sample that includes weeks before the introduction of retroactive pricing (September 2001). Estimates in row 2 are based on a sample that includes weeks after the introduction of retroactive pricing. The error structure is assumed to be autocorrelated up to five lags and heteroskedastic. The unit of measurement for both the dependent and independent variable is dollar per barrel.

Table 5: Estimated Amount of Bribes Obtained by Iraq from Underpricing (Billion of Dollars)

	If All Buyers Pay Bribes ($\gamma = 1$) (1)	If Only Individual Traders Pay Bribes (γ is estimated) (2)
Iraqi Bribes if Buyers Cut is 25%	4.580	2.166
Iraqi Bribes if Buyers Cut is 50%	3.053	1.444
Iraqi Bribes if Buyers Cut is 75%	1.526	0.722

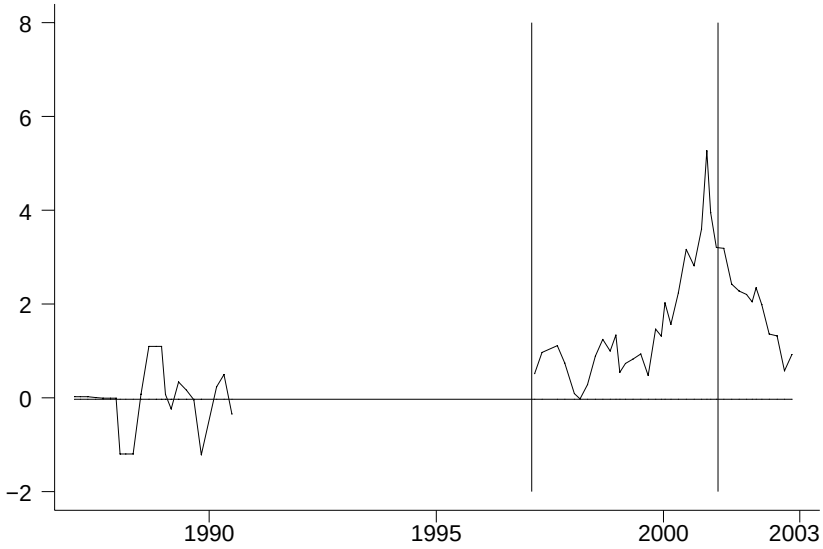
Notes: Entries are obtained by taking the relevant fraction of the product of the amount of the relevant Iraqi oil sold in each week between 1997 and 2002 times the estimated fraction of buyers willing to pay bribes times the difference between the price difference observed in each week between 1997 and 2002 and the average price difference for the period 1980-1995. See equation 4. The price differences used are the ones between the market price of Iraqi oil and the official selling price of Iraqi oil. For example, the first entry in column 1 is obtained by taking 75% of the sum of the two entries in row 2 in Table 2. The second and third entry in column 1 are obtained by taking 50% and 25% of the sum of the two entries in row 2 in Table 2, respectively. Entries in column 2 are obtained by estimating γ as the fraction of buyers that are individual traders in the relevant phase of the Oil for Food Program. The unit of measurement is billions of dollars. See text for details.

Figure 1: Difference Between the Market Price of Close Subsitutes and the Official Selling Price of Iraqi Oils

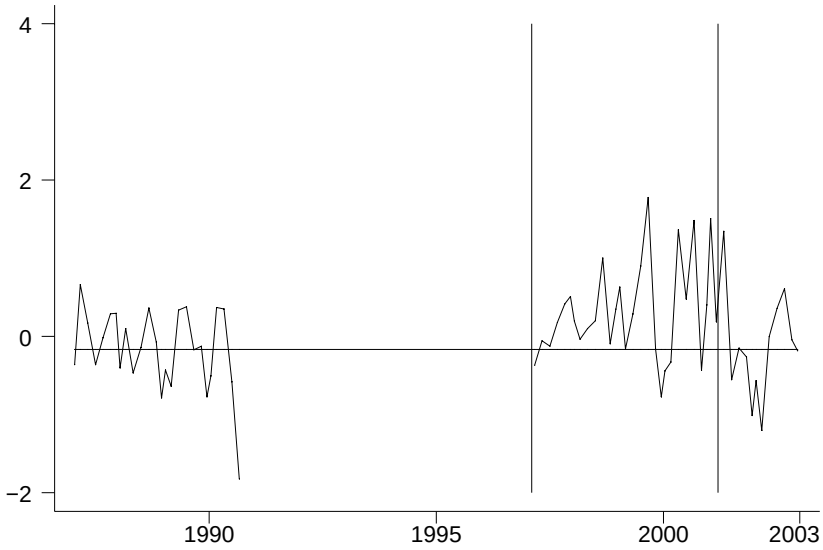


Notes: The top panel shows the difference between the market price of Arabian Light and the official selling price of Basrah. Arabian Light is the closest substitute of Basrah. The bottom panel shows the difference between the market price of Urals and the official selling price of Kirkuk. Urals is the closest substitute of Kirkuk. The first vertical line marks the beginning of the Oil for Food Program. The second vertical line indicates the beginning of retroactive pricing. The horizontal line is the average difference for the years before the Oil for Food Program. Iraqi oil was not traded in 1991-1993 due to the first Gulf War; and in 1995-1997 due to delays in the Oil for Food Program.

Figure 2: Difference Between the Market Price of Iraqi Oils and the Official Selling Price of Iraqi Oils



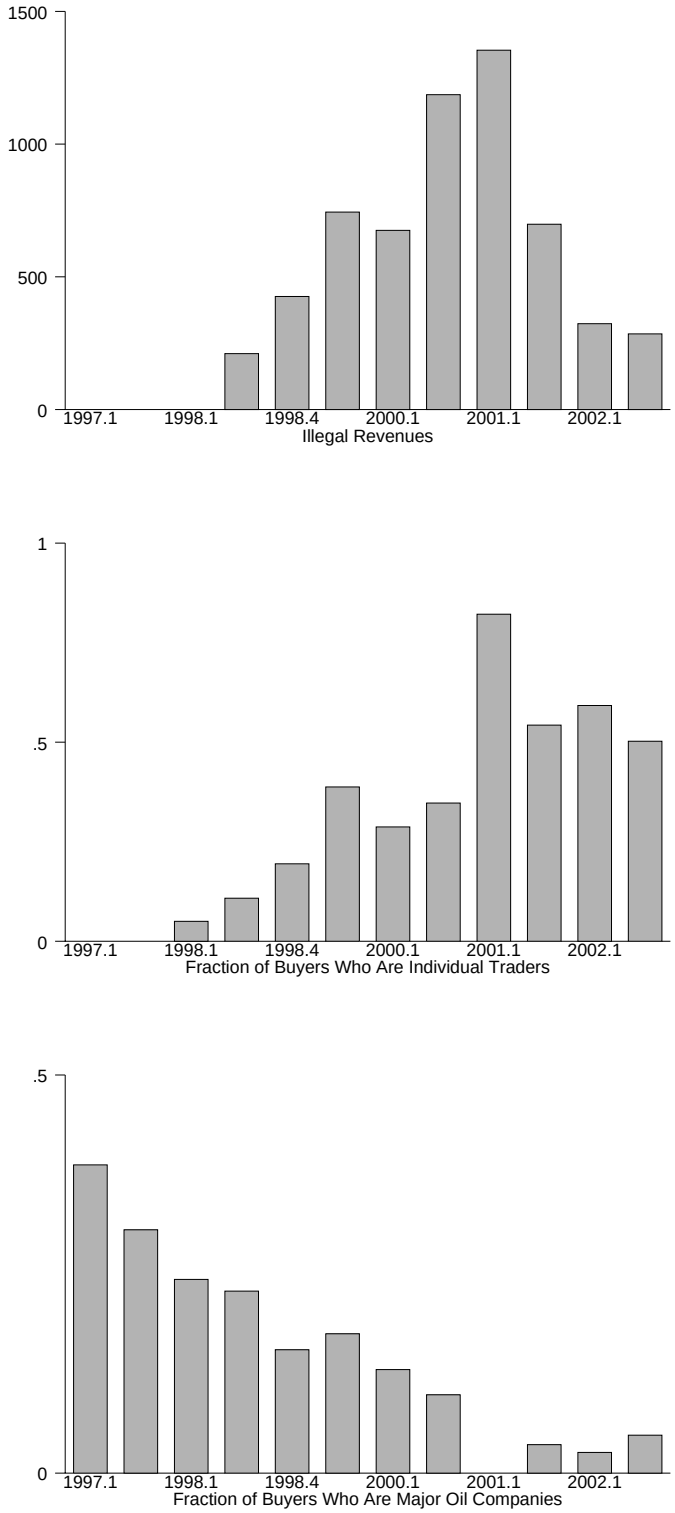
Difference between Basrah Spot and Basrah OSP



Difference between Kirkuk Spot and Kirkuk OSP

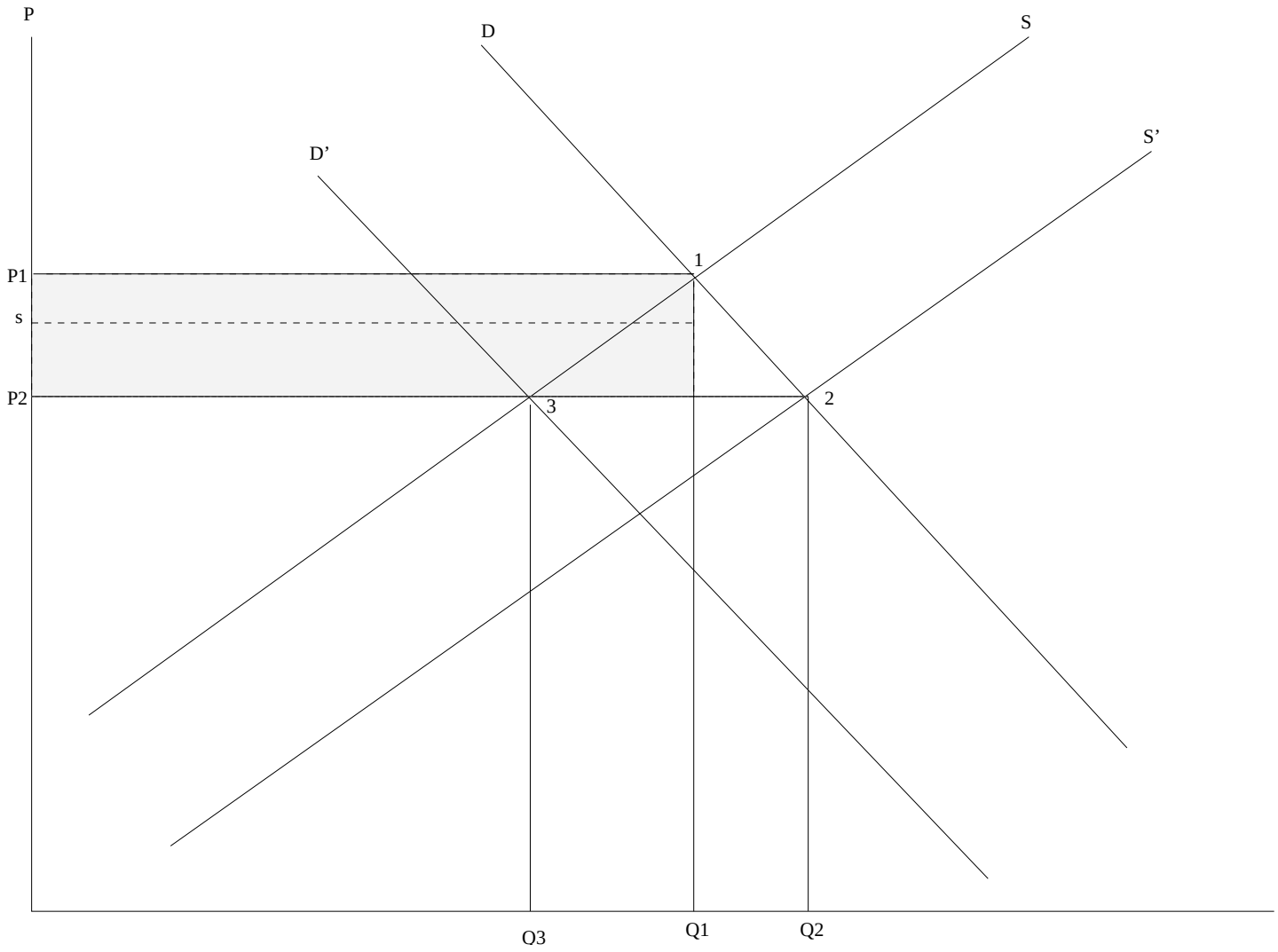
Notes: The top panel shows the difference between the market price of Basrah and the official selling price of Basrah. The bottom panel shows the difference between the market price of Kirkuk and the official selling price of Kirkuk. The first vertical line marks the beginning of the Oil for Food Program. The second vertical line indicates the beginning of retroactive pricing. The horizontal line is the average difference for the years before the Oil for Food Program. Iraqi oil was not traded in 1991-1993 due to the first Gulf War; and in 1995-1997 due to delays in the Oil for Food Program.

Figure 3: The Relationship Between Illegal Revenues and Type of Buyers.



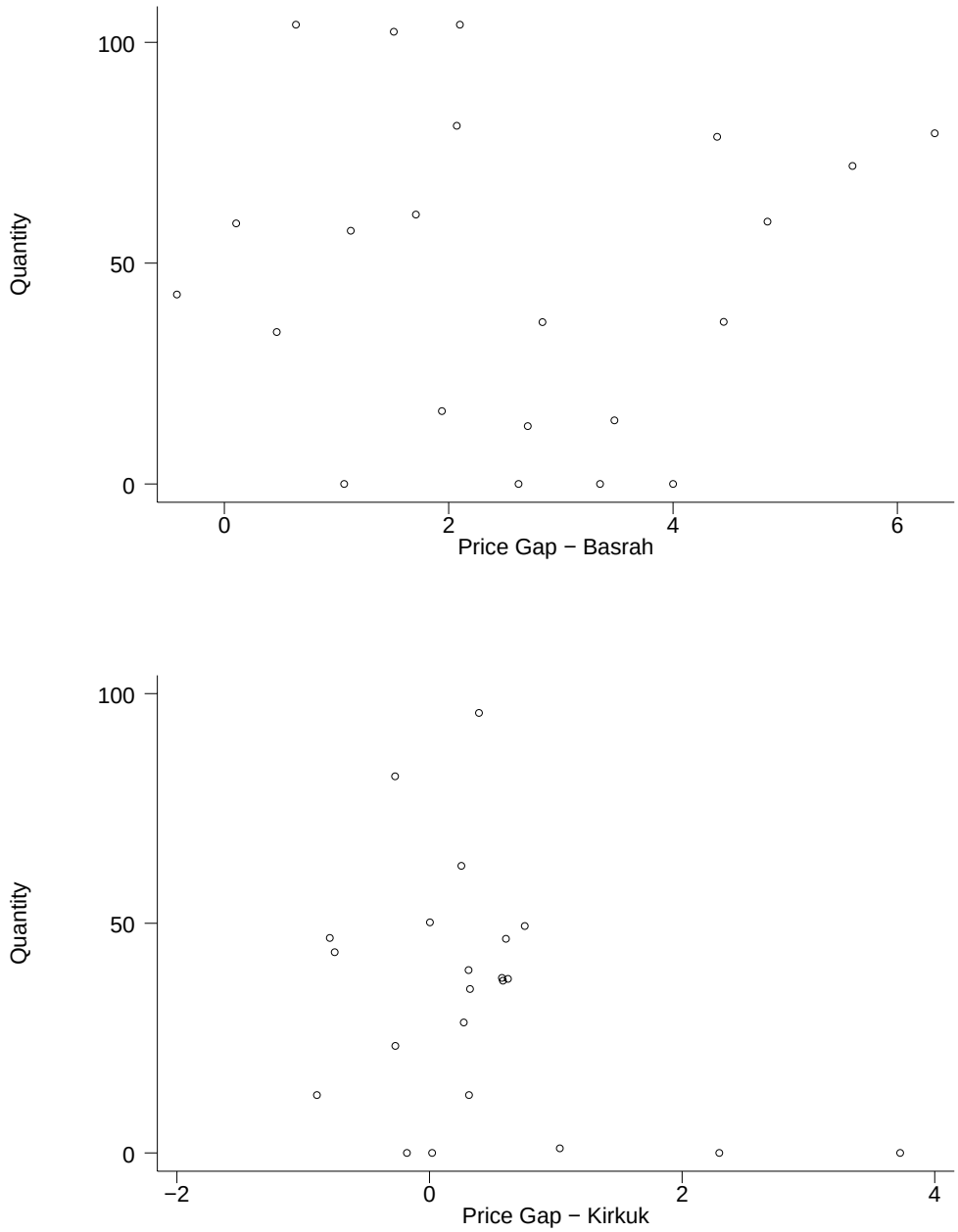
Notes: In the top panel, each bar shows the estimated total amount of illegal revenues, in each period. In the middle panel, each bar shows what fraction of the buyers of Iraqi oil are individuals (as opposed to corporations). In the bottom panel, each bar shows what fraction of buyers of Iraqi oil are one of the 200 major oil companies (as defined by Forbes, 2004). The correlation between the top and the middle panel is .48. The correlation between the top and the bottom panel is -.42.

Figure 4: Three Alternative Explanations for the Decline in the Price of Iraqi Oil.



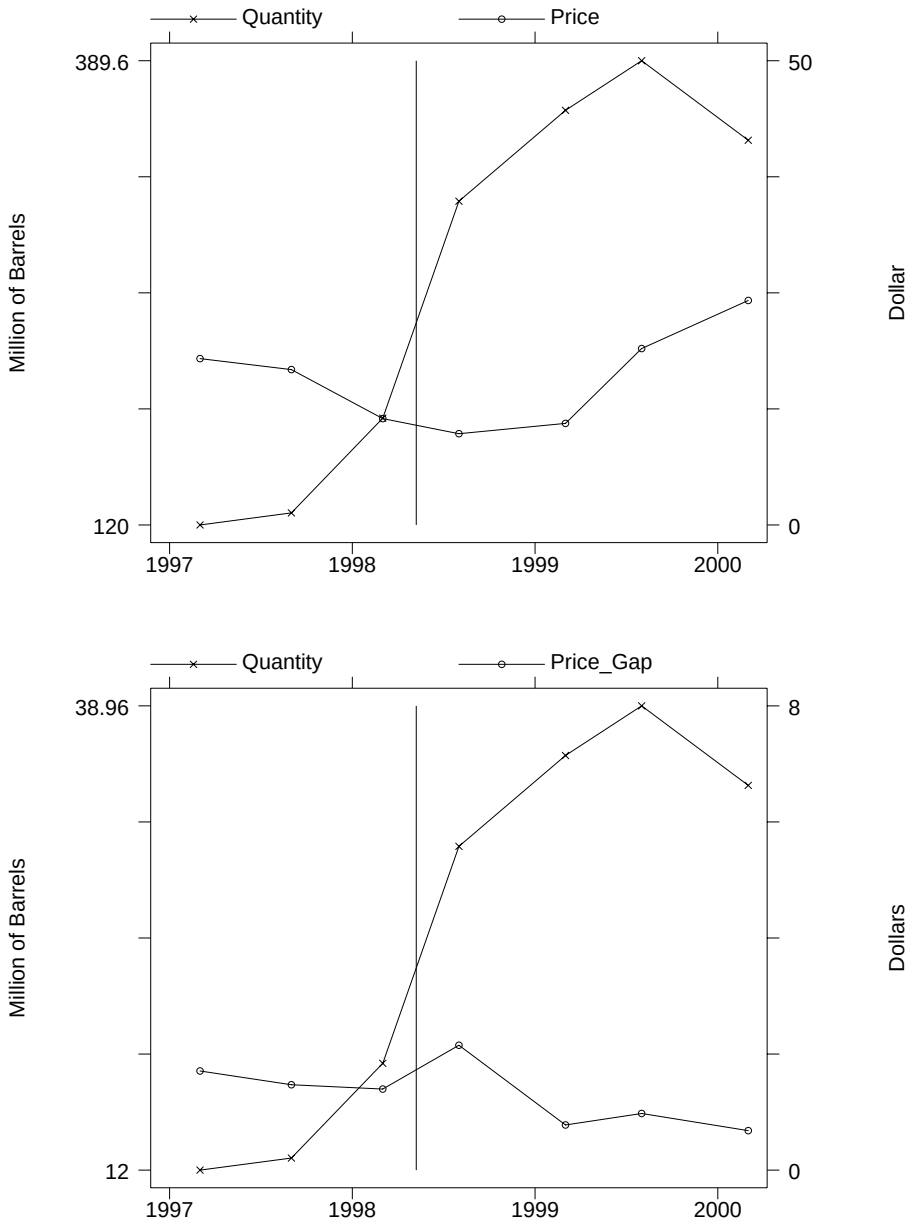
Notes: Point 1 represents the market equilibrium without underpricing and without shocks to the demand or supply. The equilibrium price and quantity are $P1$ and $Q1$. With underpricing, the price paid by the oil trader is $P2$. The trader resells the oil to end users in spot markets at the market price $P1$. Since the underpricing does not affect final price paid by the end users of Iraqi oil, there is no change in the equilibrium quantity of Iraqi oil, $Q1$. The shaded area is the total amount of illegal rents (the quantity I in equation 3). These rents are presumably split between Iraq and the traders. (The point s defines the split.) Point 2 represent an alternative scenario where no underpricing takes place, and the price drop from $P1$ to $P2$ is caused by an increase in supply (the supply curve shifts from S to S'). Point 3 represent the case where there is no underpricing, and the price drop is caused by a decrease in demand (the demand curve shifts from from D to D').

Figure 5: Quantity of Iraqi Oil Sold and Underpricing of Iraqi Oil



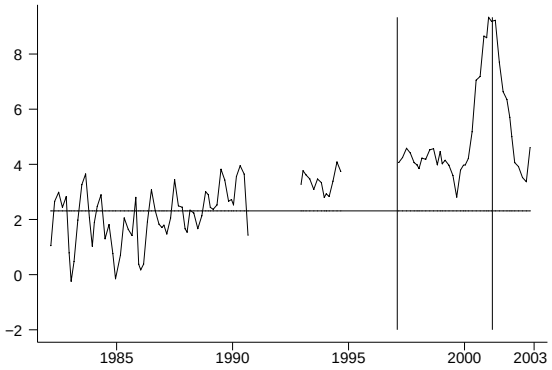
Notes: The top figure shows the quantity of Basrah oil sold and the difference between the market price of its closest competitor, Arabian Light, and the official selling price of Basrah. A larger price difference means a larger underpricing of Basrah. A regression of quantity sold on the price gap yields a coefficient (std error) of -2.17 (.4.00). The bottom figure shows the quantity of Kirkuk oil sold and the difference between the market price of its closest competitor, Urals , and the official selling price of Kirkuk. A larger price difference means a larger underpricing of Kirkuk. A regression of quantity sold on the price gap yields a coefficient (std error) of -8.61 (4.34).

Figure 6: Quantity of Iraqi Oil Sold and Price of Iraqi Oil

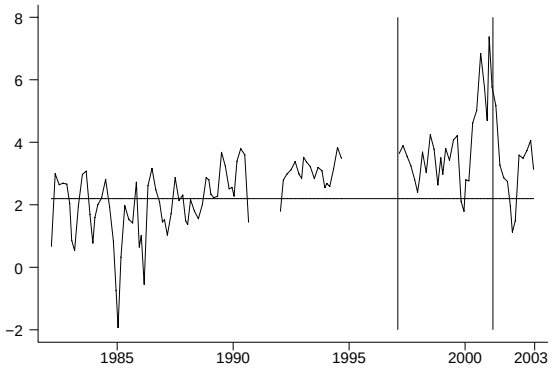


Notes: The top figure shows the total quantity of Iraqi Oil sold (Basrah + Kirkuk) and the average price, by phase of the Oil for Food Program. The vertical line denotes an exogenous change in quantity sold between pahse 3 and phase 4. Starting in phase 4 of the program (beginning on May 30, 1998), the cap on Iraq's exports of oil was doubled from $1 billion every 3 months to $5.2 billion every six months. Seprate figures on the quantity of Basrah and Kirkuk traded are not available until mid-1998. The bottom figure shows the total quantity of Iraqi Oil sold and the average price difference between Iraqi oil and its closest competitors, by phase of the Oil for Food Program. The price difference is the difference between a weighted average of the price of Arabian Light and Urals minus the price of Iraqi oil, with weights reflecting the average share of production of Basrah and Kirkuk in the period where separate information on the quantity sold of Basrah and Kirkuk is separately available.

Appendix Figure A1: Difference Between The Market Price of International Benchmark Oils and the Official Selling Price of Iraqi Oils

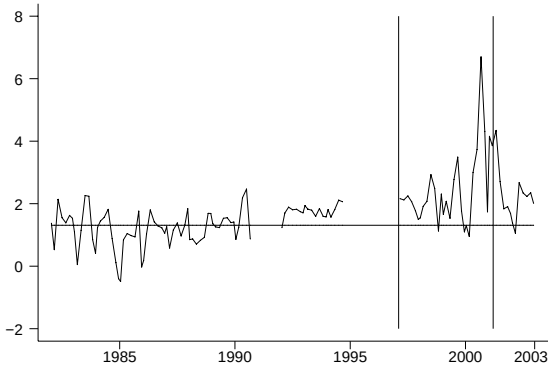


Difference between Wti and Basrah



Difference between Wti and Kirkuk

Difference between Brent and Basrah



Difference between Brent and Kirkuk

Notes: The 2 top graphs show the difference between the market price of West Texas Intermediate and the official selling price of Iraqi oils. The bottom 2 graphs show the difference between the market price of Brent and the official selling price of Iraqi oils. The first vertical line marks the beginning of the Oil for Food Program. The second vertical line indicates the beginning of retroactive pricing. The horizontal line is the average difference for the years before the Oil for Food Program. Iraqi oil was not traded in 1991-1993 due to the first Gulf War; and in 1995-1997 due to delays in the Oil for Food Program.