Essays in Oil, Conflict, and the Development of Resource-Rich Countries

by

Jennifer Randolph Peck

Submitted to the Department of Economics
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

September 2013

Author . . . .
Department of Economics
August 9, 2013

Certified by . . . .
Michael Greenstone
3M Professor of Environmental Economics
Thesis Supervisor

Certified by . . . .
Esther Duflo
Abdul Latif Jameel Professor of Poverty Alleviation and Development Economics
Thesis Supervisor

Accepted by . . . .
Michael Greenstone
3M Professor of Environmental Economics
Chairman, Department Committee on Graduate Theses

Essays in Oil, Conflict, and the Development of Resource-Rich Countries

by

Jennifer Randolph Peck

Submitted to the Department of Economics
on August 9, 2013, in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

Abstract

This thesis examines three topics in the political economy of global oil markets and the development of resource-rich countries. The first chapter examines the effect of Saudi Arabia's crude pricing policies on the political behavior of U.S. firms. Between 1991 and 2003, Saudi Aramco sold its crude to U.S. refineries at a substantial discount relative to Asian refineries at a total cost of approximately 8.5 billion dollars. Using variation in discount receipts across refineries over time, I find that the discount rents were entirely captured by refiners as profits and were not passed through to consumers in the form of lower retail gasoline prices. There is also evidence that the discount policy affected refiners' political action. In particular, I find that discount receipts are associated with an increase in refiners' overall political donations, and that other types of profit shocks were not associated with changes in political giving. This suggests that the effect of the discount was not simply a consequence of the increase in refining profits. Finally, I show that the discount resulted in a reallocation of contributions toward members of congressional committees that reviewed bills of interest to Saudi Arabia and away from those who received donations from pro-Israel interest groups.

In the second chapter, I assess the impact of a nationalization quota policy in Saudi Arabia on workers and private-sector firms. In the past two years, Saudi Arabia has dramatically extended its active labor market policies in order to address the issue of growing youth unemployment and low Saudi participation in the private sector workforce. This paper studies the 2011 introduction of the Nitaqat program, which imposed a quota system for Saudi hiring at private firms. The analysis uses a unique dataset from the Saudi Ministry of Labor on the full universe of Saudi private-sector firms and exploits kinks in firm incentives generated by the program to examine the effects of this quota policy on nationalization, firm size, and firm exit. I complement the regression kink results with a differences-in-differences approach to estimate the overall effects of the program. The analysis finds that the program succeeded in increasing native employment but also had significant negative effects on firms. Program compliance rates were high, with firms increasing their Saudization rate by 0.2 percentage points on average for every percentage point increase required by the quota. Quota compliance was primarily accomplished by hiring Saudis, and Nitaqat was responsible for the addition of an estimated 52,000 Saudi workers to the private sector workforce over the 16 month period. There were also significant costs, however, and the program caused approximately 11,000 firms to shut down, raising exit rates by nearly 50%. Among surviving firms, the program decreased total employment by 198,000 workers.

The third chapter investigates the direct effect of conflict-related supply disruptions on the downstream U.S. oil industry. The security of petroleum supplies is a major issue in U.S. domestic and foreign policy. Although conflict in oil-exporting countries affects the entire global downstream industry, supply disruptions may also have an additional effect on refiners who are dependent on these crude streams. This study uses variation in the sources of oil supplies across refineries to estimate the effect of conflict-related supply disruptions on refiner profits and local retail gasoline prices. The analysis shows that while conflicts do cause supply interruptions, these shortfalls have little effect on the refiners and markets exposed to these disruptions. On average, then, refineries appear to adjust quickly to unexpected changes in their supplies without significant increases in their input costs.

Thesis Supervisor: Michael Greenstone
Title: 3M Professor of Environmental Economics

Thesis Supervisor: Esther Duflo
Title: Abdul Latif Jameel Professor of Poverty Alleviation and Development Economics

Acknowledgments

I am extremely grateful to Michael Greenstone and Esther Duflo for their extensive advice and support throughout the preparation of this dissertation. My sincere thanks also to David Autor and Christopher Knittel for their detailed feedback on these projects. I also thank Eliza Forsythe, Anil Jain, Horacio Larreguy, Jessica Leight, Laura Ralston, Joseph Shapiro, Sarah Venables and Xiao Yu Wang for their valuable comments and suggestions as well as their help and encouragement. This work also benefited greatly from the comments of seminar participants at the MIT Public Finance and Labor Lunches as well as the MIT Labor/PF seminar.

The work for the second chapter of this thesis was undertaken as part of the Labor Market Decision Support System at the Center for Complex Engineering Systems at MIT and the King Abdulaziz City for Science and Technology. I am extremely grateful to thc LMDSS team and to Ahmed Fadol of the Ministry of Labor of the Kingdom of Saudi Arabia for their considerable assistance with this project.

Financial support for these projects was also provided by the George and Obie Shultz Fund and the Center for International Studies at MIT.

I also thank my husband, Philip Gressman, for his unwavering support and encouragement throughout this process.

Contents

List of Figures

List of Tables

Chapter 1

Do Foreign Gifts Buy Corporate Political Action? Evidence from the Saudi Crude Discount Program

1.1 Introduction

Political and economic concerns are fundamentally linked in the world petroleum market. Access to a dependable oil supply is critical to economic and political stability, and these supplies are very dependent on local political climates. Oil is used as a political tool by suppliers, and is a frequent topic of diplomatic intervention. At the center of this is Saudi Aramco, the world's largest single producer of crude oil and holder of 25 percent of global reserves. Because of its position as a global swing producer, the economic and political drivers of its output decisions attract a great deal of attention.

In addition to deciding how much to produce, however, Saudi Arabia also decides where to sell its crude, a decision which receives much less attention but which is perhaps no less strategic. From 1991 to 2003, Saudi Arabia maintained a position as the top supplier of foreign crude to U.S. refiners in order to support its political alliance with the United States. Although oil is often thought of as having one world price, Saudi Aramco supported this export strategy by selling the same crude at different prices in different geographic markets. Maintaining the pricing differentials

I am extremely grateful to Michael Greenstone and Esther Duflo for their extensive feedback on this project. I also thank Christopher Knittel, James Poterba, Jessica Leight, Laura Ralston, Horacio Larreguy, Joseph Shapiro and Eliza Forsythe as well as seminar participants at MIT for their insightful questions and comments. The George and Obie Shultz fund provided financial support to acquire the data for this project.

required by its export targets appears to have been both politically strategic and quite expensive: between 1991 and 2003, Saudi Arabia spent approximately 8.5 billion dollars selling discounted crude to the United States. The per-barrel discount relative to the Asian price reached a high of 6.30 dollars, 30 percent of the U.S. crude price in 2001, and was worth 1.9 billion dollars that year alone. In achieving its export target, Saudi Arabia therefore transferred substantial rents to the U.S. oil industry in the form of discounted crude supplies. In addition to determining the total value of this transfer through its export quotas and pricing policies, Saudi Arabia also controlled how these rents were distributed within the United States; discounted crude was targeted at specific refineries using highly restrictive sales contracts.

Despite the magnitude of this transfer, the Saudi crude discount program has received almost no attention in the academic literature or in the popular press.[1] The first task of this paper is to document both the size of these rents and identify the refiners that received this gift. This paper then evaluates the success of this allocation mechanism as a political tool by identifying where rents accrued as a result of the policy and how these rents affected political action by discount recipients. To do this, I first determine where rents were captured by estimating the effect of discounts on refinery-owner profits and local gasoline prices. I then examine the effect of discount receipts on one particular type of measurable corporate political action: contributions to congressional campaigns. The analysis follows the money from the original oil shipment to the campaign funds of federal politicians.

The empirical analysis relies on several key features of the market for Saudi crude in the United States. All U.S. refiners pay the same official per-barrel price for Saudi crude each month, but quantities differ both across refineries and within a single refinery from month to month. These quantities are based on long-term contracts, but are subject to unilateral changes by Saudi Aramco each month. This yields variation in the total value of the discount to each refinery, which in turn creates variation in discount receipts across refining companies and in the geographical distribution of discounted crude. Because of this, it is therefore possible to estimate the effect of the discount on company-level outcomes (profits and political contributions) and market-level prices for refined products.

There are several key results. First, I find that there was a great deal of heterogeneity in the value of the discount received by different companies and significant geographical dispersion

[1] Despite considerable attention to Saudi Arabia's petroleum production and exports, *The Quest* – Daniel Yergin's history of the world energy market post 1991 – never mentions this program.

in the destination of Saudi crude. Despite their similar refining capacities, for example, refiners Marathon and Tosco received very different amounts of Saudi crude: a total of 680 million barrels were delivered to Marathon's refineries, and just 20 million to Tosco refineries over the period. The amount received also varied considerably from year to year; in just two years, Marathon's crude receipts increased from 41 million barrels in 1997 to 75 million barrels in 1998 and then fell to 62 million barrels in 1999. Similar variation is found across refineries and within a single refinery over time; Chevron's Richmond refinery near Oakland received 118 million barrels of Saudi crude over the period, with annual receipts varying by as much as 24 million barrels from year to year. The nearby (and similarly-sized) refinery in Martinez, which was owned by Shell for most of the period, processed no Saudi crude.

This variation allows for an estimation of the impact of discount receipts both on refiner profits and gasoline prices in local markets. Correspondingly, the second result is that most of the discount rents were captured by refinery owners as profits rather than passed through to consumers as lower gasoline prices. This is to be expected given that the discount was targeted only at certain refineries, so the effect on market-level costs tended to be infra-marginal. The capture of rents appears to have been almost complete, supporting the idea that the discount was purposefully targeted at specific refiners. Finally, I find that discount receipts affected refining company political contributions, with recipients targeting more of their financial support to politicians on committees that considered bills of interest to Saudi Arabia. I also find that funds tended to be diverted away from congressmen who received donations from pro-Israel interest groups.

The results described above tie together several different areas of study. First, although the Asian price premium (or, U.S. discount) for Saudi crude has attracted occasional comment in the trade press on petroleum markets, it has received very little attention in the academic energy literature. Exceptions are several papers that have attempted to explain the premium in terms of models of price discrimination[2] or regulatory distortions[3]. Other papers have discussed strategies for Asian consuming nations to reduce or eliminate the premium through regulatory reform (Ogawa 2003) or by improving pipeline infrastructure (Jaffe & Soligo 2004).

This paper also provides evidence on the incidence of non-marginal cost changes in the oil

[2] Soligo & Jaffe (2000) model Saudi Aramco's pricing decision as that of a dominant firm operating in two fully separated markets and assert that Asian/European price ratio is consistent with reasonable values of supply and demand elasticities and Saudi market shares. In a response, Parsons & Brown (2003) propose an alternative model of international oil markets as a Cournot duopoly, with Gulf OPEC producers competing in both markets with local suppliers.

[3] Horsnell (1997) argues that government involvement in Asian procurement has been at least partially responsible for the higher prices Asian firms pay for oil.

refining industry. Borenstein & Kellogg (2012) examine the effect of a similar change in average input costs caused by the oil glut in the U.S. Midwest beginning in early 2011. As in this paper, they find that the relative decrease in local crude oil prices did not pass through into wholesale gasoline and diesel prices, and conclude that refiners must have received the rents generated by the crude price shock. This paper complements their analysis by examining a setting with richer variation in cost changes and showing that not only was the cost decrease not passed through into prices, but that it was instead captured by refiners as profits rather than by retailers or other market intermediaries.

In addition to documenting the existence and incidence of the discount, this paper also adds a quantitative dimension to the literature on the political economy of global energy markets. As far as I know, this paper is the first to provide empirical evidence for the use of Saudi oil not only directly as a tool of political leverage, but through transfers to American companies. The political motivations behind Saudi supply patterns have been previously examined from a historical perspective, notably by Moran (1981) and more recently in a comprehensive history by Jaffe & Elass (2007). Moran (1981) argues that OPEC behavior is best understood by looking at the political motivations of Saudi Arabia between 1973 and 1980. In an unpublished working paper, Jaffe & Elass (2007) similarly argue that Saudi Aramco's strategies and aims have been often designed to meet the kingdom's foreign policy goals; they outline the kingdom's policy of maintaining a position as the top global supplier of crude to the United States beginning in 1990, and provide a historical survey that follows the eroding relationship between the two countries and subsequent policy reversal in 2003.

The rest of the paper proceeds as follows. Section 2 gives some background on U.S.-Saudi relations, and Section 3 describes the history of the discount policy and how Saudi Aramco targeted the discount rents. Section 4 provides evidence on who captured the discount rents, and Section 5 discusses how discount receipts affected political action by U.S. oil refiners. Section 6 concludes.

1.2 Background: U.S.-Saudi Relations

1.2.1 Aramco Before Nationalization

Although the discount policy did not begin until 1990, the defense of Saudi political interests by American oil companies began in the 1930s with the simultaneous foundation of Saudi Arabia and its oil concession to an American oil company. What followed over the next sixty years was the evolution of a complex web of political and economic connections between the Saudi government, a consortium of American oil companies, and the U.S. government. Throughout this period, the Saudi government used its oil to try to influence U.S. foreign policy, with U.S. oil companies acting as both its willing conduits and active partners.

The Kingdom of Saudi Arabia was founded by King Abdul-Aziz Ibn Saud in September of 1932, four months after Standard Oil of California (SoCal, now Chevron) discovered oil in Bahrain. The United States recognized the new country in 1933, the same year that the King granted SoCal an exclusive sixty-six year concession for oil exploration and production in the al-Ahsa region (FTC 1952). The King hoped that this concession to the geographically distant United States would protect the kingdom from the more immediate interference of the British (Jaffe & Elass 2007). In 1936, SoCal joined with Texaco to form the California-Arabian Standard Oil Company (Casoc), which first struck oil at Dammam Well No. 7 in 1938. Impressed by the discovery, the king extended Casoc's original concession to cover a 440,000 square mile area of Saudi Arabia (Sampson 1975, 109). This discovery also prompted President Roosevelt to charge the Secretary of State with protecting U.S. interests in the Saudi oil concession (Jaffe & Elass 2007). Following the subsequent discovery of three more major oil fields, the company was renamed Aramco (the Arabian-American Oil Company) in 1944.

The consortium of American partners expanded following the Second World War, with what later became Mobil and Exxon buying in to the partnership. The kingdom also began to take a more active role in the company, with Saudi representatives joining the newly-formed Executive Committee in 1950. To bolster its alliance with Saudi Arabia and to protect the company against nationalization pressures, the U.S. government arranged a deal in December 1950 to give 50 percent of Aramco's profits to the kingdom as a "tax", which was deducted from the taxes owed by the consortium companies to the U.S. government (Yergin 1991, 447). This was the first in a series of moves by the U.S. government to use Aramco as a channel of influence between the two countries.

By the Arab-Israeli wars of the 1960s and 1970s, the company had become both a source of leverage for the United States as well as a representative of Saudi foreign policy toward the U.S. In 1967, oil minister Sheikh Yamani warned the U.S. government of the "consequences" of giving aid or support to Israel, sending his message through Aramco for emphasis (Brown 1999, 268). Another account quotes Yamani as saying that "if the United States directly supports Israel, Aramco can anticipate being nationalized 'if not today, then tomorrow.' If the U.S. does not stay out of this conflict, the U.S. is finished in the Middle East" (*Foreign Relations of the United States*, 1967).

The company managed to resist full nationalization over the next few decades, with the country instead opting to slowly increase its profit share and replace American managers with Saudi personnel. As Saudi influence over the company grew and the political situation in the Middle East deteriorated, the American consortium began to feel increasing tension between the interests of the Saudi and U.S. governments. Following the outbreak of the Yom Kippur War, Aramco's American partners advocated for the Saudi political agenda. In May of 1973, the directors of Exxon, Mobil, Texaco and SoCal called on their contacts at the State Department, the Pentagon and the White House to urge the government to support the Saudi position in the Arab-Israeli hostilities (Sampson 1975, 292-293). On June 21, 1973, Mobil published an "advertorial" in the New York Times calling on the U.S. government to join with the Soviet Union in insisting on a peace agreement in the Middle East. The article argued that continued American prosperity depended on U.S. support of Saudi interests in the Middle East, and warned that "political considerations may become the critical element in Saudi Arabia's decisions, because we need the oil more than Saudi Arabia will need the money" (*New York Times*, 1973). Oil minister Yamani later wrote to Mobil's president praising the ad and calling it a "positive step".[4] That July, SoCal's chairman sent out his own letter to the company's employees and shareholders asking them to pressure their representatives to "acknowledge the legitimate interests of all the peoples of the Middle East" and encourage Washington to improve relations with Arab governments (Sampson 1975, 294). On October 12, six days after the start of the Yom Kippur War, the chairmen of Exxon, Texaco, Mobil and SoCal sent a joint memo to President Nixon's chief of staff warning that U.S. aid to Israeli forces would result in "a critical and adverse effect on our relations with the moderate Arab producing countries" and the loss of American influence in the region "to the detriment of both our economy and our security" (Sampson 1975, 300). Indeed, the oil embargo began five days later on October 17th, and Aramco was compelled to enforce the Saudi boycott of oil sales to the United States and other Israeli supporters to maintain its concession.

In 1981, American oil companies again inserted themselves in the middle of Saudi-U.S. diplomacy concerns preceding the controversial sale of the AWACS (Airborne Warning and Control

[4]In an extremely bizarre incident, Mobil Oil took out another full-page ad in the New York Times on May 8, 1980 regarding a documentary called "Death of a Princess" that was set to air on PBS two days later. The film told the story of a young Saudi princess who had been publicly executed for committing adultery. It was considered extremely unflattering by the Saudi regime, and Mobil (which was one of the major supporters of PBS) called on the network to cancel the broadcast. The last line of the article read:

"We hope that the management of the Public Broadcasting Service will review its decision to run this film and exercise responsible judgment in the light of what is in the best interest of the United States." (*New York Times*, 1980).

System) surveillance planes, which was proposed by the Reagan administration.[5] Once again, the oil industry launched an extensive political campaign in support of Saudi Arabia. Mobil in particular spent more than half a million dollars on full-page advertorials in the New York Times, again emphasizing the importance of the economic partnership between Saudi Arabia and the United States. Mobil's president also personally called Arkansas senator David Pryor to lobby for the sale (Bard 2010). Congress eventually approved the landmark sale, despite strong opposition from American voters, the State of Israel, and the Israel lobby.

In the meantime, Aramco's ownership had been slowly transferred to the Saudi government, with Saudi Arabia completing its purchase of Aramco's assets by the end of 1980. American interests continued to manage the company, however, and the final paperwork for full nationalization was not signed until 1990 (Yergin 1991, 652). During this time, a precursor to the discount scheme resulted in Yamani's termination as oil minister. In 1986, Yamani had been charged by the king to both increase Saudi production and increase the worldwide oil price. Yamani thought this was impossible, and instead offered some customers a secret 50 cent-per-barrel discount on their contract price to try to meet the production quotas. The discount caused overall oil prices to fall and spurred tensions with other OPEC members, and the King relieved the previously highly successful oil minister of his post. This action announced the King's intention to control oil policy more directly rather than working through OPEC (*New York Times* 1986, *PIW* 1986, *Financial Times* 1986, Adelman 1995, Jaffe & Elass 2007).

After nearly sixty years of Saudi-U.S. partnership, control of Aramco passed fully to the Saudi government in 1990. Even without its American partners, the newly-independent Saudi Aramco would continue in its role as a critical conduit for diplomatic relations between Saudi Arabia and the United States.

1.2.2 Diplomacy After Nationalization: "Oil for Security"

Just as the American-owned Aramco served as an intermediary for American and Saudi interests through the 1980s, Saudi Aramco has continued to work to achieve the kingdom's foreign policy goals since nationalization. While the company's core mission is to maximize oil profits, this goal is often superseded by the government's foreign policy agenda. The most significant examples of this are the use of Saudi Arabia's considerable excess production capacity to stabilize U.S. oil supplies

[5] James Atkins, former Ambassador to Saudi Arabia, predicted that Saudi Aramco would keep the crude price at 32 dollars if the AWACS sale was allowed to proceed (Adelman 1993).

and the U.S. export quota policy.

Saudi Aramco has used its excess capacity at key moments to serve U.S. economic interests during oil supply emergencies. The first such incident occurred just after full nationalization in 1990, when Iraqi forces invaded Kuwait at the start of the first Gulf War. As promised, American forces were immediately deployed to Saudi Arabia, and President Bush sent a letter to King Fahd requesting that the kingdom immediately increase production in order to replace lost U.S. crude supplies from Iraq and Kuwait. The King agreed, and within three months the company had raised production by 2 million barrels per day (bpd) to 7.3 million bpd. The oil price, which had surged to 40 dollars per barrel on the news of the invasion and UN boycott, fell immediately back to pre-invasion levels (Jaffe & Elass 2007). Another notable instance of this strategic export expansion occurred in 2002, when Saudi Aramco pledged to replace U.S. supplies lost during the Venezuelan oil strike. In return for this type of strategic assistance, the United States provided the Saudis with domestic intelligence, protection against external threats, and advanced weaponry. The American commitment to protect the Gulf states was first explicitly stated in 1980[6] and later reiterated by President Reagan, who specifically articulated a commitment to intervene to protect Saudi Arabia in particular. This commitment was borne out most clearly at the beginning of the Gulf War, when American forces arrived in Saudi Arabia less than two weeks after the invasion of Kuwait.

The United States is also by far the main supplier of military equipment to Saudi Arabia, with U.S. supplies accounting for 66.4 percent of Saudi arms imports between 1990 and 2010 (SIPRI, 2011). In 1990, President Bush waived a number of congressional bans to proceed with a multi-billion dollar arms sale to Saudi Arabia that included F-15s, Stinger and Patriot missiles and launchers, M60A3 and Abrams tanks, Apache and Blackhawk helicopters and other equipment (SIPRI, 2011). The size of these arms deals continued to increase throughout the 1990s under both the Bush and Clinton administrations (Figure 1-1).

1.2.3 Saudi Interests in the Middle East Peace Process

In addition to security and weapons, Saudi Arabia's other main diplomatic concern has been American engagement in the Israeli-Palestinian peace process. Saudi Arabia has long supported Palestinian claims to sovereignty, and has used its economic and diplomatic relationship with the

[6] "Let our position be absolutely clear: An attempt by any outside force to gain control of the Persian Gulf region will be regarded as an assault on the vital interests of the United States of America, and such an assault will be repelled by any means necessary, including military force."
President Jimmy Carter, *State of the Union Address*, 1980.

United States to pursue this agenda. Indeed, the most overt use of Saudi oil as a political weapon occurred before 1990, with the threatened expropriation of Aramco in 1967 and the oil embargo of 1973, both of which occurred in response to American support of Israeli military actions. Since then, Saudi advocacy has focused mostly on U.S. diplomacy toward Israel.

There have been several notable instances where the Saudi regime has put diplomatic pressure on the United States to intervene in the Arab-Israeli conflict. Following the surge in violence that followed the failure of the 2000 Camp David summit, Crown Prince Abdullah reportedly refused an invitation to visit Washington in June 2001 to indicate Saudi displeasure over insufficient U.S. efforts to prevent Israeli military action against Palestinians (*New York Times*, 2001a). Later that year (and less than two months after the September 11th attacks), the Saudi Foreign Minister declared that the Saudi government was "angrily frustrated" with the Bush administration's failure to engage with the Palestinian leadership in the peace process (*New York Times*, 2001b). Crown Prince Abdullah subsequently proposed a new Saudi-backed peace plan, which was adopted by the Arab League in 2002. Despite repeated diplomatic pressure from Saudi Arabia, however, the United States failed to pressure Israel to accept the plan and U.S.-Saudi relations continued to deteriorate. As described in the next section, this deterioration in diplomatic relations coincided with the abandonment of the discount policy.

1.3 The Discount Policy

1.3.1 History

The discount policy began in 1990 as a politically-motivated export quota policy. Following Aramco's full nationalization and transition to Saudi control, King Fahd directed the company to maintain a position as the top supplier of foreign crude to the United States (Jaffe & Elass 2007). The stated purpose of this policy was to cement Saudi Arabia's strategic alliance with the United States by making itself critical to U.S. energy security. Achieving the quota on a month-to-month basis was initially quite straightforward; Aramco supplied as much as a third of total U.S. imports in the early 1990s while keeping the U.S. price for Saudi crude roughly the same as the world price. By the end of the decade, however, increasing competition from Mexico, Venezuela and Canada forced Aramco to cut its U.S. prices to defend its market share (Figure 1-2). The discount reached a high of $6.30 per barrel in 2001, 30 percent of the U.S. selling price at the time (Figure 1-3). The total value of the discount over the policy period from 1991-2003 was 8.5 billion dollars.

As the discount became larger, the Saudi government faced increasing pressure from Aramco to abandon the expensive quota policy.[7] Faced with a string of political disappointments at the beginning of the 2000s, the Saudi government also began to question the benefits of a close alliance with the United States.[8] Saudi Arabia also began to feel the political strain of its relationship with the United States. Although Saudi Arabia declined to participate in Operation Iraqi Freedom in 2003 (and voiced its disapproval of American intervention in Iraq), it became a target of a string of Al Qaeda attacks in the aftermath of the war. Tensions again worsened after the report on the 9/11 terrorist attacks described alleged Saudi links with the hijackers and funding sources from within the Saudi government. At the same time, Saudi pressure for the United States to intervene in the escalating Arab-Israeli conflict went unheeded, and President Bush declined to intervene with Israel in support of King Abdullah's proposed peace plan. In light of the lackluster geopolitical response of the United States to Saudi interests, the commercial costs of the export policy seemed too great.

The policy was suspended in 2003, with Aramco allowing the average discount to fall to zero and ceding the top exporter spot to Canada.[9] Saudi crude exports, which had averaged 15.9 percent of total gross imports in the first half of 2003, fell to 13.1 percent in the second half of the year and then to 11 percent in the beginning of 2004. Industry observers noted the apparent policy change[10], and Saudi Aramco President Abdullah Jumah publicly acknowledged the shift in February 2005[11].

1.3.2 Discount Distribution

The prices that refiners pay for Saudi crude deliveries are determined by Aramco's Official Selling Prices, or OSPs. Aramco's OSP announcement is made about a month in advance of delivery, and consists of a differential relative to the spot price of a different benchmark crude for each of the four markets (see Figure 1-4). Over the policy period, these benchmark crudes were West Texas Intermediate (WTI) for the United States, dated Brent for Europe and the Mediterranean, and

[7] For more details see Jaffe & Elass (2007).

[8] Saudi arms purchases also fell dramatically after 2000, dropping from 1.7 billion dollars a year from 1990-1999 to .5 billion from 2000-2011.

[9] At the same time, all American troops were withdrawn from Saudi Arabia in September 2003.

[10] "Has Saudi Arabia abandoned its pivotal policy of being the largest crude supplier to the U.S.? The world's top oil exporter has long had the biggest share of the world's largest oil market and has favored volume over price to retain the top spot. Intriguingly, since the spring of last year, in the wake of the U.S.-led invasion of Iraq, the Saudis have ceded their prime position to others." ("Saudis Drop Volume, Lose U.S. Top Spot" *Petroleum Intelligence Weekly*, May 12, 2004.)

[11] Jad Mouawad and Simon Romero, "Saudis in Strategy to Export More Oil to India and China," *The New York Times*. February 18, 2005.

the Oman-Dubai average (ODA) for Asia. These differentials reflect factors such as the quality differences between the marker crude and the Saudi crudes, transportation costs,[12] and product prices in different markets. The price that refiners pay is then calculated using the previously announced differential and the average price of the marker crude over the month. Figure 1-4 shows a sample OSP release from Platts from December 2001 announcing the pricing differentials on January deliveries.

For example, the January differentials for Arab Light to the United States and Asia were -4.05 and +0.25, respectively. During January, the average WTI price was 19.48 dollars per barrel, and the average spot prices of the Oman and Dubai crude markers was 18.34 dollars per barrel. The price paid by U.S. refiners for January deliveries of Arab Light was $19.48 - 4.05 = 15.43$ dollars per barrel, and the price for Asian refiners was $18.34 + 0.25 = 18.59$ dollars per barrel. The value of the "discount" that month was therefore the difference between the realized Asian and U.S. prices, i.e. $18.59 - 15.43 = 3.16$.

$$\begin{aligned}
\text{Discount} &= \text{Asian Price} - \text{U.S. Price} \\
&= (\text{ODA} + \text{Asia Differential}) - (\text{WTI} + \text{U.S. Differential}) \\
&= (18.34 + 0.25) - (19.48 - 4.05) \\
&= 18.59 - 15.43 \\
&= 3.16.
\end{aligned}$$

In addition to dictating the prices that refiners pay, Saudi Aramco also directly controls how much crude each refinery receives each month. Saudi Aramco only sells crude through long-term contracts with specific refineries, and crude resale is not permitted. Although many petroleum producers trade their crude on a spot basis and/or allow their crude to be traded by buyers ex post, Saudi Aramco does neither and keeps tight control over where its crude is processed. Any resale by refiners results in permanent blacklisting from future contracts, and even companies that refine Saudi crude in multiple locations must specify the particular refinery where they will process each shipment. Refineries must therefore be prepared to either process or store whatever quantity they receive in a particular month. Contract quantities are specific to refinery capacity to process Saudi crude, and potential buyers submit detailed contract applications to the Crude Oil

[12] Although Aramco considers differences in transportation costs in determining the price differentials, all OSPs reflect fob prices and do not include transportation.

Sales Department in Dhahran that provide refinery specifications and operating figures as well as audited balance sheets and detailed corporate profiles. Once approved, these contracts may then be renewed on an annual basis at the discretion of the refinery and Saudi Aramco.

Despite the rigidity of the contract rules for refiners, the actual delivered quantities vary significantly from month to month. While annual contracts specify the quantity that refiners are willing to buy in terms of barrels per day, deliveries are subject to unilateral cuts by Aramco. Quantities may be cut, for example, following a decrease in OPEC quotas or a mandate from the Saudi government.[13] Indeed, there is significant monthly variation in the quantities that buyers receive each month, both at the refinery and company level. Although Aramco frequently changes quantity deliveries, it is very unusual for refiners to cut their orders even when prices are high.[14] Refinery inputs are constrained by physical capital in the short run, and most refineries require the composition of their input blend to be fairly consistent. Refiners can replace a shortage of Saudi crude by buying a fairly close substitute crude on the spot market, but these prices are usually higher than the Saudi term contract prices. Aramco also tries to keep its contract terms fairly attractive on average so that customers want to renew their contracts over the long term and so that they can continue to place their desired quantities in the U.S. market.

1.4 Where Did the Discount Go?

The first task of this paper is to track down where discount rents accrued when Saudi Aramco sold discounted crude to the United States, whether captured by refiners as excess profits or passed on to consumers in the form of lower product prices. I next provide an overview of the relevant features of the U.S. refining industry and a basic model to give some intuition on the incidence of the discount. I then discuss the data required for this part of the analysis, the empirical framework, and the results from the estimation.

[13] In practice, Saudi Aramco can at its discretion give some flexibility to buyers to switch between the several crude grades it produces or to ask for a change in the total quantity. In the month prior to delivery, Saudi Aramco announces its price differentials. Customers then indicate their preferences, and Saudi Aramco takes their requests into account when issuing the final allocation.

[14] "Despite their grumbling, customers - sensitive to the strategic importance of Saudi contracts - will not dare threaten to reject their March supplies. 'We can only hope that we're compensated next month with a deep discount on the April formula,' says an industry source. ... One US contract holder, none too pleased with the March price adjustment, carefully described the change as 'very inconsistent with the market.' .... Again, however, loyalty to Aramco seems certain to win out over momentary irritation. 'We are painfully aware of the new prices, but we're dealing with it,' the customer added." *Petroleum Intelligence Weekly*, "Buyers Bemoan Saudi Price Hikes, Eyes Now on Iraq" (Feb. 8, 1999).

1.4.1 Market Details

At their most basic, refineries blend input crude oil and then distill it into its constituent hydrocarbons, isolating the molecules and then blending them into end products like propane, gasoline, jet fuel and diesel. Although all refineries perform this same basic process, they vary a great deal in their complexity and in what sorts of crude oil they can process and what finished products they output. Topping refineries, the most basic type, include only distillation units and produce mainly unfinished oils. Hydroskimming refineries add a hydrotreating and reforming unit to the basic topping refinery configuration, allowing the refinery to remove sulfur from more sour crudes so that outputs conform to environmental standards. The most versatile (and most expensive) refinery type are catalytic cracking or coking refineries, which also feature gas-oil conversion plants, olefin conversion plants, and coking units to reduce or eliminate the production of residual fuels. These refineries are able to break larger (and less valuable) molecules and reform them into lighter, more valuable products like gasoline and jet fuel. The product mix is determined both by the blend of molecules in the input crude mix as well as the sophistication of the refinery.

Most refineries blend different crude oils before distillation begins. This allows them to maintain consistent processing conditions and mitigate the corrosive effects of cheaper sour crudes. Refiners periodically run linear programming models to determine the optimal quantity and quality of their inputs and outputs and to make (small) adjustments to their refinery operating parameters. Most secure a certain amount of "baseload" crude under term contracts, which are less flexible but offer more attractive prices, and then balance their remaining crude slate in the spot markets. If a refinery gets a cut in its monthly crude order from Saudi Aramco, then, they will buy other similar crudes on the spot market to fill the shortfall rather than curtailing their run. Mexican Isthmus-34, for example, is a good substitute for a refinery using Arabian Light in its crude mix and is available on the spot market at most locations where Saudi crude can be delivered. Spot market prices are usually higher than Saudi term contract prices, however, so replacing a shortfall of Saudi crude on the spot market tends to increase input costs.

Once the crude oil has been fully processed, refined products are transported to wholesale racks by either pipeline, barge, truck or rarely by railroad (Figure 1-5) (Association of Oil Pipelines 2009). Pipelines are the least expensive way to move products,[15] and mainly connect areas of high refining output with those of high demand. Trucks usually make only local trips, and most trips by

[15]Transportation costs by pipeline, barge and truck are estimated at 2, 4.5 and 35 cents per gallon per thousand miles of transportation (Jacobs 2002).

petroleum tank trucks are no longer than 50 miles (Untiet 1984). Refiners sell products to retailers out of these local wholesale racks, who then mark up the prices to sell to consumers. These retail margins make up only a small proportion (about ten percent) of consumer prices.[16]

The two primary possible destinations for Saudi discount rents are therefore refiner profits and consumer prices.

1.4.2 Model

Although changes in crude oil costs certainly influence the consumer price of gasoline,[17] there is reason to think that discounts targeted at specific refineries will be captured as profits rather than passed on to consumers, even in a competitive market.[18] Over the policy period, Saudi oil accounted for about ten percent of crude refined in the United States, and crude receipt varied substantially across refineries in the same local area. This section therefore models the receipt of Saudi crude as a heterogeneous cost shock across refineries in a given market.

The gasoline wholesale market is characterized by a relatively small number of refineries with fixed capacities. At most, cities have 12 refineries that supply refined gasoline to wholesale racks for retail distribution. Most refineries operate at full capacity for most of the year, and even with regular shutdowns for maintenance overall capacity utilization is around 90%. Though fixed costs are large, the majority of marginal costs are the price of crude inputs. These vary across time as the price of crude fluctuates, and across refineries according to refinery sophistication. While common shocks to costs do pass through into gasoline prices, cost shocks targeted to specific refineries will tend to affect profits but not prices. To make this clear, I consider a simple model of the wholesale refined product market characterized by a finite number of refineries with fixed short-run capacities.

Consider a city (or wholesale market) with n possible refineries with marginal costs c_i such that

$$c_1 \leq c_2 \leq \cdots \leq c_n$$

[16]See http://www.eia.gov/petroleum/gasdiesel/ for the components of the price of a gallon of gasoline.

[17]The literature on the nature of the dynamics of crude price pass-through into gasoline prices began with Bacon (1991), though the link between crude and gasoline prices was already well-established. Further detailed work on the magnitude and speed of gasoline price responses to crude prices can be found in Borenstein & Shepard (1996), Borenstein, Cameron & Gilbert (1997), Borenstein & Shepard (2002), and Bachmeier & Griffin (2003). Even though several of these papers find that the pass-through of crude price changes to gasoline prices is not immediate, full pass-through of all common shocks occurs within a month or two of the initial shock. Because I examine pass-through at the annual level, I avoid these dynamic pass-through concerns and assume that all discount effects pass through to gasoline prices in the year that they occur.

[18]Borenstein & Kellogg (2012) find that refiners, not consumers, captured the rents generated by a temporary depression in crude prices in the Midwest. As in this section, their model generates this lack of pass-through into product prices as a consequence of the fact that most refiners are capacity-constrained, and are therefore operating at the vertical part of their supply curves.

and capacities $k_1, \ldots, k_n$. Demand is given by $D(p)$, where p is the gasoline (or product) price. In this market, equilibrium will consist of an m and p^* such that

1. No additional firms want to begin producing:

$$c_{m+1} \geq D^{-1}\left(\sum^{m} k_i\right)$$

2. No producing firms want to exit the market:

$$D^{-1}\left(\sum^{m-1} k_i\right) > c_m$$

3. The marginal refinery (m) is maximizing profits:

$$p^* = \text{argmax}_{p:D^r(p) \leq k_m}(p - c_m)\left[D(p) - \sum^{m-1} k_i\right]$$

The equilibrium price p^* therefore comes from the marginal firm's profit maximization facing the residual demand from all lower-cost firms producing at capacity.

Therefore (for non-corner solutions):[19]

$$p^* = \frac{c_m}{1 + \frac{1}{\epsilon^r_D}}$$

where ϵ^r_D is the elasticity of residual demand:

$$D^r(p) = D(p) - \sum^{m-1} k_i$$

Note that p^* is only a function of the marginal firm's marginal costs, i.e. $p^* = p^*(c_m)$.

The profit of the marginal firm is:

$$\pi_m(c_m) = (p^*(c_m) - c_m)D^r(p^*(c_m))$$

[19] For solutions where the marginal firm produces at capacity, decreases in costs will not affect prices even for marginal firms. Increases will sometimes increase prices if they are sufficiently large.

For inframarginal firms ($i < m$):

$$\pi_i(c_i, c_m) = (p^*(c_m) - c_i)k_i$$

Therefore non-marginal shocks to marginal cost will only affect refiner profits (π_i) and will not pass through into prices. Decreasing the costs of the marginal firm (c_m) will lower prices, increase profits of the marginal firm (π_m) and lower profits for other firms (π_i). Figure 1-6 shows a simple example of how profits and prices are affected under targeted and common (non-targeted) cost cuts. Panel i shows the market without any discounts. There are m firms in the market, and the marginal firm m sets a price p^* above its own marginal cost (the highest one in the market) to maximize its own profits facing the residual demand curve. Panel ii shows the effect of a common shock to costs, such as a decrease in the "world price" of crude, i.e. a drop in price affecting all grades and types of crude oil. Because this common shock reduces the costs of the marginal refinery, this refinery increases its production and the price of gasoline decreases. In Panel iii, several of the inframarginal refineries experience a targeted decrease in costs (such as the discount) that is not given to the marginal refinery. In this case, profits increase for all of the discount recipients, but the market product price remains unchanged.

Consequently, this simple model shows that we would expect most receipts of discounted crude to affect refiner profits and not to pass through into product prices. Since most refiners are inframarginal, most of the discounted crude is also inframarginal; only changes in the amount of Saudi crude sold to the one marginal producer in each market would even partially be passed through into the price.

1.4.3 Data

In this part of the analysis, I follow the discount through each stage of the refining process from the delivery of the discounted crude to the refinery to local gasoline prices.

Total Discount Value

The key independent variable for the analysis in this paper is the refinery-level value of the discount received from Saudi Aramco, i.e. the per-barrel discount multiplied by the quantity of crude delivered to each refinery. I calculate the per-barrel discount that U.S. refiners receive relative to Asian refiners using Saudi Aramco's official selling prices. As described above, Saudi Aramco takes a variety of measures to prevent the emergence of a secondary market in its crude, so these prices should accurately reflect the prices that refiners pay to purchase Saudi crude oil. The OSP releases are published each month by Platts for each of the major crude grades in each market, and the time series of the realized selling prices (these differentials plus the relevant benchmark) are available from Bloomberg. The series for Arabian Light, Arabian Medium, and Arabian Heavy are available for Europe, the United States, and Asia beginning in January 1991, and I use these series to construct a single average discount for Saudi crude.[20] I use the Asian price as the benchmark to calculate the discount, as East Asia was the primary alternative destination for Saudi crude exports. Asian markets received about half of total Saudi crude exports by 2003 and 65 percent by 2010. At the same time, the share that went to the North American market fell from what had been a steady 25 percent from 1991 to 2003 down to 18 percent in 2010.[21]

In order to estimate the effects of the discount on refinery profits and local retail prices, it is critical to identify which refineries received crude shipments from Saudi Arabia in each month. All of this information comes from the Energy Information Administration (EIA), which monitors domestic petroleum refining operation and which collects data on all foreign crude imports through the EIA-814 Monthly Imports Report. This data is publicly available at the refinery-level from the EIA starting in 1986. I match this data to a list of all operating refineries in each year constructed using the EIA Refinery Capacity Report (from EIA-820), which lists all operating U.S. refineries in each year for 1994, 1995, 1997, and 1999-2010 and reports capacity, owner, and state for each refinery. There are 178 refineries listed in the report. When matched with the importer data, this lists all refineries operating in a given year and how much crude each refinery imported from Saudi Arabia and elsewhere.

Receipts vary a great deal across refineries and within each refinery from month to month, which leads to considerable variation in discount values among refinery owners and across states. Of the 178 operating refineries, 58 used crude imported from Saudi Arabia between 1991 and 2003. Most deliveries of Saudi crude go to refineries along the Gulf Coast, but a surprising amount also goes to inland refineries and to refineries in California and along the East Coast (Figure 1-7).

[20] Since only overall sales volumes for all the crude types are available, I calculate the discount as a weighted average of the discounts on the three different crude grades. The weights are left fixed over time and are based on the volumes published in the IEA Oil Market Report over the 1998-2003 period. The average discount is calculated as

$$AvgDiscount_t = 0.35 \cdot LightDiscount_t + 0.46 \cdot MediumDiscount_t + 0.19 \cdot HeavyDiscount_t.$$

[21] Export figures are from United Nations Commodity Trade Statistics Database.

Coastal refineries are mostly supplied by tanker and offshore terminal, and inland refineries receive deliveries by pipeline within a couple of weeks of delivery by tanker. There is also a great deal of variation in the fraction of inputs that come from Saudi Arabia. The Texaco refinery in Delaware, for example, got more than half of its inputs from Saudi Arabia over the period. Mississippi and Arkansas also got over half of their crude inputs from Saudi Arabia (Figure 1-8).

Refiner Profits

To estimate the impact of the Saudi crude discount on refiner profits, I use data on annual profits from refining operations for the 40 publicly-traded companies that owned at least one U.S. refinery during the sample period. These data come from Standard and Poor's Compustat North America dataset. Because many U.S. refineries are owned by large corporations with multiple business lines, I use profits data from the Business Segments Dataset, which includes companies' self-reported balance sheet data by business type. The relevant segments were identified using the segment-specific NAICS classification for petroleum refining and the segment name as reported by the company. The analysis focuses on operating profits, which represents sales of the refining business segment less its allocated share of operating costs and expenses. For comparison, I also use overall net income as a measure of total company profits. This is also available from Compustat, and represents quarterly income (or loss) after subtracting all expenses and losses from all revenues and gains. The reporting for this item is more consistent across companies, but is a much noisier indicator of the variable of interest.

In order to link company profits to refinery imports, it is also necessary to determine annual corporate ownership of each refinery. Ownership of individual refineries was established using the EIA Refinery Capacity Reports and supplemented using corporate profiles from the Moody's/Mergent Industrial Manuals. Refineries owned through a join enterprise were assigned to either the U.S.-listed corporation or to the majority stakeholder.[22] Refineries that changed ownership mid-year were assigned to the company that owned the refinery for the majority of the year. Table 1.1 provides some summary statistics on the publicly-traded refinery owner companies that appear in the profits analysis. Discount receipts for these companies also vary tremendously, and are not necessarily related to company size. Chevron and Texaco, for example, received over 4 billion dollars worth of crude discounts, an amount equal to 10% of their overall refining profits. The

[22] Texaco is an exception to this, and is excluded from the regressions due to its Motiva joint venture with Saudi Aramco. In general, including Texaco in the regressions either has no effect or slightly decreases point estimates and increases their statistical significance.

similarly-sized Shell, however, received only 0.08 billion in discounted crude, 0.2% of total refining profits. Smaller companies like Marathon and Valero received about a billion dollars in discounts over the period as well. Although a substantial share of the discounted crude went to the former Aramco partners (ExxonMobil, Chevron and Texaco), other companies like BP, ConocoPhillips, Marathon and Valero were also top recipients. There is also great deal of variation in the fraction of inputs that come from Saudi Arabia. Texaco, for example, received Saudi imports at seven of its ten refineries and devoted approximately 45 percent of its processing capacity to refining Saudi crude.

Retail Gasoline Prices

In addition to examining the effect of the discount on refining profits, I also look at the impact on consumers though changes in the retail price of gasoline in local refinery markets. For this part of the analysis, refineries were matched to the largest city within an hour travel time by road. Monthly retail price averages for the 75 cities with local refineries was provided by the Oil Price Information Service (OPIS). OPIS uses data from credit card receipts to capture daily station-specific retail gasoline prices for up to 120,000 stations throughout the United States, and their data include prices for most major retailers regardless of ownership. This daily station data for regular unleaded gasoline was aggregated up to the city-month level for this paper.

I link this price data for each city to refining capacity and Saudi crude quantities in its wholesale market. I define a city's market in two different ways. In the first, local markets are defined using the assumption that refineries serve only cities within an hour travel time by truck. I alternatively define a refinery's market as any city that is "down-pipe" of the refinery using directional product pipeline information from 2004 (Figure 1-9).[23] Under the first definition, for example, retail prices in St. Paul and Chicago are assumed to be affected only by the refineries operating in their local area. The second market definition takes into account that there is a product pipeline going from Bismarck to St. Paul, and from St. Paul to Chicago. Prices in Bismarck are still only affected by refineries in the local area, but St. Paul prices are now also affected by refineries in Bismarck as well as in St. Paul, and prices in Chicago by refineries in Bismarck and St. Paul.

[23]This is similar in spirit to Muehlegger (2006), who also uses product pipelines (as well as truck and barge access) to calculate the approximate transportation costs for a refinery to serve markets in each state.

1.4.4 Empirical Framework and Results

In this section, I investigate what refiner characteristics determine receipt of Saudi crude, and where discount rents went. To determine whether the discount was captured as profits or passed through to consumers, I estimate the effect of discount receipts on refinery owner profits and local retail gasoline prices.

Who received the discount?

To get a sense of which features made companies most likely to receive Saudi crude, I first construct a dummy variable ($D(Recipient)$) equal to 1 if the company received Saudi crude at any point over the policy period. I estimate a simple descriptive linear probability model for this dummy variable on a set of refiner characteristics. These include total refining capacity over the period as well as a dummy variable indicating whether the company owned any refineries that had processed Saudi crude in the 1989/1990 period, indicating that the company had the technical capacity (without any further investment) to process crude from Saudi Arabia. I also construct a set of dummy variables that indicate whether the company owned a refinery in a particular state to get at geographical effects. Anticipating the results in section 5, I also include a set of variables indicating political contributions by these companies in the 1989/1990 period to check whether recipients differed from non-recipients in their political leanings.[24]

The results from the LPM for discount receipt on refiner characteristics (Table 1.2) reveal that the most important requirements to have received Saudi crude are technical. Companies that owned at least one refinery with demonstrated capacity to process Saudi crude were 65 percent more likely to have received Saudi crude over the policy period. Of course, the availability of substitute crude inputs means that these firms do not require Saudi crude, and that refineries that did not process Saudi crude in the pre-period may still have had the capacity to do so. Firms may also have updated refinery specifications during the period to enable Saudi crude capacity. Nonetheless, this variable is significant in all seven specifications and its magnitude is quite consistent. There is no indication that firms with larger overall refining capacity were more likely to receive Saudi crude, and these coefficients are close to zero and statistically insignificant. Former Aramco partners were surprisingly no more likely to get Saudi crude than other refiners controlling for technical refining capacity.

[24]The political contributions data are discussed in detail in section 5.

The coefficients for the state dummy variables are not reported in the table, and are jointly significant but mostly individually not statistically significant. These estimates tend to be positive for states that are easily accessible by barge (e.g. Alabama, Louisiana, California, New Jersey) and negative for those that are difficult to reach (e.g. Alaska, Arizona, Illinois, Nevada). (Including these dummy variables in the other LPM regressions has very little effect on the point estimates, but makes the standard errors on the other coefficients larger.)

The estimates on the aggregates for overall contributions, contributions to politicians and contributions to committees are all small and statistically insignificant. The aggregates by politician characteristics (party, pro-Israel donation recipients) are also very small and close to zero, indicating that the overall contribution patterns of recipients and non-recipients were very similar in the pre-period. Recipients and non-recipients do appear to have varied in how their contributions were allocated across members of various committees, however; companies with more contributions to members of the House Armed Services and Senate Foreign Relations committees were more likely to receive Saudi crude. Companies with more donations to members of the House Energy, House Foreign Affairs, and Senate Armed Services committees were less likely to get Saudi crude.

Refining Profits

To determine the extent to which the discount was captured as profits, I estimate the relationship between company-level refining profits and total annual discount value as well as the relationship between log profits and log quantity:

$$\pi_{jt} = \beta \cdot DiscValue_{jt} + \alpha_j + \gamma_t + \epsilon_{jt} \quad (1.1)$$

$$\log(\pi_{jt}) = \tilde{\beta} \cdot \log(q_{jt}^{saudi}) + \tilde{\alpha}_j + \tilde{\gamma}_t + \tilde{\epsilon}_{jt} \quad (1.2)$$

The motivation for these two specifications comes from the expression for the refiner's profits. The value of the discount to a refiner can be expressed in terms of the percentage discount on the crude price (d_t), the per-barrel price of crude (c_t), and the number of barrels the refiner receives from Saudi Arabia in year t, q_{jt}^{saudi}. We can then write the refiner's profit function:

$$\begin{aligned} \pi_{jt} &= (p_t - c_t)q_j^{cap} + \beta \cdot DiscValue_{jt} + \epsilon_{jt} \\ &= \mu_t q_j^{cap} + \beta \cdot d_t \cdot c_t \cdot q_{jt}^{saudi} + \epsilon_{jt} \end{aligned}$$

where p_t is the average product price and q_j^{cap} is refinery capacity. μ_t is the difference between the average product price and the cost of crude, i.e. the refining profits per barrel or the "crack spread".

In this case, β can be consistently estimated using firm fixed-effects as long as μ_t is fixed over time and does not vary with the crude price, i.e. $\mu_t = \mu$. This leaves us with:

$$\pi_{jt} = \underbrace{\mu q_j^{cap}}_{\alpha_j} + \beta \cdot DiscValue_{jt} + \epsilon_{jt} \tag{1.3}$$

This was approximately true from 1983-2003, with the crack spread, which estimates the value added by the refining operation, remaining fairly constant in real terms at around 12 dollars per barrel (Figure 1-10).[25]

A more serious empirical problem is created by integrated refiners. Since these firms also sell crude, the crude price now enters the calculation for the discount value as well as the profitability of their exploration and production business lines:

$$\pi_{jt} = \mu \cdot q_j^{cap} + \beta \cdot \underbrace{d_t \cdot c_t \cdot q_{jt}^{saudi}}_{DiscValue_{jt}} + \underbrace{c_t \cdot q_j^{crude} + \epsilon_{jt}}_{\eta_{jt}}$$

Now $\text{Cov}\left(DiscValue_{jt}, \eta_{jt}\right) > 0$, and $\hat{\beta}$ overestimates the effect of the discount on refiner profits. Intuitively, the discount per barrel can only be large when the price of crude is also large – you cannot have a six-dollar discount when the crude price is only five dollars. We would also expect refiners that produce crude to have higher profits when the oil price is higher. Even though I use refining profits in this analysis to try to mitigate this effect, these self-reported segment profits are likely to co-move with overall company profits.

One solution to this problem is to use a log-log specification and add time fixed effects to remove time-varying factors (c_t, d_t) from the discount. The coefficient $\tilde{\beta}$ now estimates the percent change in profits associated with an increase in the quantity of Saudi crude that a refiner receives.

$$\log \pi_{jt} = \tilde{\beta} \cdot \log(q_{jt}^{saudi}) + \tilde{\alpha}_j + \tilde{\gamma}_t + \tilde{\epsilon}_{jt} \tag{1.4}$$

[25]The crack spread is calculated as the difference in cost between a barrel of crude and a representative mix of typical outputs. For example, a simple version (the 2-1-1) is calculated as the difference in cost of 2 barrels of crude and a barrel of gasoline and a barrel of heating oil/diesel. Here I use the 6-3-2-1 crack spread, which is the difference in the total cost of 6 barrels of crude and outputs of 3 barrels of gasoline, 2 barrels of heating oil/diesel, and 1 barrel of residual fuel oil. Trends are the same for each of the four standard spreads.

Since the discount per barrel is mostly positive over this period, a positive estimate indicates that an increase in the total discount value to a refiner is associated with an increase in firm profits.

Results from the profit regressions (Table 1.3) indicate that most of the discount appears to be captured by refiners as profits. On average, the discount value is equal to about two percent of refining profits, and the average discount is one dollar per barrel over the period. Full capture would therefore be consistent with a coefficient of 0.02 in column 1. The actual point estimate is 0.016, i.e. a 1.6 percent increase in profits associated with doubling the amount of Saudi crude delivered. When the sample is restricted only to observations with non-zero amounts of Saudi crude and positive profits, the point estimate increases to 0.17 relative to the full pass-through benchmark of 0.09 for this subsample.

The point estimate from the level regression in column 3 is large, implying a three dollar increase in profits for every dollar of discount, and may be biased upward for the reasons discussed in the previous section.[26] Nonetheless, the test of this coefficient against the full pass-through benchmark of 1 cannot be rejected.

To support the interpretation that the receipt of discounted crude increases profits through reducing costs rather than by increasing output, I also estimate the effect of annual district-level Saudi crude receipts on total refinery output.[27] Because events like refinery shutdowns and capacity expansions are likely to affect both production levels and inputs, I control for total district refining capacity. I use time fixed effects to capture trends in capacity utilization rates and district fixed effects to control for district-level heterogeneity in refinery efficiency.

Table 1.4 reports the results from this regression of the log of production on Saudi crude receipts controlling for refining capacity and year and district fixed effects. These estimates are all very small; a doubling in the Saudi crude delivery is associated with around a 0.3 percent increase in production even though about ten percent of crude inputs came from Saudi Arabia. This is in contrast to the estimates in column (1) of Table 1.3, which indicates a 1.6 percent increase in profits for the same increase in Saudi crude quantity. The primary channel for the impact of the receipt of discounted crude on profits is therefore the discount on costs rather than an increase in

[26] Consistent with the hypothesis that the upward bias of the estimate in the level regression is due to measurement error due to other business lines, the point estimate in column 3 decreases to 2.48 when I exclude the supermajors (BP, ExxonMobil, Chevron and Shell), which had the largest incomes from crude production. The estimates in columns 1 and 2 decrease slightly but remain statistically significant.

[27] Although refining capacity is available at the refiner level, capacity utilization rates are only released at the district level. The EIA defines twelve such refining districts: East Coast, Appalachian No. 1, Indiana-Illinois-Kentucky, Minnesota-Wisconsin-North and South Dakota, Oklahoma-Kansas-Missouri, Texas Inland, Texas Gulf Coast, Louisiana Gulf Coast, North Louisiana-Arkansas, New Mexico, Rocky Mountain, and the West Coast.

production.

Retail Gasoline Price

As for profits, I examine the extent to which the discount was passed through to consumers by estimating the effect of the city-level discount per gallon of refined gasoline and quantity share in production on local gasoline prices:

$$\begin{aligned} RetailPrice_{mt} &= \rho \cdot DiscGal_{mt} + \lambda_m + \eta_{st} + \epsilon_{mt} \\ \log\left(RetailPrice_{mt}\right) &= \tilde{\rho} \cdot \log\left(\frac{q_{mt}^{saudi}}{q_{mt}^{cap}}\right) + \tilde{\lambda}_m + \tilde{\eta}_{st} + \tilde{\epsilon}_{mt} \end{aligned}$$

The retail gasoline price can be expressed as a per gallon markup on the crude costs per barrel (p_t^g) plus some state-level tax τ_{st}. The observed price is this counterfactual price (η_{st}) plus the effect of the discount, which is expressed here as the discount value per gallon of gasoline refining capacity multiplied by ρ, the share of the discount which is passed on to consumers. This yields:

$$RetailPrice_{mt} = \underbrace{p_t^g + \tau_{st}}_{\eta_{st}} + \rho \cdot DiscGal_{mt} + \epsilon_{mt} \tag{1.5}$$

Using the constant crack spread μ, p_t^g can be expressed as a markup μ over the price of crude c_t divided by the number of gallons of gasoline per barrel:

$$p_t^g = \frac{\mu + c_t}{19.5}$$

where 19.5 is the average number of gallons of gasoline refined from a 42 gallon barrel of crude oil. The discount per gallon is calculated as the total discount to refineries in market m divided by the total number of gallons of gasoline refined in that market:

$$DiscGal_{mt} = \frac{d_t c_t q_{mt}^{saudi}}{q_m^{cap}}$$

As discussed earlier, one of the primary challenges here is defining the local market in order to link refineries to the appropriate retail gasoline prices. I do this two ways: first by assuming that refineries only serve cities within an hour travel by truck, and second by linking each refinery to all cities "down-pipe" of the refinery. These two definitions affect how q_{mt}^{saudi} and q_m^{cap} are calculated. Under the first definition, they refer to Saudi imports and refinery capacity only in refineries within an hour's travel from the city. Under the second, they refer to imports and capacity of all refineries up-pipe.

Again, taking logs and using state by month fixed effects removes any bias caused by the crude price appearing in both the counterfactual gasoline price and the value of the discount.

$$\log\left(DiscGal_{mt}\right) = \underbrace{\log(d_t c_t)}_{\gamma_t} + \log(q_{mt}^{saudi}) - \underbrace{\log(q_m^{cap})}_{\lambda_m}$$

The primary specification is therefore

$$\log\left(RetailPrice_{mt}\right) = \tilde{\rho}\log\left(\frac{q_{mt}^{saudi}}{q_m^{cap}}\right) + \tilde{\lambda}_m + \tilde{\eta}_{st} + \tilde{\epsilon}_{mt} \tag{1.6}$$

The pass-through coefficient $\tilde{\rho}$ is therefore identified off of variation in the changes in Saudi crude shares across cities within the same state.

The results from these regressions show no evidence that discounts were passed on consumers in the form of lower refined product prices (Table 1.5). Estimates in column 1 give fairly precise zeros (with standard errors clustered at the city level), even when compared with a full pass-through benchmark of -0.04[28]. The full pass-through benchmark for cities that receive positive amounts of Saudi crude (column 2) is -0.15, so these estimates are also very close to zero. Large standard errors on the estimates in column 3 make their interpretation more difficult, but the point estimates are nonetheless quite small. Panel A of column 3, for example, indicates that a one-cent increase in the per-gallon discount value decreases gasoline prices by 0.03 cents. These estimates are consistent with the large pass-through into refining profits in Table 1.3.

Taken together, the profits and retail price results indicate that, as expected, the discount rents were captured by refining firms as profits rather than passed on to consumers. Since refining companies appear to have been the primary beneficiaries of the discount, the next section examines how discount receipts affected political action by these firms.

1.5 Political Action by Discount Recipients

While it is impossible to directly measure the effect that the discount actually had on U.S. foreign policy toward Saudi Arabia, we can observe how the companies that received the discount

[28]The average unleaded gasoline price is 1.34 dollars, and Saudi inputs make up about 5.5 percent of total inputs, so a one percent increase in the Saudi input share would decrease prices by 0.04 percent.

behaved as a result of the policy. As described earlier in the paper, there are plenty of cases where American oil companies took (sometimes rather extraordinary) political action to support Saudi interests. The most easily measurable type of corporate political action is financial contributions to political campaigns. In this section, I examine the relationship between discount receipts and political contributions by American refiners during the policy period. In particular, I focus on refiner contributions to Members of Congress, particularly those who serve on key committees and those who appear to be most sympathetic to Israeli political interests. It is important to note that direct contributions to politicians from individual donors represent only a fraction of financial support from companies to politicians, and a smaller fraction still of total political action by corporations. Overall, individual donors account for only about half of the money that goes to House candidates and two thirds of the money that goes to Senate candidates (Center for Responsive Politics 2012). The rest comes from PACs and candidates' personal resources. The advantage of focusing on individual donations is that it shows the direct link from refiners to politicians so that patterns of giving can be examined in addition to overall levels of giving. Patterns that are seen in this small, transparent part of political action by discount recipients may be suggestive of overall patterns of behavior as it relates to the receipt of the crude discount.

1.5.1 Saudi Arabia and the U.S. Congress

The empirical results in the literature on political contributions and policy influence are mixed. In particular, despite the conventional wisdom in political economy, it has proven very difficult to show direct causal links between contributions and voting behavior, though there is some evidence that regulatory outcomes are influenced by political contributions (de Figueiredo & Edwards 2007). In their study of the incidence of the costs and benefits of several transportation-sector environmental regulations, Holland, Hughes, Knittel, & Parker (2011) find patterns in the political donations by organizations and politician voting behavior that suggest that districts used campaign contributions to influence the House vote on the Waxman-Markey cap and trade bill. In particular, they find evidence that organizations that opposed the Waxman-Markey bill were more likely to donate money to House members from districts that would be negatively impacted by the bill, with a similar pattern in the contributions of supporters to candidates from districts that would benefit. Further, they find that political contributions from organizations that opposed the bill were associated with a large reduction in the likelihood of voting for the bill. As discussed by Ansolabehere, de Figueiredo & Snyder (2003), campaign contributions likely affect policies in other ways besides through roll call votes, including securing access to legislators at other stages of the policy-making process. Indeed, politicians likely find it desirable to promote client interests in ways that are observable to clients but not to voters. Because of these difficulties in observability, I assume that corporate donors allocate their donations strategically, whether with the intent of affecting policy or to demonstrate loyalty to Saudi interests.

In particular, contributions to federal legislators are an important channel corporations can use to advocate for Saudi interests. Many bills pass through Congress that affect Saudi Arabia, including bills regarding arms sales, trade, aid[29], and immigration[30]. Most of these are referred to the House Committee on Foreign Affairs or the Senate Committee on Foreign Relations. Committees exercise a great deal of power over the legislation they review, and can both block legislation by tabling it or by revising the bill before they send it to the floor for a vote. In 1992, for example, none of the bills opposing the sale of F-15XP fighter planes to Saudi Arabia made it out of committee. In another example, the House Foreign Affairs Committee tabled the Persian Gulf Security Cost Sharing Act (2001), which would have required Saudi Arabia to defray the cost of U.S. military deployments in the region.

Committees can also amend popular bills to turn them from aggressive foreign policy changes into purely symbolic gestures. The House Committee on Foreign Affairs had added Presidential waiver authority to several anti-Saudi bills, including the Anti Economic Discrimination Act of 1995, which would have stopped the sale of military equipment to countries participating in the boycott of Israel. Another notable example of this was an amendment to the 2005 Foreign Appropriations bill, which stated that "[n]one of the funds appropriated or otherwise made available pursuant to this act shall be obligated or expended to finance any assistance to Saudi Arabia." Changes to this amendment made in committee allowed the President to waive this rule provided that he certified to the Congressional Appropriations committees that Saudi Arabia was cooperating in the war against terrorism. Although the amendement passed,[31] it was immediately waived by Presidential Determination. A subsequent bill (the Prohibit Aid to Saudi Arabia Act of 2005) that attempted to impose the ban on U.S. aid to Saudi Arabia without waiver authority was not passed on by the

[29]Examples of aid-related bills include H.R.3137.IH (2003) which prohibited assistance or reparations to Cuba, Libya, North Korea, Iran, Syria and Saudi Arabia, as well as Amendment 708 to H.R. 4818 (the Foreign Operations Appropriations bill for FY2005).

[30]See for example, H.R. 604 and 3934. These bills would have halted the issuance of visas to Saudi citizens until the President certified that the Saudi government did not discriminate in its visa policies on the basis of religious affiliation or cultural heritage.

[31]Vote 217-191, see roll call http://clerk.house.gov/evs/2004/roll389.xml

House Foreign Affairs Committee.[32]

In the rest of the paper, I look at how the level and composition of direct corporate donations to Members of Congress vary with discount receipts.

1.5.2 Data

In this part of the analysis, I match company-level discount receipts to corporate political donations. Although it is illegal for corporations to contribute to political campaigns directly, in practice they do contribute through personal donations by their managers and employees. These individual donors account for approximately two-thirds of campaign money to Senate candidates and half of the financing for House candidates. By federal law, all contributions to federal candidates, political action committees (PACs), or parties of over 200 dollars must be reported to the Federal Election Commission (FEC). These reports include the name and address of the donor, as well as the donor's employer and occupation. These data are published by the FEC and aggregated by the Center for Responsive Politics (among others). I use these data to construct total annual campaign contributions by employees of all U.S. refining companies to each member of the House and Senate for the 1991-2003 period. I merge these with data on congressional committee assignments from Stewart & Woon (2012) and Nelson (2012) to construct total contributions by committee. Table 1.6 shows some summary statistics on political contributions for the 26 companies that received crude from Saudi Aramco, both public and private. (Though they are excluded from this table, all 126 refining companies are used in the analysis.) The positive relationship between Saudi imports and total political contributions over the period can be seen graphically in Figure 1-11, which plots the log of total company campaign contributions against the log of total Saudi imports over the discount policy period.

For the politician-level contributions analysis, committee assignments and political contributions are matched to the set of all Members of Congress collected in Stewart & Woon (2012), which begins in 1993. The merged politician by refiner-level dataset contains information on politician characteristics including party affiliation, committee assignments, chamber seniority, and contributions from other types of interest groups. In particular, the analysis classifies politicians according to the degree to which they receive contributions from donors affiliated with pro-Israel groups. One categorization simply assigns a dummy variable equal to one for politicians who received any

[32] In practice the United States provides almost no aid to Saudi Arabia, and the ban targeted a small 25,000 dollar International Military Education and Training grant for Saudi military training.

contributions from pro-Israel donors. Another categorizes politicians according to their approximate quintile of average pro-Israel donations. The first group is the approximately 27 percent of politicians who never received any contributions from pro-Israel organizations during their time in Congress. The second group collects the 27th through 40th percentile of recipients, the third the 40th through 60th percentile, the fourth the 60th through 80th percentile, and the fifth the 80th percentile and above.

Table 1.7 gives some summary statistics for the total annual contributions at the company by politician level. Since most politician-refinery-year observations are zeros, the left hand panel shows statistics conditional on a donation occurring. The median contribution to a single politician is around one thousand dollars per year, though the maximum contribution is very high; in 1996, Koch Industries affiliates and employees contributed almost 45,000 dollars to Representative Sam Brownback's (R-KS) campaign. The median total giving by a company in a single year is 7,404 dollars, but again the maximum is quite high; ExxonMobil donated over 374,000 dollars in direct contributions in 2000.

1.5.3 Results

Contribution Aggregates

As in the profits analysis, I estimate the relationship between discounts and political contributions using the regression

$$Contrib_{jt} = \theta \cdot DiscValue_{jt} + \alpha_j + \gamma_t + \epsilon_{jt} \tag{1.7}$$

where j is the contributing refining company and t is the year. One possible concern here is the effect of refiner profits on contributions. If corporations increase overall contributions or change their contribution patterns when their profits are high, θ may capture the spurious common effect of overall crude price on contributions (via profits) and the discount value or the indirect effect of the discount through its effect on profits. I therefore also run this regression on a the subsample of public companies (for which I have refining profits) both with and without profit controls.

Results for the aggregate contribution regressions are reported in Tables 1.8a and 1.8b. Table 1.8a shows the results for the whole sample of refiners (both public and private). Column 1 shows the relationship between discount receipts and total donations, and Columns 2 and 3 break this out into aggregates for contributions to politicians and to PACs. The estimate in Panel A of Column 1 indicates a small but positive relationship between the discount and overall political contribution by refiners – a one-million dollar increase in the discount value is associated with an approximately 385 dollar increase in contributions. This is consistent with the fact that contribution magnitudes tend to be much smaller than the discount value. Among discount recipients, the average discount amount is 45 million dollars per year and often varied substantially from year to year; the average annual fluctuation in the value of the discount was 25 million dollars. The average discount, then, is associated with a contributions increase of 17,325 dollars, which is quite substantial compared with the annual company average of 18,578 dollars from Table 1.7. Positive and significant estimates of the elasticity of contributions with respect to discount receipts in Panel B confirm this relationship. Table 1.8b reports the same results for the subsample of corporations that report profits data. The results are consistent with the estimates in Table 1.8a, though the point estimates tend to be larger. Controlling for profits has almost no effect on the estimates for this subsample, which is reassuring for the full sample results.

Interestingly, these estimates are close to previous estimates of the relationship between corporate profits and political contributions. Jayachandran (2006) finds that for every dollar companies had donated to the Republican party, firms lost 2,313 dollars of their market value following the shift of control in the U.S. Senate when Senator Jim Jeffords switched his party affiliation from Republican to Democrat in May 2001. This estimate implies that a one million dollar decrease in market value would have been associated with a contribution of 432 dollars to the Republican party. My estimates of the effect of discount receipts on overall political giving indicate an increase of 385 dollars in response to the receipt of one million dollars in discounted crude. Ansolabehere et al. (2003) find that top corporate executives increased their personal giving to congressional campaigns by 510 dollars for every additional million dollars of income per year.

I also address the direct effect of profits on contributions by comparing the effect of the discount with that of non-discount profit shocks. To capture non discount-related variation in refiner profits, I use hurricane landfall events as an instrument for annual profits. Hurricanes affect oil and petroleum product production in several ways. As a hurricane approaches the coast, offshore platforms are evacuated and wellheads are plugged to prevent leakage. These offshore platforms are sometimes destroyed by hurricanes, which imposes direct costs on producers and disrupts oil supplies. In addition to shutting down upstream crude, hurricanes also affect downstream infrastructure. Underwater pipelines can be damaged, and ports may stop accepting shipments. Onshore refineries can also be heavily damaged; Hurricane Rita, for example, caused refining capacity losses of more than 4.9 million bpd due to direct damage or power interruptions along the Texas coast (EIA 2006).[33]

To construct the hurricane instrument, I create a dummy variable equal to 1 if a company had a refinery in a state that was hit by a hurricane in that year. This is further split into dummy variables for each hurricane category – i.e. dummy variables indicating the most severe hurricane level experienced by a refinery owned by company j in year t. I focus on the most damaging hurricanes, i.e. those that were classified as category 2, 3, or 4 on the Saffir-Simpson scale (Simpson & Saffir 1974), with sustained surface wind speeds of 82-95 knots, 96-112 knots, and 113-136 knots, respectively.[34]

I then use these hurricane indicators to instrument for profits in a regression of political contributions on refining profits and discount receipts.[35]

$$(FS) \qquad Profits_{jt} = \delta \cdot DiscValue_{jt} + \zeta_1 \cdot \mathbb{1}(\text{Category } 2)_{jt} + \zeta_2 \cdot \mathbb{1}(\text{Category } 3^{+})_{jt} + \alpha_j + \gamma_t + \epsilon_{jt}$$

$$\widehat{Profits}_{jt}^{hurr} = \widehat{\zeta_1} \cdot \mathbb{1}(\text{Category } 2)_{jt} + \widehat{\zeta_2} \cdot \mathbb{1}(\text{Category } 3^{+})_{jt}$$

$$(SS) \qquad Contrib_{jt} = \beta_1 \cdot DiscValue_{jt} + \beta_2 \cdot \widehat{Profits}_{jt}^{hurr} + \alpha_j + \gamma_t + \nu_{jt} \tag{1.8}$$

I then test $\beta_1 > \beta_2$ to determine whether discount receipts had a larger effect than other types of profits. Table 1.9 reports the results for the regression of total contributions on discount value and profits orthogonal to the discount. Panel A reports results from the first stage regression, which confirm that discounts increase profits and hurricanes decrease them, and that the hurricane instruments and the discount have comparable explanatory power for profits. The results in panel B show that only discount receipts seem to have an effect on total contributions, with a one million dollar increase in the discount associated with a 317 dollar increase in contributions (column 1). Column 2 shows the corresponding elasticity estimate, and a ten percent increase in the discount is associated with a 3 percent increase in political contributions. Profits not associated with the

[33] Other papers have examined the effect of hurricanes and tropical storms on U.S. refined product markets, including Fink, Fink & Russell (2010), Kaiser, Dismukes & Yu (2009) and Lewis (2009).

[34] There are five relevant hurricane landfall events in the sample. Two of these were category two hurricanes: Bob (New York 1991) and Georges (Mississippi 1998). The two category three hurricanes were Andrew (Louisiana 1992) and Bret (Texas 1999), and there was one category four hurricane, Iniki (Hawaii, 1992). Hurricane landfall and severity data comes from NOAA (2006).

[35] Allowing for more flexibility in the effects of hurricane landfall events on profits has little impact on the results. In particular, indicators for refineries owned in adjacent states were statistically insignificant in the first stage and had no effect on the two-stage least squares results.

discount have no statistically significant effect on contributions, and the point estimates are close to zero as well. In both regressions we can reject the hypothesis that discount receipts and orthogonal profit shocks have the same effect on contributions.

The second set of results (Table 1.10) shows the relationship between the discount value and the way that total contributions were allocated among various committees. For the foreign policy committees, for example, the regression is of the share of congressional contributions that go to members of the House or Senate foreign policy committees.

$$Share_{jt}^{FP} = \frac{Contrib_{jt}^{FP}}{Contrib_{jt}^{total}} = \theta \cdot DiscValue_{jt} + \alpha_j + \gamma_t + \epsilon_{jt} \tag{1.9}$$

Though the standard errors on these estimates are large, the pattern is suggestive. The coefficient on contributions to the foreign policy committees is not statistically significant, but there is a substantial increase in contributions to members of the Appropriations committees, which also review Saudi-relevant legislation. The coefficient in Column 2 indicates that a one billion dollar increase in the discount is associated with a 39 percentage point increase in the share of contributions that go to Appropriations committee members. The average discount of 45 million dollars would therefore correspond to a 1.8 percentage point increase in contributions to members of the Appropriations committees. This is about seven percent of the average share of 27 percent. I also include some results for "placebo" committees, that would be less likely to be concerned with Saudi affairs. Most of these coefficients are negative and significant with the exception of the House Post Office and Senate Labor committees, which appear to be unaffected.[36]

1.5.4 Politician-Level Contributions

To further understand the effect of the discount on political giving, I also examine the effect of the discount on corporate contributions at the politician level. In this part of the analysis, company-year level discount receipts are interacted with a set of politician characteristics (g_i) to estimate how discount receipts affected contributions to different types of politicians. These politician characteristics include a dummy variable for receiving contributions from Pro-Israel interest groups, quintiles of the level of pro-Israeli contributions, party affiliation and committee membership. This yields:

$$Contrib_{ijt} = \theta \cdot g_i \cdot DiscValue_{jt} + X_{it}\beta + \alpha_{ij} + \gamma_t + \epsilon_{jt} \tag{1.10}$$

[36]As in Table 1.9, most of these results remain the same when I control for profits, though the further loss of observations increases the standard errors.

where the subscript i indicates the politician, and j and t the company and year. Controls X_{it} are dummies for the time-varying politician characteristics (chamber seniority and committee membership).

In Table 1.11a, we see that the discount tended to decrease giving to pro-Israel politicians, with a one billion dollar increase in discount receipts decreasing annual contributions by an additional 180 dollars to politicians who received pro-Israel funding (column 1). Column 2 shows this same result split up by quintile, and the point estimates (though not statistically significant) indicate larger penalties for politicians in the highest pro-Israel funding quintiles associated with the discount. The pattern is similar in the regression with the full set of interactions and the coefficients are individually significant. Republican politicians benefit more from the discount than Democrats and independents. Republican candidates get a 166 dollar boost from companies that received an additional billion dollar discount relative to Democrats and independents (column 3). Again, the pattern is the same in column 5, with Republicans taking a 141 dollar increase. The evidence on the committee membership patterns is much more mixed, and contrasts with the patterns in the aggregate contribution regressions. Point estimates on the committee membership interactions are very sensitive to controls, and are large and negative for the House Foreign Affairs committee in both columns 4 and 5. Estimates for members of other committees are noisy, and although point estimates are quite large none are statistically significant.[37]

In general, these results indicate significant politician-level heterogeneity in the impact of the discount on funding by refining companies. Top beneficiaries were Republicans and candidates who did not receive funding from pro-Israeli groups. If Israeli interest groups donated more to candidates that were perceived as being pro-Israel, this could indicate that the discount caused refining companies to divert funds away from pro-Israel politicians, a move consistent with the Saudi political agenda toward the Arab-Israeli conflict.

It is important to note here that all of these estimates are quite small. The 253 dollar penalty to pro-Israel donation recipients, for example, implies that the average discount of 45 million dollars would be associated with just an eleven-dollar decrease in contributions to these candidates. From Table 1.7, the average contribution to these candidates, however, is only 38 dollars, so the eleven-

[37]When the sample is restricted to years when the discount was large (1998-2003, Table 1.11b), the patterns become more clear for the pro-Israel and committee assignment results. In particular, the estimate of the discount penalty to pro-Israel donation recipients increases to 253 dollars, and a statistically significant pattern of larger penalties to politicians who received more pro-Israel money emerges (column 2). The large positive effect on members of the Senate Appropriations committee is statistically significant in columns 4 and 5 at around 2,400 dollars. The negative estimate for members of the House Foreign Affairs committee decreases to 621 dollars (column 4), and the magnitude of the (still statistically insignificant) point estimate for the Senate Foreign Affairs members decreases as well.

dollar increase is a reasonable proportion of the total, though difficult to think of as practically significant. Nonetheless, the pattern of the change in this type of contribution is likely suggestive of other political responses, both financial and otherwise, by discount recipients.

1.6 Conclusion

This paper examines the effect of the Saudi crude discount program on the political behavior of U.S. firms. This policy is an empirically appealing example of Saudi strategic political behavior both because it had a clearly measurable cost and because it was effectively directed at specific recipients. There are three main sets of results. First, I calculate that the program transferred substantial rents to the U.S. market, with a total discount value of 8.5 billion dollars over the policy period. Second, I find that the discounted crude was almost entirely a gift to refinery owners, with full pass-through of discount receipts into refiner profits. Finally, the results suggest that this gift induced some amount of pro-Saudi political action on the part of recipients. In particular, I find that discount receipts were associated with higher levels of overall political giving and with an increase in the share of funds directed toward members of key congressional committees. On the politician level, there is also some evidence that recipients tended to divert funds away from congressmen who received donations from pro-Israel interest groups.

There are two possible explanations for this observed pattern in the data. First, the pro-Saudi shift in corporate political contributions could reflect a direct and intentional effort by Saudi Arabia to influence the U.S. political process. However, the pattern is also consistent with rent-seeking by firms trying to protect their future access to discounted crude. This behavior could reflect either a desire to be seen as friendly by Saudi Arabia, or simply efforts to protect the interests of a country with which they had developed close economic ties. In any case, the results indicate that U.S. refiners responded to the discount, and that the policy successfully influenced their political action.

Figures

Figure 1-1: Annual Value of U.S. Weapons Sales to Saudi Arabia, mil 1990 USD. Source: SIPRI

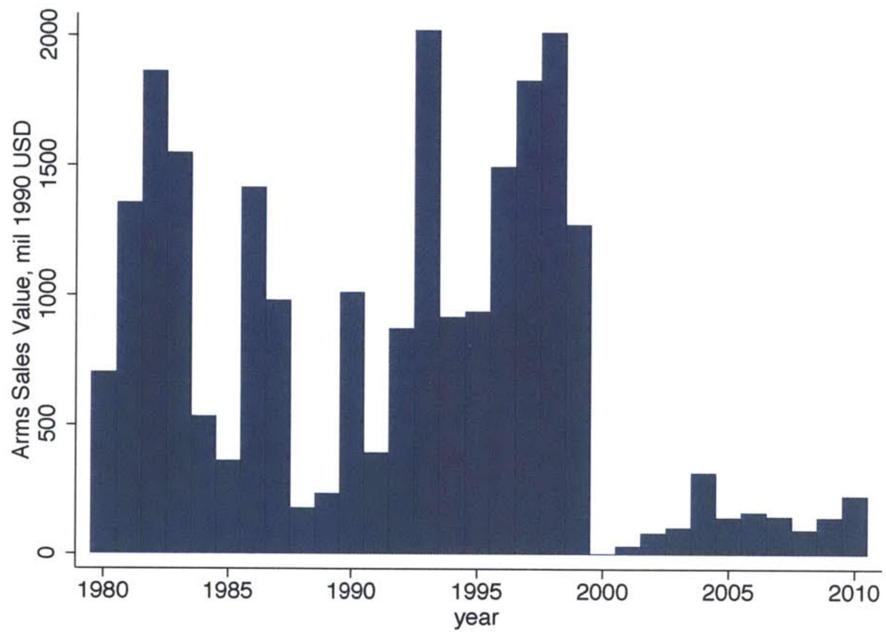


Figure 1-2: U.S. Crude Imports by Country, mil bbl per month (12mma). Source: EIA-814.

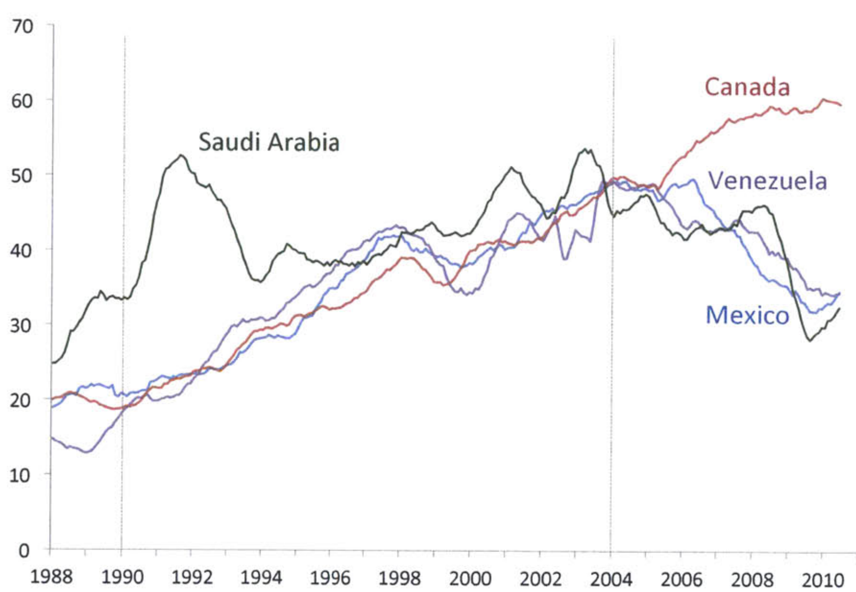
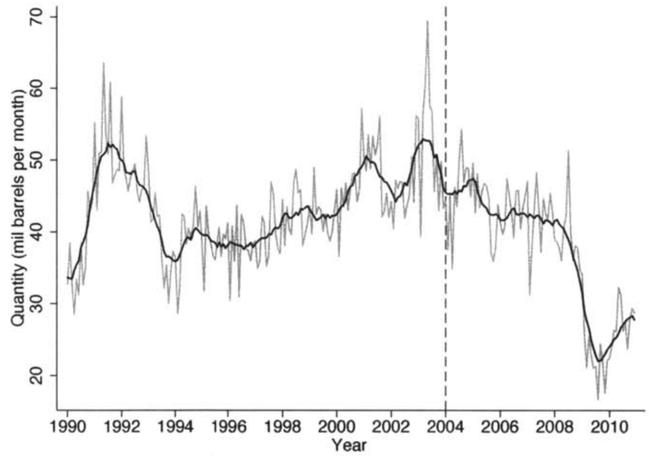
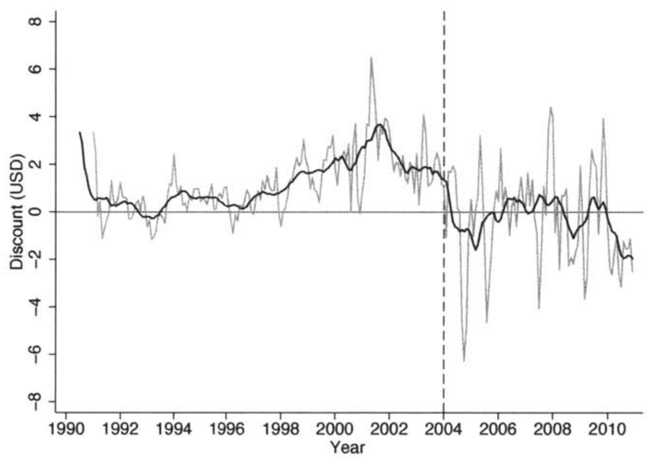


Figure 1-3: Saudi Crude Quantity, Discount, and Discount Value

(a) Saudi Crude Deliveries to U.S. Refineries, mil bbl per month. Source: EIA-814



(b) Saudi Crude Discount to U.S. Refineries, $(p_{ASIA} - p_{US})$. Source: Platts



(c) Total Value of the Saudi Crude Discount, mil 2000 USD per month

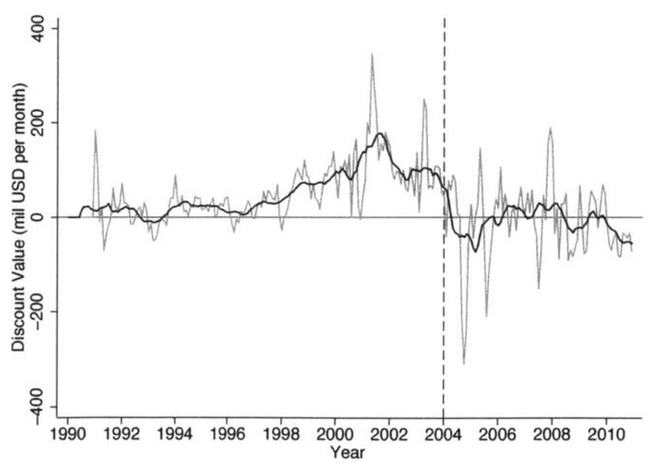


Figure 1-4: Sample OSP Releases for December 2001. Source: Platts

Singapore (Platts) - 4 Dec 2001/9.58 pm EST/2.58 GMT

	Benchmark	Aug	Sep	Oct	Nov	Dec	Jan
Extra Light	WTI	-2.75	-3.35	-3.25	-3.05	-3.05	-2.75
Arab Light	WTI	-4.30	-4.80	-5.10	-4.75	-4.75	-4.05
Arab Medium	WTI	-5.35	-6.05	-6.40	-5.95	-5.75	-4.85
Arab Heavy	WTI	-7.00	-7.40	-6.80	-6.30	-6.65	-5.65

All prices are FOB Ras Tanura.

--Platts Global Alert--

Singapore (Platts) - 4 Dec 2001/7.20 pm EST/0.20 GMT

	Benchmark	Aug	Sep	Oct	Nov	Dec	Jan
Super Light	(Oman+Dubai)/2	+2.85	+1.95	+1.55	+1.15	+1.05	+1.05
Extra Light	(Oman+Dubai)/2	+1.65	+1.15	+1.15	+0.75	+0.55	+0.55
Arab Light	(Oman+Dubai)/2	+0.50	+0.30	+0.30	+0.20	+0.20	+0.25
Arab Medium	(Oman+Dubai)/2	-0.30	-0.20	-0.20	-0.10	-0.20	-0.10
Arab Heavy	(Oman+Dubai)/2	-1.10	-0.80	-0.80	-0.55	-0.65	-0.50

Sales of Saudi crude into Asia loading FOB Ras Tanura are priced versus the average of Oman/Dubai, plus or minus a differential.

--Platts Global Alert--

Figure 1-5: Crude Refining Inputs and Refined Product Distribution

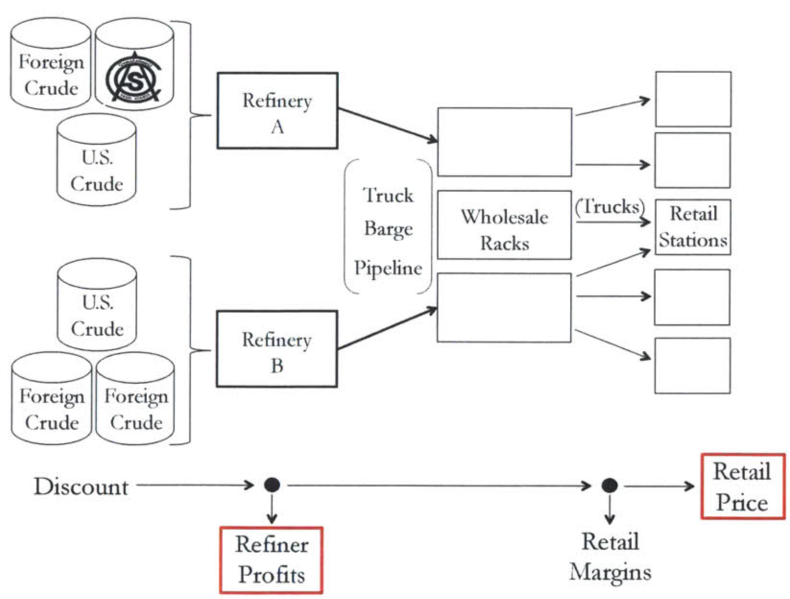
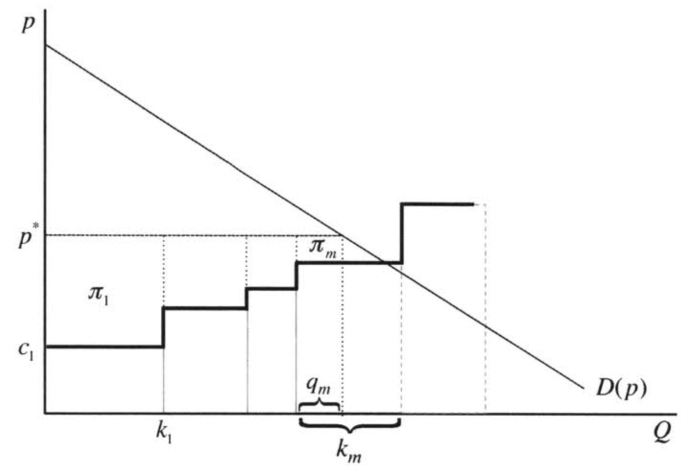
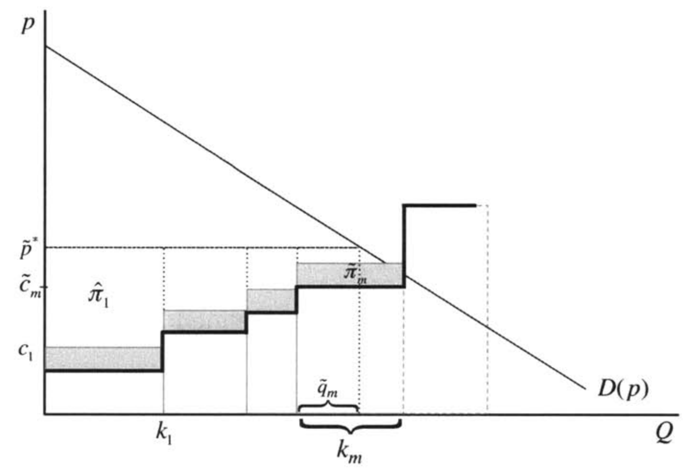


Figure 1-6: Common cost shocks affect both price and profits, but inframarginal shocks affect only profits.

(a) Equilibrium without discounts



(b) Common crude price shock affects both price and profits



(c) Discount to inframarginal producers affects profits but not prices

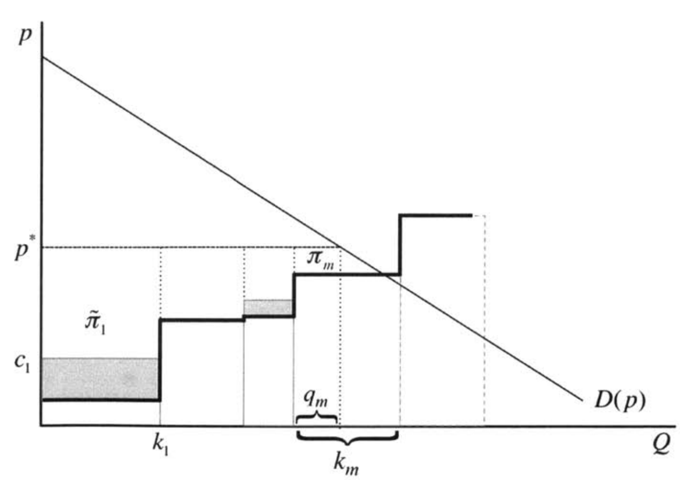
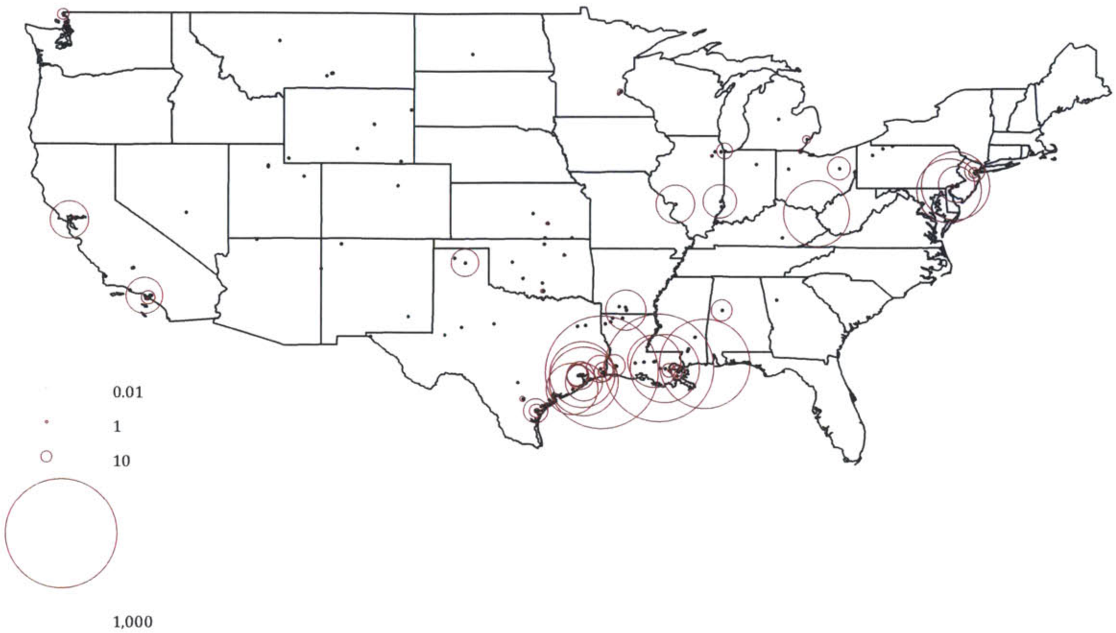


Figure 1-7: Geographic Destinations of Saudi Crude and Discount Value, 1991-2003

(a) Saudi crude quantity by refinery, mil bbl



(b) Total discount value by refinery, mil 2000 USD

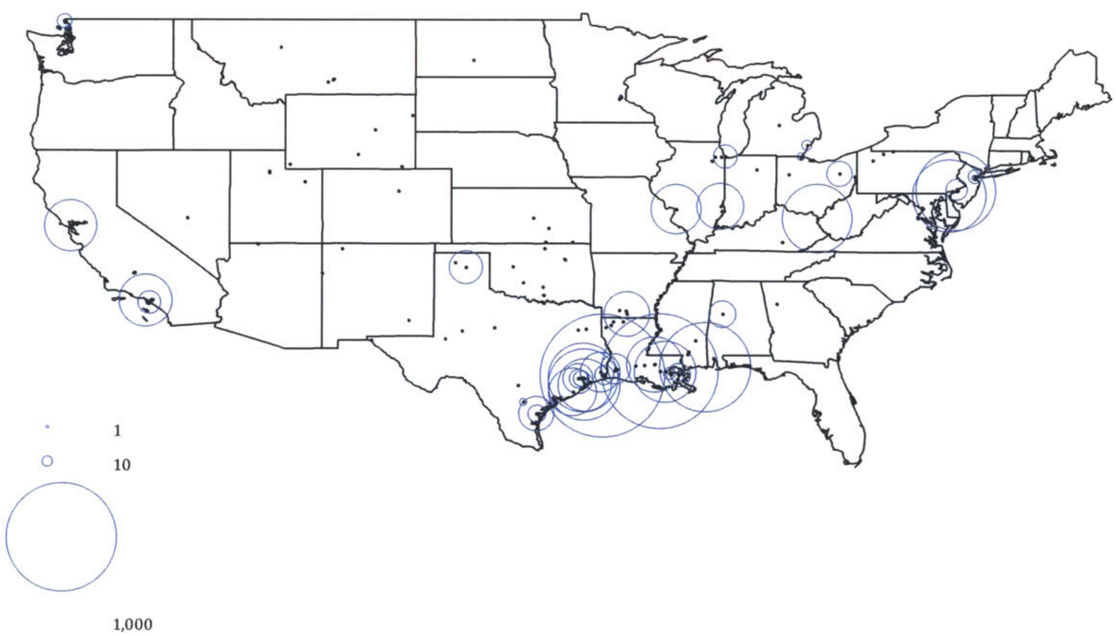


Figure 1-8: State-level Saudi inputs as a share of total refining capacity

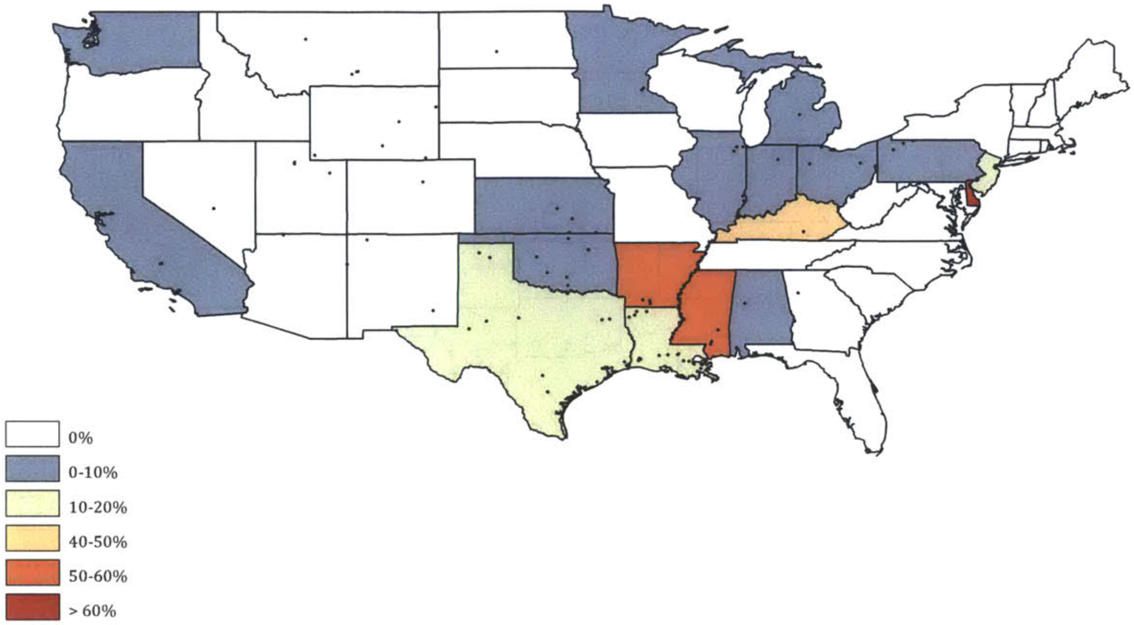
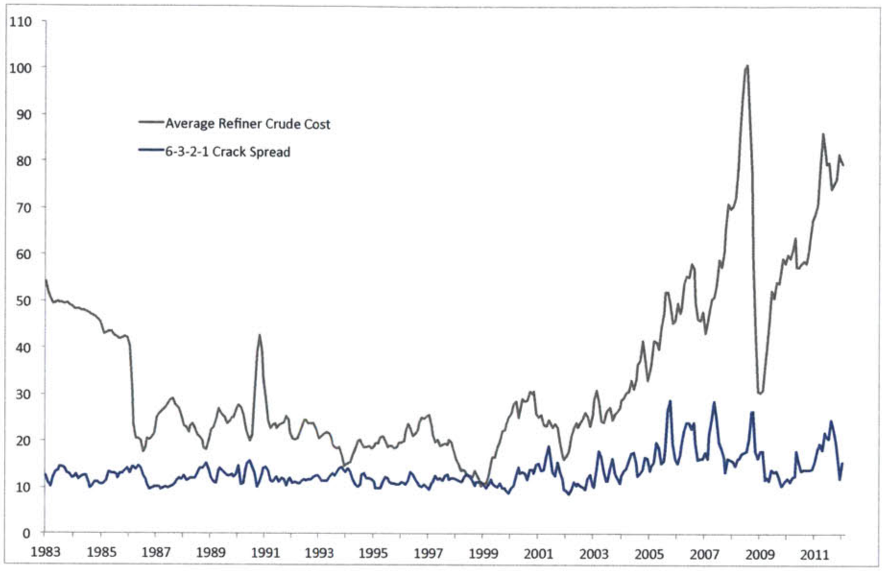


Figure 1-9: Product Pipelines, 2004.

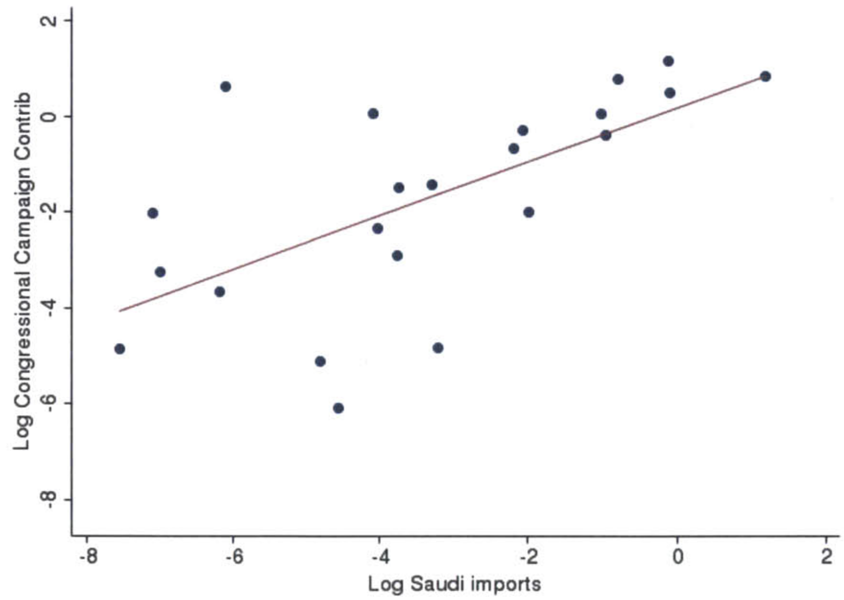
Note: The pipelines in this map were used to construct the markets in panel B of table 1.5.
Source: `http://www.theodora.com/pipelines/united_states_pipelines.html#map`

Figure 1-10: Crack Spread and Average Refiner Crude Cost



Note: The crack spread is calculated as the difference in cost between a barrel of crude and a representative mix of typical outputs. For example, a simple version (the 2-1-1) is calculated as the difference in cost of 2 barrels of crude and a barrel of gasoline and a barrel of heating oil/diesel. Here I use the 6-3-2-1 crack spread, which is the difference in the total cost of 6 barrels of crude and outputs of 3 barrels of gasoline, 2 barrels of heating oil/diesel, and 1 barrel of residual fuel oil. Trends are the same for each of the four standard spreads. Source: EIA.

Figure 1-11: Correlation of Total Saudi Imports and Total Campaign Contributions by Company



Note: This figure plots the log of total congressional campaign contributions (mil USD) over the 1991-2003 period against the log of total Saudi imports (thousands of barrels).
Fitted line is ln(amount) = 0.562 * ln(Saudi imports) + 0.175; F(1,20) = 13.55.

Tables

Table 1.1: Refinery owner characteristics and receipts, 1991-2003

Owner	Disc Value (bil USD)	Saudi Imports (bil bbl)	Refining Capacity (bil bbl)	Share Inputs Saudi	No. Refs	No. Saudi Refs	Refining Profits (bil USD)	Disc/ Profits
Chevron / Texaco	4.05	3.26	10.16	0.32	18	12	39.84	0.10
Marathon	1.01	0.68	3.50	0.19	7	6	10.81	0.09
ExxonMobil	0.97	0.89	9.03	0.10	10	8	73.94	0.01
Valero	0.84	0.39	1.82	0.21	14	6	4.71	0.18
BP / Amoco	0.57	0.45	9.28	0.05	15	6	34.68	0.02
ConocoPhillips	0.46	0.37	4.97	0.07	17	5	1.17	0.39
Royal Dutch Shell	0.09	0.13	4.13	0.03	15	7	40.13	0.002
Premcor	0.08	0.04	1.70	0.02	6	2	1.10	0.07
Tosco	0.06	0.02	2.53	0.01	10	2	3.22	0.02
Murphy	0.05	0.02	0.61	0.03	2	1	0.33	0.12
Sunoco	0.05	0.11	3.45	0.03	6	2	1.52	0.03
Lyondell	0.03	0.04	1.25	0.04	1	1	0.99	0.03
Alon USA	0.02	0.01	0.34	0.02	2	1	0.04	0.50
Fina	0.01	0.02	0.78	0.03	3	1	0.05	0.20
Total	0.002	0.002	0.62	0.003	3	1	13.72	<0.001
UDS	0.001	0.001	1.27	0.001	4	2	3.31	<0.001
Amerada Hess	0	0	2.46	0	2	0	0.13	0
Citgo	0	0	2.37	0	4	0	1.53	0
Tesoro	0	0	0.94	0	6	0	1.12	0
UnoCal	0	0	0.67	0	3	0	0.57	0
Mapco	0	0	0.56	0	2	0	0.64	0
Farmland Ind	0	0	0.54	0	2	0	0.07	0
Crown Central	0	0	0.47	0	1	0	-0.04	0
PDVSA	0	0	0.39	0	1	0	0.99	0
Frontier	0	0	0.35	0	2	0	0.42	0
Holly	0	0	0.31	0	3	0	0.55	0
United Refining	0	0	0.29	0	1	0	0.09	0
Delek	0	0	0.26	0	1	0	0	.
Pennzoil / Quaker	0	0	0.28	0	3	0	0.72	0
Giant Industries	0	0	0.18	0	3	0	0.42	0
Big West	0	0	0.11	0	1	0	0	.
Calumet	0	0	0.10	0	3	0	0.00	.
Huntway Refining	0	0	0.06	0	2	0	0.06	0
AIPC	0	0	0.03	0	1	0	-0.06	0
Suncor	0	0	0.02	0	1	0	0.34	0
Greka Energy	0	0	0.01	0	1	0	0.00	.
SABA Petrol	0	0	0.01	0	1	0	0	.

Notes: This table provides sample statistics on the refinery-owners that are publicly-listed. Columns 1-6 are calculated using refinery-level observations on monthly Saudi imports and crude prices and annual refinery capacity reports from the EIA. Columns 5 and 6 indicate the number of unique refineries that were owned by the company during the policy period and the number of these that received any amount of Saudi crude during the period. Total refining profits is the sum of the annual operating profits variable for refining operations from the Compustat Business Segments data, and total net income is the sum of the quarterly net income entries from the Compustat aggregation of the SEC-10K filings. Column 8 reports the ratio between the value of discount receipts relative to total refining profits. All dollar values are billions of real 2000 USD.

Table 1.2: Refiner Characteristics and Saudi Crude Receipts

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Saudi Crude Refinery (89/90)	0.647***	0.639***	0.637***	0.642***	0.635***	0.637***	0.626***
	(0.086)	(0.125)	(0.090)	(0.090)	(0.089)	(0.087)	(0.103)
Total Refining Capacity	0.025	0.062	0.007	-0.005	0.008	0.002	0.062
	(0.030)	(0.058)	(0.032)	(0.039)	(0.035)	(0.035)	(0.082)
Former Aramco Partner	-0.012	0.036	-0.080	-0.090	-0.079	-0.070	-0.554
	(0.113)	(0.247)	(0.130)	(0.130)	(0.104)	(0.132)	(0.676)
Overall Political Contrib (89/90)			0.001				
			(0.001)				
Politicians				0.001			
				(0.001)			
Committees				-0.001			
				(0.002)			
Pro-Israel Recipients					0.001		
					(0.001)		
Republican						0.001	
						(0.001)	
Democratic						0.001	
						(0.001)	
House Appropriations							0.072
							(0.053)
House Armed Services							0.116**
							(0.056)
House Energy							-0.058**
							(0.026)
House Educ & Labor							-0.024
							(0.073)
House Foreign Affairs							-0.213**
							(0.087)
House Post Office							-0.199
							(0.135)
Senate Appropriations							0.011
							(0.015)
Senate Armed Serv.							-0.158*
							(0.083)
Senate Energy							-0.026
							(0.024)
Senate For. Rel.							0.095*
							(0.054)
Senate Govt Affairs							0.145
							(0.102)
Senate Labor							0.088
							(0.068)
State Dummies		x					
R^2	0.373	0.620	0.379	0.381	0.376	0.380	0.434
N	115	115	115	115	115	115	115

Notes: Results for LPM regression of a dummy for whether a refining company received Saudi crude during the policy period on a set of refiner characteristics. These include whether the company ever owned a refinery that had processed Saudi crude in the pre-policy period (1989-1990), total refining capacity in billions, an indicator for the former Aramco partners, and pre-period political contributions to Members of Congress by party affiliation and committee membership. All political contributions are in thousands of 2000 USD. State dummies indicate whether a company owned any refineries in a particular state.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.3: Impact of the Discount on Refining Profits

	Quantity: log (1)	Quantity: log (2)	Value: level (3)
Discount Value	0.016**	0.169***	3.38**
	(0.007)	(0.045)	(1.56)
H_0: full pass-through (p-value)	0.620	0.101	0.135
Companies	39	16	39
N	317	81	317

Notes: Columns 1 and 2 report results from the regressions of log annual company-level refining profits on log quantity of Saudi crude delivered to refineries owned by the same company in that year for the 1991-2003 period. In the regression in Column 1, 1 is added to profits and 1 to quantity to avoid losing observations (both in billions) and column 2 drops observations with negative profit observations or zero Saudi quantities. Column 3 shows the results from a regression of the level of refining profits on total discount value. The second row reports the p-value of an F-test of the coefficient against the full pass-through benchmark of 0.02 for column 1, 0.09 for column 2 and 1 for column 3. All regressions include company and year fixed effects. Standard errors are clustered at the company level.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.4: Saudi Crude Receipts and Refinery Output

	(1)	(2)	(3)
ln(Saudi Crude Receipts)	0.001	0.004*	0.003*
	(0.002)	(0.002)	(0.001)
ln(Refining Capacity)	1.103***	1.142***	0.661***
	(0.081)	(0.065)	(0.174)
District FE	x	x	x
District FE * t			x
Year FE		x	x
N	156	156	156

Notes: This table shows the results from the regression of log annual district-level production on the log of Saudi crude receipts to all refineries in the district for the 1991-2003 period. Refinery output is calculated at the district level for twelve refining districts using refining capacity from the EIA Refining Capacity Report and capacity utilization rates from the EIA-810 Monthly Refinery Report. One is added to all three variables to avoid dropping observations. Standard errors are clustered at the district level.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.5: Impact of the Discount on City-Level Retail Gasoline Prices

	Quantity: log (1)	Quantity: log (2)	Value: level (3)
	Panel A: Local Markets		
Discount per Gallon	-0.0002	-0.001	-0.031
	(0.0007)	(0.002)	(0.112)
H_0: full pass-through (p-value)	<0.001	<0.001	<0.001
	Panel B: Pipeline-Connected Markets		
Discount per Gallon	0.0001	-0.001	-0.002
	(0.0009)	(0.002)	(0.142)
H_0: full pass-through (p-value)	<0.001	<0.001	<0.001
Cities	75	31	75
N	5326	1375	5326

Notes: Columns 1 and 2 report results from the regressions of the log of monthly city-level gasoline prices on log of Saudi crude deliveries as a share of total local refining capacity for the 1998-2003 period. In the regression in Column 1, 0.01 is added to share to avoid losing observations and column 2 drops observations with zero Saudi quantities. Column 3 shows the results from a regression of gasoline price levels on monthly discount per gallon of local refining capacity. Panel B reports the same results accounting for all imports and refining capacity "up-pipe" of the city. The second row in both panels reports the p-value of an F-test of the coefficient against the full pass-through benchmark of -0.04 for column 1, -0.15 for column 2 and -1 for column 3. All regressions include city and state x year x month fixed effects. Standard errors are clustered at the city level.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.6: Political Contributions and Discount Value by Company, 1991-2003

Corporation	Total Contrib	Politician Contrib	PAC Contrib	Disc Value	Share Inputs Saudi	Share Saudi Exports	Refining Profits	Disc / Profits
Chevron/Texaco	7.720	2.704	4.928	4,049	0.683	0.475	39,840	0.10
Marathon	3.806	2.053	1.682	1,005	0.441	0.131	10,810	0.09
ExxonMobil	7.093	4.296	2.669	970	0.185	0.129	73.940	0.01
BP/Amoco/ARCO	8.592	2.586	2.681	567	0.130	0.066	34,680	0.02
Valero	1.636	0.745	0.852	835	0.211	0.056	4,710	0.18
ConocoPhillips	3.403	1.370	1.938	460	0.218	0.053	1,170	0.39
Ergon	0.263	0.202	0.049	172	0.345	0.020	.	.
Royal Dutch Shell	1.245	0.810	0.384	85	0.030	0.018	40,130	0.002
Sunoco	1.696	0.561	1.112	45	0.033	0.016	1,520	0.03
Lyondell	0.0002	0	0.0002	34	0.035	0.006	990	0.03
Premcor	0.014	0.009	0.003	81	0.024	0.006	1,100	0.07
Hunt	1.036	0.286	0.700	62	0.232	0.005	.	.
Tosco	0.793	0.306	0.474	64	0.009	0.003	3,220	0.02
Fina	0.113	0.052	0.058	13	0.030	0.003	50	0.26
Murphy	0.688	0.150	0.496	45	0.029	0.003	330	0.14
Coastal	2.762	1.136	1.575	27	0.014	0.002	.	.
Phibro	0.007	0.007	0	2	0.018	0.002	.	.
Chalmette	0	0	0	19	0.027	0.002	.	.
Alon USA	0.010	0.007	0.003	22	0.024	0.001	40	0.55
Koch	6.214	2.471	3.615	1	0.001	0.0003	.	.
Total	0.037	0.031	0.006	2	0.003	0.0003	13,720	<.001
Basis	0.001	0.001	0	0	0.021	0.0003	.	.
Orion	0	0	0	1	0.005	0.0002	.	.
Sinclair	0.046	0.040	0.004	-1	0.002	0.0001	.	.
UDS	0.186	0.150	0.010	1	0.001	0.0001	3,310	<.001
Flint Hills	0.008	0.008	0	1	0.001	0.0001	.	.

Notes: Includes all public and private companies with any Saudi imports over the period. Columns 1-3 are calculated using data from the FEC filings available at http://data.influenceexplorer.com/docs/contributions. Column 2 includes only direct contributions to campaigns for House and Senate seats, and Column 3 totals contributions to political committees. Columns 4-6 are calculated using refinery-level observations on monthly Saudi imports and crude prices and annual refinery capacity reports from the EIA. Total refining profits is the sum of the annual operating profits variable for refining operations from the Compustat Business Segments data. Column 8 reports the ratio between the value of discount receipts relative to total refining profits. All dollar values are millions of real 2000 USD.

Table 1.7: Summary Statistics for Politician-Level Political Contributions: 1993-2003

	Conditional (>0)					Unconditional	
	Mean	Median	Max	SD	N	Mean	N
Overall	1,487	997	44,901	1,883	10,680	34	464,954
Received pro-Israel Contribs	1,595	1,026	44,901	2,042	8,218	38	337,583
ISR27-40	1,187	933	38,732	1,852	1,314	26	59,307
ISR40-60	1,182	937	17,618	1,370	2,204	28	92,447
ISR60-80	1,709	1,053	31,402	2,074	2,534	46	93,418
ISR80+	2,130	1,157	44,901	2,496	2,166	50	92,411
Republican	1,572	1,006	44,901	2,014	7,701	52	230,456
Democrat	1,269	958	21,155	1,472	2,977	16	232,655
Independent	721	721	963	342	2	1	1,354
House	1,247	951	44,901	1,584	8,515	28	379,093
Senate	2,431	1,406	31,402	2,554	2,165	61	85,861
House Appropriations	1,244	960	38,732	1,746	1,210	1,224	1,223
Senate Appropriations	2,508	1,877	21,155	2,517	708	2,454	721
House Foreign Affairs	1,136	697	44,901	2,085	591	1,097	606
Senate Foreign Relations	2,478	1,199	31,402	3,103	393	2,439	399
Company-Level Total	34,861	7,404	374,089	57,333	453	18,578	850

Notes: This table reports annual average values for contributions by refining companies to members of congress. The left panel reports statistics on the non-zero entries in the dataset, e.g. the size of an annual contribution conditional on a contribution being made by that company to that politician in a given year. The right panel reports statistics on the entire annual company by politician sample, including zeros for years in which the politician was a member of congress and the company existed but no contribution was made. The last row of the table gives annual averages by company. Contribution values are in 2000 USD.

Table 1.8: Discount Correlation with Refiner Political Contributions

(a) All RefiningFirms

	Total (1)	Politicians (2)	PACs (3)
	Panel A: Levels		
Discount Value	0.385**	0.107	0.271***
	(0.170)	(0.092)	(0.086)
	Panel B: Elasticities		
ln(Discount Value)	0.440***	0.432***	0.418**
	(0.149)	(0.114)	(0.186)
Companies	115	115	115
N	1033	1033	1033

Notes: Panel A shows the results from regressions of total annual political contributions on total discount value (in thousands) in the same year over the 1991-2003 period, and Panel B reports the elasticity of giving with respect to changes in the value of the discount. Column 1 shows the correlation with total overall political contributions, and columns 2 and 3 break this overall effect into the effects on contributions to individual politicians and to PACs. All regressions include company and year fixed effects. Standard errors are clustered at the company level.

*** p<0.01, ** p<0.05, * p<0.1

(b) Public Refining Firms Only

	Total (1)	Politicians (2)	PACs (3)
	Panel A: Levels		
Discount Value	0.385**	0.107	0.271***
	(0.170)	(0.092)	(0.086)
	Panel B: Elasticities		
ln(Discount Value)	0.440***	0.432***	0.418**
	(0.149)	(0.114)	(0.186)
Companies	115	115	115
N	1033	1033	1033

Notes: Panel A shows the results from regressions of total annual political contributions on total discount value (in thousands) in the same year over the 1991-2003 period, and Panel B reports the elasticity of giving with respect to changes in the value of the discount. Column 1 shows the correlation with total overall political contributions, and columns 2 and 3 break this overall effect into the effects on contributions to individual politicians and to PACs. All regressions include company and year fixed effects. Standard errors are clustered at the company level.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.9: Profit Shocks and Total Political Contributions

	Levels (1)	Elasticity (2)
Panel A: First Stage (Profits on Discount and Hurricane Indicators)		
Discount Value	3.89**	1.90***
	(1.67)	(0.57)
I(Category 2)	-2.57***	-0.93***
	(0.24)	(0.05)
I(Category 3^+)	-0.21**	-0.11*
	(0.09)	(0.06)
Partial R^2 (Discount Value)	0.004	0.006
Partial R^2 (Hurricane Indicators)	0.010	0.010
Panel B: Second Stage (Contributions on Profits)		
Discount Value	0.317***	0.302**
	(0.089)	(0.092)
Profits from Hurricane Shocks	-0.005	-0.002
	(0.013)	(0.030)
F-test p-value	0.001	0.007
Companies	38	38
N	316	316

Notes: Results from a two-stage least squares procedure showing the effects of discount receipts and profits shocks associated with hurricanes on total refiner political contributions over the 1991-2003 period. Profits are in thousands of 2000 USD and contributions in 2000 USD. Regressions include company and year fixed effects. One is added to contributions, discount, and profits (all in billions of 2000 USD) to avoid losing observations in the regressions in column 2.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.10: Discount Value and Share of Political Contributions by Committee

	FP (Both) (1)	Approp (Both) (2)	Energy (Both) (3)	Educ (House) (4)	Post Office (House) (5)	Labor (Senate) (6)	Indian Affairs (Senate) (7)
Discount Value	0.113	0.385**	-0.508**	-0.677**	-0.035	0.021	-0.358**
	(0.084)	(0.156)	(0.254)	(0.280)	(0.067)	(0.068)	(0.148)
Sample Avg	0.104	0.271	0.223	0.040	0.010	0.030	0.065
Companies	77	77	77	77	77	77	77
N	532	532	532	532	532	532	532

Notes: This table reports the relationship between the total Saudi discount value and share of total refiner political contributions by committee membership over the 1991-2003 period. Discount value in billions of 2000 USD. All regressions include company and year fixed effects. Standard errors are clustered at the company level.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.11: Discount Receipts and Politician-Level Political Contributions

(a) Full Sample: 1993-2003

	(1)	(2)	(3)	(4)	(5)
(ISR=1)*DiscValue	-118.21*				
	(66.70)				
(ISR27-40)*DiscValue		-65.65			-20.51
		(92.88)			(90.36)
(ISR40-60)*DiscValue		-72.93			-47.54
		(74.46)			(75.18)
(ISR60-80)*DiscValue		-140.73			-152.78
		(89.07)			(94.70)
(ISR80+)*DiscValue		-176.70			-162.53
		(138.87)			(135.90)
Republican*DiscValue			166.23**		140.54*
			(73.18)		(77.91)
(House Approp)*DiscValue				92.99	57.16
				(402.97)	(403.16)
(Senate Approp)*DiscValue				1685.37	1705.26
				(1079.05)	(1080.74)
(House For. Aff.)*DiscValue				-1177.70***	-1212.62***
				(398.24)	(402.23)
(Senate For. Rel.)*DiscValue				-1570.44	-1543.64
				(1278.91)	(1262.46)
N	464,954	464,954	464,954	464,954	464,954

Notes: This table shows the results from the regression of annual politician by company level political contributions on the interaction of company discount values with politician characteristics. All regressions include politician by company and year fixed effects and controls for committee membership and discount value. Discount value in billions of 2000 USD, contributions in 2000 USD. Standard errors are clustered at the politician by company level.
*** p<0.01, ** p<0.05, * p<0.1

Table 1.11: Discount Receipts and Politician-Level Political Contributions

(b) High Discount Period: 1998-2003

	(1)	(2)	(3)	(4)	(5)
(ISR=1)*DiscValue	-253.11***				
	(85.52)				
(ISR20-40)*DiscValue		-196.84*			-178.00
		(110.49)			(109.40)
(ISR40-60)*DiscValue		-214.56**			-208.00***
		(89.16)			(89.75)
(ISR60-80)*DiscValue		-406.76***			-438.21
		(127.28)			(129.67)
(ISR80+)*DiscValue		-175.11			-243.06
		(172.81)			(179.81)
Republican*DiscValue			30.45		0.19
			(93.02)		(102.97)
(House Approp.)*DiscValue				-605.49	-578.65
				(383.80)	(377.23)
(Senate Approp.)*DiscValue				2375.64**	2432.25**
				(1192.79)	(1185.21)
(House For. Aff.)*DiscValue				-621.36*	-616.60
				(377.95)	(378.35)
(Senate For. Rel.)*DiscValue				-582.36	-567.95
				(1043.25)	(1038.65)
N	223,213	223,213	223,213	223,213	223,213

Notes: This table shows the results from the regression of annual politician by company level political contributions on the interaction of company discount values with politician characteristics. All regressions include politician by company and year fixed effects and controls for committee membership and discount value. Discount value in billions of 2000 USD, contributions in 2000 USD. Standard errors are clustered at the politician by company level.

*** p<0.01, ** p<0.05, * p<0.1

Chapter 2

Can Hiring Quotas Work? The Effect of the Nitaqat Program on the Saudi Private Sector

2.1 Introduction

It is often observed that abundant natural resources tend to be associated with slow economic growth in resource-rich countries. This counter-intuitive combination of resource abundance and economic underperformance is called the "resource curse", a term that refers to a variety of common development problems in resource-rich countries. In particular, non-renewables like fuel and minerals tend to be associated with underdevelopment of the non-resource sector, high unemployment, weak institutions and corruption, and political instability. These challenges were particularly salient for Middle Eastern oil producers during the Arab Spring uprisings of 2011 and 2012, and protests occurred in almost all of the oil-exporting countries in the Middle East.[1] While there were certainly a variety of reasons for the demonstrations, protestors often cited unemployment as a central concern, especially in places like the usually peaceful Oman. Indeed, high unemployment rates, particularly among young people, tend to be a crucial issue for governments worried about political instability. Because the governments in the Middle East also control between a half and one third of world oil reserves, their political stability is often of great international interest as well.

Among resource rich countries, there is a subset of oil exporters that share several peculiar labor market issues. The countries of the Gulf Cooperation Council (GCC) – Saudi Arabia, Bahrain, Oman, Kuwait,

This project was undertaken as part of the Labor Market Decision Support System at the Center for Complex Engineering Systems at MIT and the King Abdulaziz City for Science and Technology. I am extremely grateful to Michael Greenstone and David Autor for their extensive feedback and to Ahmed Fadol for his considerable assistance with this project. I also thank the rest of the LMDSS team for their support and advice. Miikka Rokkanen, Heidi Williams, and seminar participants at MIT contributed many helpful comments and suggestions.

[1] Uprisings or protests were documented in Libya, Yemen, Tunisia, Egypt, Bahrain, Algeria, Syria, Iraq, Kuwait, Morocco, Oman and Saudi Arabia.

Qatar and the UAE – have economies that are characterized by several common core features. In particular, all six have a very heavy reliance on oil and gas, with fuel exports ranging from 30 to 85 percent of total GDP; in comparison, Venezuela derives only 18 percent of GDP from oil and gas. The GCC countries also tend to have dramatically segmented labor markets, with large populations of low-skilled migrant workers. These guest workers form between 20 and 80 percent of the total workforce in these countries, and non-citizens make up nearly a third of the total GCC population. Correspondingly, there is also a low participation of nationals in the private sector, with most citizens working in the public sector or in the oil and gas industry.[2] At the same time, these economies tend to suffer from high and rising unemployment, especially among young people. Saudi Arabia is a clear example of this pattern, with a large number of guest workers, high native unemployment, and sluggish growth in the non-oil private sector. Saudi nationals form about half of the labor force, with four million Saudis employed in 2011. Of these, sixty percent worked in the public sector, and only about 600,000 worked in the non-oil private sector. Expatriate guest workers make up ninety percent of the non-oil private sector workforce. Unemployment is also very high among new labor market entrants, and official figures from the Central Department of Statistics and Information (CDSI) report 40 percent unemployment in the 20-25 age group.

The reliance on migrant labor in the face of rising national unemployment has become a critical issue for the governments of the GCC. While high-skill workers are also brought in from the West for their technical expertise, the majority of expatriate workers are hired for low-skill work. In comparison to nationals, who often have access to generous government benefits and other forms of rent redistribution, expatriates tend to be accept lower wages and to work longer hours in poorer conditions. The *de facto* minimum wage for a Saudi worker, for example, is around 3000 SR per month, around 800 USD. In contrast, expatriate workers can be paid about 1500 SR per month, or 400 USD. Although expatriates must be recruited from overseas, their employment terms are also much more flexible than those of Saudi employees, who are more difficult to fire under Saudi labor laws. Foreign workers usually come to the GCC without their families, and are not offered a path to citizenship; their ties to their host countries remain very loose, and many send their wages back to their home countries as remittances.

Throughout the GCC, governments have become increasingly concerned about both rising citizen unemployment and continued dependence on foreign labor. In addition to political concerns about the potential for radicalization among unemployed youth, large expatriate populations themselves are seen by elites as potentially politically destabilizing, making nationalization efforts highly politically desirable (Randeree 2012, Al-Dosary 2004, Al-Lamki 1998). Over the past thirty years, all six countries have instituted some form of

[2]Until recently, the GCC states used public sector employment as a way to combat unemployment and redistribute oil wealth. This strategy has lately become unsustainable, however, as population growth has rapidly outpaced growth in oil revenues (Forstenlechner & Rutledge 2010, Forstenlechner, Madi, Selim & Rutledge 2012, El-Katiri, Fattouh & Segal 2011).

private-sector workforce nationalization program to address these two issues.[3] These programs are known as Saudization in Saudi Arabia, Bahrainization in Bahrain, Kuwaitization in Kuwait, Omanization in Oman, Qatarization in Qatar, and Emiratization in the UAE. These initiatives are the core government strategies to both increase national employment and to reduce dependence on a foreign workforce. Until recently, however, these programs have been relatively narrow in scope and largely unenforced (Randeree 2009).

From 1995 to 2010, Saudi Arabia's nationalization efforts were similar to others in the region, with extremely ambitious Saudization targets that were not enforced on a broad scale, but which had achieved some success in the oil and gas industry and in financial services.[4] In 2011, the Saudi Ministry of Labor began enforcing an updated version of the old nationalization program that had previously been on the books but non-binding. This new program, called *Nitaqat*, or "bands", was designed to give firms more attainable targets and to introduce incentives to achieve nationalization mandates. The program developed nationalization targets based on firm size and industry and imposed visa restrictions based on how firms performed relative to these targets. These incentives have been strictly enforced, and non-compliers have faced restrictions on their work visas for foreign workers, while firms that perform well are given expedited access to Ministry services such as recruiting assistance and visa approvals. This employment quota program is unprecedented in the broadness of its scope as well as its rigorous enforcement and close monitoring. Because of this, the Nitaqat program is a key test case to measure the potential of these programs to combat unemployment.

At the same time, one of the main concerns about these programs is that they will impose an undue burden on an already-fragile private sector (Looney 2004). These strict regulations are expected to raise costs for private sector firms, which could significantly handicap growth even as these countries become more reliant on this sector to diversify their economies away from oil and gas. The Nitaqat program is also an important case study for how the costs imposed by such a quota program can restrict the growth of the targeted firms.

This paper focuses on two main questions: was Nitaqat successful in increasing the number of Saudis in the private sector, and what were the costs to firms? To answer these questions, the analysis employs a comprehensive dataset on the full universe of Saudi private-sector firms used by the Saudi Ministry of Labor to administer the program. The data is particularly notable for its wide coverage and high quality, as employment submissions from firms were automatically checked against government social security and visa records. The establishment-level data contains weekly totals of Saudi and non-Saudi employees as well as basic firm characteristics such as industry and size category as well as the level of quota compliance. This

[3]These programs are summarized in Randeree (2012).

[4]Under the old Saudization law, companies in nine sectors were required to achieve 30 percent nationalization targets, and construction companies were assigned a 10 percent Saudization target. This law was not enforced, however, and companies in most sectors fell well short of these quotas.

is the first time that such establishment-level data has been made available to researchers, and this access provides a unique opportunity to study the firm-level effects of this program. The main empirical strategy exploits a kink in the incentive to increase Saudization generated by industry-level Nitaqat quotas. This kink in the policy rule yields an identification strategy based on discontinuities in the derivatives of the outcome variables. I use this regression kink design (RKD) to estimate the effect of the Nitaqat program on firms near the quota cutoffs in terms of program "benefits" (Saudization, Saudi hiring, and expatriate downsizing) as well as program "costs" in terms of firm size and exit. I also use a differences-in-differences approach to estimate the average effect of the program on all firms, which allows for an estimate of the overall effects of the program.

The analysis finds that the program succeeded in increasing Saudi employment, but at significant costs to firm growth and survival. Program compliance rates were significant, with firms increasing their Saudization rate by 0.2 percentage points on average for every percentage point increase required to reach the quota. Quota compliance was primarily accomplished by hiring Saudis, and the paper estimates that Nitaqat was responsible for the addition of 52,000 Saudi workers to the private sector workforce over the 16 month period, a sizable share of the approximately 460,000 new Saudi workers employed at eligible firms over the period. At the same time, the program caused almost 11,000 firms to shut down, raising exit rates from 19 percent to 28 percent. Surviving firms also tended to shrink in terms of the total number of employees, and the program decreased total employment at these firms by 198,000 workers. There is also some evidence that a small number of firms were able to game the system by hiring Saudi workers on a temporary basis in order to avoid sanctions. General downsizing does not appear to have been strategic, however, and firms do not appear to have downsized below the size cutoffs for Nitaqat inclusion as a way to escape regulation.

The rest of the paper proceeds as follows. Section 2 provides some context for the work on labor market quota programs. Section 3 gives some background on the structure of the Nitaqat program, and Section 4 describes the data used in this analysis. Section 5 describes the regression kink empirical strategy, its applicability to the analysis of the Nitaqat program, and reports the relevant RKD identification checks. Section 6 describes the main RKD results and some extensions, and section 7 concludes.

2.2 Background: Previous Literature

The analysis of the Nitaqat program relates to a large literature in labor economics on the effects of employment quota programs. The most well-studied of these are affirmative action policies in the United States.[5] Although most of this literature has focused on the effects of affirmative action on employees, there are several studies that have attempted to estimate the effects on firms. Griffin (1992), for example, estimates

[5] For a detailed survey of this literature, see the comprehensive literature review in Holzer & Neumark (2000).

establishment-level translog cost functions for firms that were government contractors (and therefore subject to affirmative action regulations) and for firms that were not in the contracting sector. He finds that the labor costs of contracting firms were 6.5 percent higher than those of non-contracting firms. In the absence of exogenous variation in which firms were exposed to the regulation, however, it is difficult to know how much of these differences are attributable to affirmative action alone. There are also several recent papers on employment quota programs outside of the United States. Recent studies by Howard & Prakash (2012), Chin & Prakash (2011), and Prakash (2009), for example, have examined the effect of Indian minority hiring quotas on employment outcomes and occupational choice of favored groups. These studies find that these programs increased the probability of finding a salaried job for some types of favored groups, and that this improved employment outcome was associated with higher household consumption expenditures and higher-skilled occupational choice.

This study adds to this literature in several ways. First, the strict enforcement and clean color-band assignment cutoffs provide quasi-experimental variation in incentives that allow this study to estimate the causal effect of the quota on firms. This type of evidence is rare in this literature, which often suffers from endogeneity problems in the identification of program effects. This study is the first to examine a quota program of this magnitude, both in terms of the number of industries included in the program as well as its geographical extent. The overall effects of programs that target a particular industry or focus on a single area are likely to be small both because the small number of affected workers as well as the fact that workers may easily be shifted from non-targeted industries or areas. Because of this, the modest effects seen in these types of programs may not be relevant when scaled up to an economy-wide program like Nitaqat. This study will therefore be able to offer a more accurate picture of the effects of a national-level quota policy. This study is also the first to examine the effect of a nationalization policy rather than one targeting a historically disadvantaged minority. The differences in the characteristics of the targeted labor force will also have an effect on the interpretation of these results.

This study is also of particular interest given the popularity of nationalization as an employment stimulus program in other resource-rich countries, particularly those in the GCC. All six GCC countries (Saudi Arabia, Bahrain, Oman, Kuwait, Qatar and the UAE) already have some form of nationalization program in place (Randeree 2012). Among these, Nitaqat is unique in its broad scope and its enforcement, and therefore provides an important test case for countries looking to expand their efforts in this area. The UAE, for example, recently announced a renewed focus on its Emiratization initiative to bring more Emiratis into the private sector.[6] This study adds important evidence to the debate about the efficacy of these programs by providing estimates of both the benefits in terms of the employment of nationals as well as the costs to

[6] Raissa Kasolowsky, "UAE mulls new labor law to attract Emiratis to private sector," *Reuters*. February 16, 2013.

private sector firms.

2.3 Background: The Nitaqat Program

2.3.1 Firm Categories

Under Nitaqat, the Saudization quotas that firms face vary by industry and size. All private sector firms are allocated into these industry by size categories based on their economic activity type and number of employees. There are currently 51 different industry categories based on the 3,127 economic activities registered with the Ministry of Commerce. These include categories such as "financial institutions", "pharmacies and drug stores", and "bakeries". Although the program initially started with only 41 categories, several of these have been split into smaller categories to account for large degrees of heterogeneity within sectors. Since June 2011, the program has added 10 new industry classifications, increasing the number of industries from 41 to 51. These new sectors were split off from the existing categories in response to complaints that dissimilar business groups were being held to the same targets. Road cargo transport, for example, was split into long-haul and intra-city trucking. Firms were allowed to change their classification up to one time by appealing to the Ministry of Commerce.

Within each category, entities are classified into size groups according to the total number of employees in a single industry category across all branches of the firm. These size groups were set somewhat arbitrarily based on natural economy-wide clustering of firm sizes.[7] The five size categories are: very small (< 10 employees), small (10-49 employees), medium (50-499 employees), large (500-2999 employees) and giant (3000+ employees). These entity sizes are calculated by the Ministry using data on the number of foreign workers visas held from the Ministry and National Information Center (NIC) records and the number of Saudi employees from the General Organization for Social Insurance (GOSI). The number of Saudi employees is entered as a moving average over thirteen weeks to prevent sharp changes in size category or Saudization percentage.

Firms are therefore assigned to industry and size categories according to the economic activity of their branches (as registered with the Ministry of Commerce) and their numbers of employees as calculated by the Ministry of Labor from NIC and GOSI data. For example, a firm with three bakeries with 30 employees at each branch would be counted as a single entity with 90 employees, putting it in the Medium size category. A firm with a jewelry store with 12 employees and a clothing store with 60 employees would be classified a two entities, one Small entity in the Jewelry sector and another Medium entity in the Retail sector. If the firm decided to list as one entity, it would be considered Medium sized with 72 employees, and it would

[7] Administrators at the Ministry believe that larger firms are seen as more desirable places to work, and therefore have an easier time recruiting Saudi employees. As such, the targets are almost all weakly increasing in firm size.

have to achieve Saudization targets for the most stringent sector in which it had any economic activity, in this case the jewelry sector with 20 percent nationalization rather than the retail sector target of 17 percent nationalization. Firms may also be listed as a conglomerate, in which case their business lines are classified as a single entity and coded in the "multiple economic activities" category.

Overall, there are 1.8 million branches and 1.2 million private-sector entities monitored by the Ministry under Nitaqat.

2.3.2 Nitaqat Color Bands

Within each cell of the industry by size classification, firms are assigned to a color group based on their Saudization percentage relative to the Ministry's color group cutoffs for that cell. Figure 2-1 shows a sample color band grid for building and construction from the Nitaqat website. For a medium-sized construction entity, for example, the color band ranges were:

Red:	0-2%
Yellow:	2-6%
Green:	6-28%
Platinum:	28+%

A construction firm with 5 Saudi employees and 95 foreign workers would therefore be classified as Yellow with a Saudization rate of 5 percent. Firms with fewer than 10 employees or who had been granted an exception from Nitaqat are classified as "white" and are not included in the program.[8]

Industry and size group cutoffs were designed based on pre-Nitaqat Saudization rates so that approximately half of firms would be coded as Green or Platinum and the other half as Red or Yellow. This means that the lower bound for the Green band was approximately set at that group's median Saudization level. Cutoffs for the red and platinum bands were determined by ministry staff.

A firm's Saudization rate is calculated using as a thirteen-week moving average of the number of Saudi workers registered with GOSI. This smooths shocks and encourages firms to improve their color band status through long-term employment of Saudis rather than through temporary positions. There are several types of non-Saudis that can be counted toward the firm's Saudi total, as well as bonuses for hiring disadvantaged groups. The formula is presented in more detail in the data section.

[8]There are some exceptions where larger companies are categorized as white. For example, international schools have no Saudi employment quotas. There are some other individual exceptions for other firms like this where Saudization is not feasible.

2.3.3 Enforcement: Sanctions and Benefits

The main services that the Ministry of Labor provides to firms are foreign recruitment and the issuance and renewal of work visas for foreign workers. The introduction of the Nitaqat program coincided with a streamlining of Ministry visa applications in which firms could renew and change their visas online. Firms in the Green and Platinum bands were offered these new expedited visa services, while firms in the Yellow and Red bands faced increasing restrictions over time in their ability to renew existing visas and to recruit foreign workers. In addition to becoming eligible for expedited and more flexible visas for their foreign workers as well as enhanced recruitment services from the ministry, firms in the Green and Platinum bands were also given the ability to offer jobs to foreign workers from the Red or Yellow color band categories. Firms in the Yellow band faced some restrictions on their visa renewals, and were not eligible for the electronic visas or recruitment services. Entities in the Red band could not renew any of their existing visas and were not issued any new visas. Their existing visas were very inflexible, and they were not allowed to open any new facilities or branches. According to the Ministry, the sanctions were designed so that firms that remained in the Red band would find it prohibitively difficult to remain in business. The sanctions and benefits are summarized in Table 2.1 along with the timing of their implementation. All sanctions and benefits were being enforced by the end of the first year of the program.

2.3.4 Program Results

Between July 2011 and October 2012, the number of Saudis employed in the private sector increased by 462,000, and the Ministry has claimed that the program was responsible for the creation of 250,000 jobs for Saudi nationals. Figure 2-2 shows the time series of Saudi and expatriate workers in the private sector. While the number of expatriates in the sector increased by almost the same amount, 467,000, the Saudi workforce grew by 72 percent while the expatriate workforce increased by only 7 percent. There was also a large improvement in firm color-band assignments, with most Red and Yellow firms moving into the Green or Platinum bands by October 2012. Table 2.5 shows the matrix of firm color band movements, depicted graphically in Figure 2-3. Approximately 68 percent of Red firms improved their status, with over half ending the period in the Green or Platinum bands. Almost 80 percent of Yellow firms improved their status, and very few Green and Platinum firms moved into lower color bands.

As expected, the reaction from Green and Platinum firms has been quite positive: an HR representative from a telecommunications company categorized as Green under Nitaqat reports that visa applications are now much quicker and that work visas are easier to obtain. Representatives from companies categorized as yellow and red complained about the prohibitive cost of recruiting and hiring Saudis and the negative effects of visa restrictions driving their business to other GCC countries. A recent article also reports that investors in the Saudi trucking industry complain that Nitaqat has hurt their business, claiming that the restrictions cause them to lose SR 250 million a year for failing to hire enough Saudi truck drivers to meet their 10 percent benchmark.[9]

2.4 Data

2.4.1 Nitaqat Program Data

The primary data for this analysis is the administrative Nitaqat program data collected by the Ministry of Labor. This dataset contains weekly entity-level observations of the employment measures and corresponding color band assignments used by the Ministry to determine program compliance and trigger enforcement measures. The dataset contains firm identifiers including geographic location, industry, size category, and a unique firm identifier. Collected employment measures include a counts of Saudi and expatriate employees as well as counts of employees in important groups, such as disabled Saudis, ex-convicts, citizens of other GCC countries, women, non-Saudi spouses of Saudi citizens, non-Saudis with Saudi mothers ("special foreigners), part-time workers, students, and members of displaced tribes from the Rub' al Khali with a Saudi passport but no national identity card. For Nitaqat purposes, the Ministry counts non-Saudis with Saudi spouses or Saudi mothers, and members of displaced tribes toward the total Saudi employee count. Former Saudi prisoners are equivalent to two Saudi employees, disabled Saudis equivalent to four Saudi employees, and students working part time as half of a full-time Saudi worker. The total number of Saudi workers for Nitaqat Saudization calculations is therefore:

$$\begin{aligned}\text{Nitaqat Saudis} &= \text{Saudis} + \text{Spouses} + \text{Special Foreigners} + \text{Gulf Citizens} + \text{Displaced Tribes} \\ &+ 2 \cdot \text{Ex-Convicts} + 4 \cdot \text{Disabled Saudis} + .5 \cdot \text{Students} + .5 \cdot \text{Part-Time}\end{aligned}$$

The Nitaqat Saudization rate is calculated as the ratio between this total and the total number of employees. Color band assignments are based on a 13-week moving average of this rate to avoid sudden reclassifications due to temporary staffing shocks. All of these employment measures are updated by the Ministry on a weekly basis using Ministry data on visa issuance for foreign workers and GOSI data on Saudi employment rolls. Data collection began on June 11, 2011, and entities were fully represented and reporting all employees by July 9, 2011. Therefore, although data exists for June, all comparisons in this paper are based on a starting date of July 9th. The dataset contains observation up through October 13, 2012.

The data includes observations for over one million firms, 116,873 were large enough to be included

[9] http://www.arabnews.com/saudis-find-salary-truckers-low

in the Nitaqat program at its start in July 2011. Of these, 83,568 also appear in the data for October 2012, reflecting exit by 33,305 from the sample.[10] 48,157 new firms entered over the intervening 16 months. These 83,568 firms form the sample for the empirical analysis of the effects of the program on employment, size, and firm value. Analysis of firm exit is done using the full set of 116,873 baseline firms. These firms are distributed across 37 industries and four size categories at baseline (Table 2.2). These firms appear in 109 of the corresponding Nitaqat industry by size categories. Just over one third of these entities were in the construction industry, with most of these in the smallest size category. Construction firms were also responsible for nearly half of private-sector employment and almost a quarter of Saudi private sector employment (Table 2.3). In addition to being the largest private sector industry, construction also had one of the lowest Saudization rates, with an industry average of 5.8 percent Saudi workers. After construction, the next largest industries were retail and manufacturing, with 20 and 11 percent of the Saudi private sector workforce, respectively. The industry category for conglomerates ("multiple economic activities") contains a large number of entities, all which have less than 50 employees and which employ less than one percent of the Saudi private sector workforce.

Although a large number of firms are exempt from Nitaqat due to the ten-employee inclusion cutoff, the firms included in the program employed over 95 percent of the Saudis and 68 percent of the expatriates in the private sector workforce at baseline.[11]

Also of note is the large variation in Saudization rates across industries and within different size groups. In July 2011, Saudis made up less than five percent of the workforce in farming, maintenance, and private labor recruitment services. Financial institutions had the highest starting Saudization rate at 80 percent; petroleum and gas followed at 76 percent, and petrochemicals at 45 percent. Though the total workforce share of firms was roughly declining in firm size, Saudi employment was greater for larger firms (Table 2.4). Tiny firms accounted for only three percent of Saudi employment, small firms for 12 percent, medium firms for 29 percent, and large firms for 37 percent. The 58 giant firms with over 3000 employees employed only eleven percent of the total workforce and 19 percent of the Saudi workforce. Correspondingly, Saudization rates are higher for larger firms: small firms were only four percent Saudi, with an average of less than one Saudi employee per firm in this category, and large firms had the highest average Saudization rate of 17 percent.

[10]It should be noted that exit from the Nitaqat sample does not necessarily reflect exit from the market, and these exit rates may overestimate overall rates of firm shutdown. Entities may exit the sample by falling below the 10-employee inclusion threshhold or by creating a new registration with the Ministry of Labor following a merger, split, or other change in firm structure.

[11]Recent updates to Nitaqat have extended the program to include more of these firms, but the current analysis does not include this time period.

2.4.2 Firm Balance Sheet Data

The analysis also uses stock price and balance sheet data for all entities included in the Nitaqat data belonging to joint stock companies that are listed on the Saudi Stock Exchange. These companies are required to submit their balance sheets and auditors' reports to the Ministry of Commerce and Industry on a quarterly basis. This data, along with the number of shares and stock price, are available through the Saudi Stock Exchange (Tadawul) on their website[12] as well as through Bloomberg. Of the 158 firms listed during the period, 147 were matched to Nitaqat entities, and 255 entities were matched to listed firms. Of these, 156 had stock price information available for the period. When multiple entities were matched to a single firm, most were subsidiaries of a larger firm that were engaged in different economic activities or that were located in different geographic areas. Balance sheet items that were reliably reported included capital, total equity, liabilities, expenses, and inventories. Compared to the rest of the sample, these firms tend to be large and to have higher Saudization rates. Only 22 percent of these firms were in the Small size category; 39 percent fell in the Medium, 36 percent in the Large, and 3 percent in the Giant category. They also tend to be concentrated in different industries, with the largest groups of Tadawul firms in manufacturing (19 percent), insurance (17 percent), and retail (15 percent). Construction is notably not well-represented, with only 8 percent of these firms in that sector compared with 35 percent of all Nitaqat firms. Although they are certainly not a representative sample, there is still some variation in their color bands at baseline, with 18 percent beginning in the Red band, 10 percent in the Yellow band, 32 percent in the Green band and 40 percent in the Platinum band.

2.5 Empirical Strategy

The purpose of the empirical analysis is to identify the causal effects of imposing a Saudization percentage quota on firms. In particular, the analysis seeks to estimate how the required increases in Saudization affected (1) actual changes in Saudization (did the program have any effect?), (2) hiring of Saudis and downsizing of expatriates (how did firms achieve their Saudization targets?), (3) firm size, exit, and value (what costs did these requirements impose on firms?). The policy variable of interest is therefore the compliance requirements that the Nitaqat program imposed on firms, i.e. the amount by which firms were required to increase their Saudization rates to meet their Nitaqat quotas. If these required changes were randomly assigned, the analysis could directly estimate the effect of these requirements on these outcome variables. In this case, however, the policy variable was mechanically determined by the firm's baseline Saudization percentage and the Saudization quota for the corresponding industry by size cell. These baseline Saudization rates are

[12]http://www.tadawul.com.sa

potentially endogenous to all of the outcomes of interest; unobserved determinants of baseline Saudization are almost certainly correlated with future changes in the employment of Saudis and expatriates as well as other measures of firm performance.

Because of this, the analysis relies on the variation in the policy rule generated by the placement of the quotas to identify the causal effects of the program on firms. In particular, the estimation relies on the variation in the incentive to increase Saudization rates created by the quota cutoffs. The Yellow/Green color band cutoffs in particular generated an incentive for firms below the quota (in the Yellow or Red bands) to increase their Saudization rates while imposing no new constraints on Green and Platinum firms with Saudization rates above the cutoff. As discussed below, the quotas generate a kinked assignment function from baseline Saudization percentages to the increase required for program compliance. Because of this, the main analysis uses the regression kink design (RKD) to estimate the effects of the program on staffing, firm value, size, and exit. Overall program effects are also estimated using a differences in differences approach comparing the relative changes of Yellow, Red and Green firms within industry and size cells.

2.5.1 Regression Kink Design

The regression kink design is a research method that estimates treatment effects using kinks in a continuous policy variable that is based on a potentially endogenous assignment variable. This method is analogous to regression discontinuity design, but can be used in cases where the policy variable is continuous but contains discontinuities in its derivative (i.e. kinks). This is critical to the analysis of the Nitaqat program because the hiring incentives approach zero as firms near the cutoff; a Yellow firm with 7.9 percent Saudization facing an 8 percent quota will have almost no need to adjust its staffing. Yellow firms below the quota, however, will need to increase Saudization by an amount that is directly increasing with their distance below the quota, while Green firms' incentives to change Saudization rates will be uniformly zero regardless of their distance above the cutoff. The RKD method will allow us to exploit this kink in the quota compliance requirements to estimate the effect of the program near the quota cutoffs. The program's treatment effect will be identified by changes in the slopes of the outcome variables around this kink point in the assignment function.

The RKD is formalized by Card, Lee, Pei & Weber (2012), which establishes the conditions under which the RKD identifies the local average response, or treatment on the treated, parameter that would be identified if the treatment had been randomly assigned. Like RDD, the treatment effect is identified by the discontinuities in the derivatives (i.e. changes in the slopes) of the outcome variables around the kink point in the policy variable. The necessary identification tests and robustness checks are similar to those for RDD outlined in detail in Lee & Lemieux (2010). This method has previously been used for the evaluation of programs with kinked benefit structures such as the EITC (Jones 2011), UI benefits (Card et al. 2012), college financial aid (Nielsen, Sorensen & Taber 2010), intergovernmental grants (Dahlberg, Mörk, Rattsø& Ågren 2008), education finance (Guryan 2001), and prescription drug reimbursement (Simonsen, Skipper & Skipper 2010).

Compliance Requirement

The RKD analysis in this paper relies on the kinked compliance requirement that was generated by the imposition of Saudization quotas on firms in each industry by size group. As discussed above, the most important quota is the one at the Green/Yellow cutoff. The incentive for firms to increase their Saudization percentage was increasing in their baseline distance below this cutoff. For example, the cutoff for medium-sized construction firms was six percent; a firm in the Yellow band with four percent Saudi workers needed to increase its Saudization rate by two percent to comply with the program; a firm in the Green band with eight percent Saudization was already in compliance, so no change was needed. This generates a kinked function mapping initial Saudi percentage to the increase mandated by the program. Figure 2-4a shows this compliance requirement for medium construction firms. This rule generates a similar compliance requirement with a kink at the quota level for each of the 109 industry by size cells; these kinked compliance requirements are plotted for each cell in Figure 2-4b.

We can combine these by normalizing the cutoff to zero and measuring the compliance requirement as the distance below the cutoff, i.e.

$$b(V_{ijs}) = \max(q_j - V_{ijs}, 0)$$

where V_{ijs} is the initial Saudization percentage for firm i and q_{js} is the quota for the corresponding industry j and size group s. This normalization collapses the compliance rules in Figure 2-4b into a rule with a single kink at zero shown in Figure 2-5.

When examining the effect of the program on variables measured in terms of employees, i.e. number of Saudi employees and number of expatriate employees, it will also be useful to define the distance from the cutoff in terms of the number of Saudis that would have to be hired or expatriates that would have to be downsized to meet the quota. For Saudis, we can express this as:

$$Distance^S_{ijs} = Saudis^*_{ijs} - Saudis_{ijs}$$

where

$$Saudis^*_{ijs} : Quota_{js} = \frac{Saudis^*_{ijs}}{Saudis^*_{ijs} + Expats_{ijs}}$$

For example, a firm with 18 expatriate employees and 0 Saudi employees facing a quota of 10 percent would need to employ 2 Saudi workers to meet the quota, so

$$Distance^S_{ijs} = Saudis^*_{ijs} - Saudis_{ijs} = 2 - 0 = 2$$

Similarly, for expatriates:

$$Distance^E_{ijs} = Expats^*_{ijs} - Expats_{ijs}$$

where

$$Expats^*_{ijs} : \ Quota_{js} = \frac{Saudis_{ijs}}{Saudis_{ijs} + Expats^*_{ijs}}$$

For example, a firm with 12 expatriate employees and 1 Saudi employee facing a quota of 10 percent would need to downsize 3 expatriate workers to meet the quota, i.e.

$$Distance^E_{ijs} = Expats^*_{ijs} - Expats_{ijs} = 9 - 12 = -3$$

These normalizations will be useful in the interpretation of the effects of the program in terms of the number of different types of workers employed. The normalized compliance requirements are plotted in Figures 2-6a and 2-6b.

RKD Identification and Estimation

The identification assumptions and estimation procedure for RKD are very similar to those required for RDD, but applied to the discontinuity in the derivative rather than the level of the treatment function. In particular, for outcome Y, starting Saudization quota distance V and Nitaqat compliance requirement B, we can express the effect of the Saudization requirement on the outcome of interest using the generalized nonseparable model

$$Y = y(B, V, U)$$

i.e. define the outcome of interest as a general function of the compliance requirement B, baseline Saudization (and potentially other observable covariates) V, and an unobserved error term U. The key relationship of interest is the effect of B on Y.[13]

If B exerts a causal effect on Y and there is a kink in the deterministic relation between B and V at $v = 0$, then we would expect to see an induced kink in the relationship between Y and V at $v = 0$. In our case the kink is sharp: the compliance requirement is a deterministic function of baseline Saudization percentage.

[13] In this formulation, the error term U may enter the model non-additively, which allows for unrestricted heterogeneity in the response of Y to V. This setup also allows heterogeneity in the response of Y to B.

For a Sharp RKD, Card et al. lay out four conditions that must be satisfied for the RKD to identify the causal effects of B on Y. Follow their notation, denote the conditional density functions of V on U by $F_{V|Y=u}(v)$ and $f_{V|Y=u}(v)$. Let $B = b(V)$ and denote the partial derivatives of $y(\cdot,\cdot,\cdot)$ by $y_1(b,v,u) = \frac{\partial y(b,v,u)}{\partial b}$ and $y_2(b,v,u) = \frac{\partial y(b,v,u)}{\partial v}$. The identifying assumptions for the sharp RKD are then:

A1: (Regularity) $y(\cdot,\cdot,\cdot)$ is continuous, and $y_1(b,v,u)$ is continuous in b for all b, v, and u.

In other words, the marginal effect of B on Y must be a continuous function of both observables and of the unobserved error term.

A2: (Smooth Effect of V) $y_2(b,v,u)$ is continuous in v for all b, v, and u. This is like the IV exclusion restriction: V can affect Y, but the effect has to be continuously differentiable, i.e. any observed kinks in Y cannot be direct the result of small changes in Y. In our case, this would rule out a kinked underlying relationship between baseline Saudization and increases in Saudi percentage, for example, in the absence of the Nitaqat program.

A3: (First Stage) $b(\cdot)$ is a known function that is everywhere continuous and continuously differentiable on $(-\infty, 0)$ and $(0, \infty)$, but

$$\lim_{v \to 0^+} b'(v) \neq \lim_{v \to 0^-} b'(v)$$

The compliance function must therefore be known to the researcher and have a kink at $v = 0$. There also must be a positive density around the kink point.

In our case, the compliance requirement is

$$b(V) = \max(V - Q, 0)$$
$$\Rightarrow \quad \lim_{v \to 0^+} b'(v) = 1 \neq 0 = \lim_{v \to 0^-} b'(v)$$

Because the quotas were placed near the median Saudization rates for each industry by size cell, there is also a large density of firms around this kink point.

A4: (Smooth Density) $F_{V|Y=u}(v)$ is twice continuously differentiable in V for all u and v. This condition rules out the manipulation of the assignment variable, and is the key identifying assumption for the RKD.

In summary, if everything else is continuous near the kink, any changes in the slope of the outcome can be attributed to the kink in the compliance requirement B. In this case, the RKD will identify the "treatment on the treated" parameter at this point, i.e. the average effect of a marginal increase in the compliance requirement near the cutoff holding the distribution of unobservables constant. The degree to which V and U are correlated will determine the degree to which this treatment effect applies to firms that are further away from the quota.

There are two testable implications of the identification assumptions above. First, in a valid Sharp RKD, $f_v(v)$ must be continuously differentiable in v. This rules out precise manipulation of baseline Saudization percentage by firms near the Saudization quota cutoffs. As in the RDD case, we can test for this by examining the baseline distribution of V. In particular, I test for a break in the density of V around the kink in the compliance function using a modified McCrary test (McCrary 2008). Figure 2-7 plots the density of baseline Saudization percentages relative to the cutoff. A McCrary test shows no evidence of bunching to the right of the quota at the start of the program, and the figure confirms that quotas were set near the median starting Saudization percentages.

The second testable implication is that there should be no kink in baseline covariates around the quota, i.e. $\frac{dPr(X \leq x|V=v)}{dv}$ is continuous in v at $v = 0$ for all x.[14] Baseline values of several sample covariates (firm size, Saudi employees, and expatriate employees) are plotted in Figure 2-8; none of these correspond to a statistically significant kink or discontinuity in averages around the cutoff. The fact that quotas were assigned near cell medians also means that there should be roughly the same number of firms above and below the cutoff within industry by size groups.

If we think of the relationship using a simple, additive model with constant effects:

$$Y = \tau B + g(V) + U$$

Then, under the above assumptions:

$$\tau = \frac{\lim_{v \to 0+} \frac{\partial E[Y|V=v]}{\partial v} - \lim_{v \to 0-} \frac{\partial E[Y|V=v]}{\partial v}}{\lim_{v \to 0+} \frac{\partial b(v)}{\partial v} - \lim_{v \to 0-} \frac{\partial b(v)}{\partial v}}$$

This "RKD estimand" is the change in the slope of the conditional expectation function $E[Y|V = v]$ at the kink point $v = 0$ divided by the change in the slope of the assignment function $b(\cdot)$ at that same point.

In our case, the assignment function is

$$b(V) = \max(V, 0)$$

where V is the percentage point distance below the relevant Saudization quota. For Yellow and Red firms, this will be positive: a firm with a baseline Saudization rate of 5 percent facing a quota of 8 percent would have $b(3) = \max(3, 0) = 3$. A Green firm with 9 percent Saudization facing the same quota would have $b(-1) = \max(-1, 0) = 1$.

[14]This is like a test for true random assignment in an RCT.

Therefore the change in the slope of the assignment function is 1 at the cutoff, so we have

$$\begin{aligned}\tau &= \frac{\lim_{v\to 0+} \frac{\partial E[Y|V=v]}{\partial v} - \lim_{v\to 0-} \frac{\partial E[Y|V=v]}{\partial v}}{\lim_{v\to 0+} \frac{\partial b(v)}{\partial v} - \lim_{v\to 0-} \frac{\partial b(v)}{\partial v}} \\ &= \lim_{v\to 0+} \frac{\partial E[Y|V=v]}{\partial v} - \lim_{v\to 0-} \frac{\partial E[Y|V=v]}{\partial v} \\ &= \hat{\beta}_1\end{aligned}$$

which can be estimated from the model:

$$E[Y|V=v] = \alpha_0 + \sum_{p=1}^{P} \Big[\alpha_p(v-k)^p \ + \beta_p(v-k)^p \cdot D\Big]$$

where $|v-k| < h$ and p is the polynomial order of the fit. The analysis estimates these local polynomial regressions using a symmetric uniform kernel and several values of the bandwidth and the polynomial order. In estimating the derivative at the kink point, Card et al. (2012) point out that a local quadratic ($p = 2$) leads to asymptotically smaller bias than a local linear regression ($p = 1$), but find that this comes at the cost of significantly larger asymptotic variance.[15] While the analysis reports the estimates from both $p = 1$ and $p = 2$, the local linear specification is therefore preferred. The results will also be reported for several choices of bandwidth.[16]

2.5.2 Differences in Differences

While the RKD analysis focuses on changes in incentives to hire around the kink in the policy rule, it is also useful to estimate the overall effects of the Nitaqat program on Saudi employment, expatriate employment, firm size and exit. This can be done by estimating the average effect of assignment to the Red or Yellow color bands as compared to firms in the Green band within the same industry by size cell:

$$\Delta Y_{ijs} = \gamma_1 \cdot D(Red)_{ijs} + \gamma_2 \cdot D(Yellow)_{ijs} + \alpha_{js} + \epsilon_{ijs}$$

Because Green firms that were well-above the cutoff may have also been affected by the program, the analysis also reports estimates where only Green firms within five Saudi employees of the cutoff are used as

[15]They calculate that the bias in the linear specification would have to be $\sqrt{15}$ times larger than the standard error for a local quadratic to reduce the mean squared error over the local linear regression.

[16]Work is currently in progress to implement the optimal RKD bandwidth calculation as described in Rokkanen (2013). The methodology is similar to that of the RDD optimal bandwidth from Imbens & Kalyanaraman (2012).

a comparison group:

$$\Delta Y_{ijs} = \gamma_1' \cdot D(Red)_{ijs} + \gamma_2' \cdot D(Yellow)_{ijs} + \gamma_3' D(Green > 5) + \alpha_{js}' + \epsilon_{ijs}'$$

where $D(Green > 5)$ is a dummy variable for the group of Green firms which began above the quota by more than five Saudi employees.

To complement the RKD analysis, I also examine how this effect changes with starting distance from the cutoff. When this distance is measured in Saudi employees, for example, we can define a set of dummy variables for each value of distance from the cutoff:

$$\mathbf{d} = \{dk_{ijs}^S\}_{k=-D}^{D} = \mathbb{1}\{Distance_{ijs}^S = k\}$$

These dummy variables are constructed similarly for distance in terms of expatriates, and using percentage-point bins for regressions where the distance is measured in terms of Saudization percentage.

I then estimate:

$$\Delta Y = \gamma \mathbf{d} + \epsilon$$

In this specification, all effects are compared Green firms just at the cutoff, i.e. the omitted category $k = 0$. Results from these specifications are reported graphically, with the estimated coefficients plotted against distance from the cutoff.

2.6 Results

2.6.1 Quota Compliance

The RKD plots of the change in Saudization percentage against the starting quota distance are presented in Figure 2-9a. The program appears to have had at least some of the intended effect on firms below the quota: Yellow and Red firms tended to increase their Saudization percentages to comply with quota requirements. This compliance is particularly sharp very close to the quota, where firms needed to make smaller changes to their employee mix to improve their color band rating. This effect is partially offset by Green firms, however, who tended to reduce their Saudization percentage with increasing distance above their quotas. Although compliance rates are high among Yellow and Red firms, this reduces the estimated effect of the program. The estimates for the size of the kink are reported in Table 2.6, with most local linear estimates around 0.20. This indicates that the effect of the program was to increase Saudization in Yellow and Red firms by 0.2 percentage points for every percentage point they started below their Nitaqat quota.

Firms could achieve these increases in Saudization percentage both by downsizing expatriates and by hiring Saudis. Figures 2-9b and 2-9c show the RKD results for the Saudi and expatriate employment outcomes. There is a clear kink in the number of Saudi hires as a function of the firm's initial distance from the quota in terms of Saudi employees. Yellow and Red firms close to the cutoff hired almost exactly as many Saudis as they needed to reach their Saudization quotas without changing their expatriate worker totals. In contrast, Green firms just to the right of the cutoff experienced no change in their number of Saudi employees. The econometric results in Table 2.6 confirm this, with estimates ranging from 0.35 to 0.59 Saudi workers hired for each one needed to meet the quota. Expatriate workers, on the other hand, show little responsiveness to quota cutoffs, though expatriate hiring increases in distance above the quota. This suggests that firms were not changing their expatriate staffing in order to achieve the quotas. The visa restrictions placed on Yellow and Red firms (and the streamlined renewals offered to Green firms) likely reduced expatriate hiring at Yellow and Red firms while encouraging an increase in hiring at Green firms. Yellow and Red firms far below the cutoff were the least likely to improve their color band assignment and become eligible for the enhanced recruitment services. Similarly, Green firms well-above the cutoff were both unconstrained by quotas and likely to maintain access to visa services over the period. The estimates in Table 2.6 confirm that there is little evidence of a kink, with all of the point estimates close to zero and most not statistically significant.

These findings are supported by Figure 2-10, which plots the coefficients from the differences-in-differences specification described above. Panel (a) shows the results for Saudi employees. As in Figure 2-9b, there is again evidence of a kink in Saudi hiring at the Nitaqat quota. There is also some evidence that Green firms farther above the cutoff tended to reduce their numbers of Saudi employees. This may be because the program made experienced Saudi employees more valuable to Yellow and Red firms, so firms well-above the cutoff allowed their employees to be "poached" by other firms. This effect will mitigate the overall impact of the program on Saudi employment by simply shuffling already-employed Saudis between firms. It is therefore important to allow this group of Green firms well-above the cutoff to be "treated" by the program in the analysis below estimating the overall program effects.

2.6.2 Program Costs

The effects of the program on firm size, exit, and market value are shown in Figure 2-11. Panel (a) shows the RKD figures for the percentage point change in firm size relative to the initial percentage point distance from the Nitaqat cutoff. Firms that remained in the sample over the whole period grew on average, and the kink height indicates a growth of about 25 percent among firms just at the cutoff. On average, firms above the cutoff appear to have grown at about this rate. For Yellow and Red firms below the cutoff, however, the effect on firms size is dramatic, with the growth of these firms dropping off sharply in cutoff distance. The estimates for firm size in Table 2.6 mostly indicate a 0.5 percentage point decrease in firm growth for every percentage point below the cutoff. This indicates that the increase in Saudi employees was not the only effect of the program, and that Nitaqat imposed serious constraints on firm growth over the 16-month period.

Also on the cost side, the Nitaqat program also appears to have increased firm exit. Panel (b) shows the graphical results, plotting average exit rate against percentage point distance from the cutoff. Firms above the cutoff experienced little effect on exit rate, with the average exit rate for Green firms at around 15 percent regardless of cutoff distance.[17] For Yellow and Red firms, exit rates are increasing in distance below the cutoff; although estimates for exit rate are sensitive to the choice of bandwidth, and all linear kink estimates fall in the 0.72-2.17 range. This indicates that exit rates increased by between 0.72 and 2.17 percentage points for every percentage point distance below the cutoff.

The RKD figure for the market value of the 147 publicly-listed firms is shown in panel (c). Unfortunately the small sample size makes it impossible either to detect a kink in market value or to find a sufficiently precise zero. As suggested by the figure, parametric estimates of the kink are very noisy and usually not statistically significant. This is also the case for other balance sheet measures available in the Tadawul data for these firms.

2.6.3 Overall Effects

Estimates for the overall effects of the program are displayed in Table 2.7. These estimates are based on cell-level difference-in-difference estimates calculating the average effects by initial color band assignment. As discussed above, odd-numbered columns show comparisons against all firms in the Green band; even-numbered columns allow for "poaching", or changes in Green firms that were more than five employees above the cutoff, by using only Green firms near the cutoff as the comparison group. Because this effect appears to be important, our conclusions focus on these results. The last two rows of the table show the total estimated effect of the program based on these estimates as well as the relevant full-compliance benchmark. In odd columns this benchmark is the change in the outcome variable associated with all firms moving up to the relevant Nitaqat quota, with no change in Green and Platinum firms. In even columns, the benchmark includes the effect of all firms above the quota adjusting down to the quota as well.

The table shows that Yellow and Red firms increased their Saudization percentages by 3.5 percentage points on average, with Green firms reducing their Saudization rates by 5.45 percentage points. Overall, the program is estimated to have increased Saudization by 2.73 percentage points, compared to a benchmark of

[17] About 10-12 percent of businesses in the U.S. and the U.K. close each year.

3.22. On the Saudi employment side, Red and Yellow firms increased their Saudi employment by around one employee on average, while Green firms reduced their employment of Saudis by almost nine employees. Because there are many more Red and Yellow firms, however, the overall effect is to increase Saudi employment by 52,000; close to the benchmark of 57,000 but well short of the no-poaching benchmark of 211,000. This implies that Nitaqat was responsible for 13 percent of the total increase in Saudi employment over the period. There is also evidence that Nitaqat reduced the overall size of the expatriate workforce, with Red firms hiring 5.29 fewer expatriates than firms in the comparison group. Expatriate hiring in Green firms increased for firms farther above the cutoff, however, and these increased expatriate employment by 39.36 on average. Overall, the estimated effect was a reduction in expatriate employment of 250,000, a decrease of nearly 40 percent relative to the implied counterfactual increase in expatriate employment in the Kingdom.

These effects on Saudi and expatriate employment are reflected in the estimates for the changes in total firm size. Red firms were smaller by 4.29 employees, while Green firms hired 30.55 more employees than the comparison group. The overall effect was to reduce total employment in the private sector by 198,000 workers. The effects on exit rates were also largest for Red firms, with these firms 11.67 percent more likely to exit than the comparison group. Yellow firms had an average exit rate 4.31 percent higher as a result of the program. Unlike with the other outcomes, Green firms with more than five "excess" Saudi employees did not experience a differential effect on their exit rates relative to Green firms closer to the cutoff. Overall, the effect of the program was to increase exit by 10,665 firms. This is a significant proportion of the 33,305 firms that exited during the period, implying that the program increased exit rates from 19 percent to 28 percent.

2.6.4 Sector Breakdown

The impact of the program also seems to have varied by industry, and Figure 2-12 presents the main RKD results by sector. The strongest effects, both in terms of compliance (hiring Saudis) and costs (exit and downsizing), were experienced by the secondary sector, which includes construction (the largest private-sector industry) and manufacturing. Effects were more muted in the services sector, with lower compliance rates as well as more muted kinks in the size and exit relationships. The primary sector (agriculture and extraction) shows little effect of the program – there is no evidence of an increase in the number of Saudis employed at Yellow and Red firms, and no corresponding decrease in firm size or increase in exit. This pattern is likely the result of several factors, including the degree to which different industries rely on foreign labor as well as the degree of competitiveness in the included industries. The services sector is the least exposed to competition from imports, and while these firms did increase Saudi hiring as a result of the program the exit and downsizing effects were lower than in the secondary sector. In construction in particular, Saudization rates are among the lowest, and the industry has historically relied heavily on low-cost foreign labor. It was critical that these firms improve their color band status in order to keep the bulk of their workforce, so compliance rates were very high. The costs were also very acutely felt, however, with a strong response to the program in terms of firm size and exit rates. In the retail sector, which is less reliant on expatriate labor, compliance rates were slightly lower and costs were more muted.

2.6.5 Temporary Saudi Hiring

In addition to the costs that were an expected consequence of the program, (increased turnover and downsizing), there are also unintended consequences from incentives created by the particular structure of the program. The extent to which firms are able to game the system may account for the less than full-compliance rates as well as suggest some ways in which the program effects are mis-measured.

Because most of the increase in compliance is achieved through increasing Saudi employment, one potential concern is that this hiring does not reflect a real, long-term increase in Saudization. One way that firms can avoid hiring restrictions on expatriate workers is to temporarily improve their color band assignment by hiring a large number of Saudi workers when they need to hire more expatriate workers or renew existing work visas. The program rules try to prevent this by assigning color bands based on the 12-week moving average of Saudi employees. Nonetheless, there are occasionally reports of firms hiring large numbers of low-wage Saudi workers for short periods. To get a sense of the magnitude of this effect, I identify firms whose Saudi employment patterns follow a strong cyclical pattern, with temporary hiring booms followed by an increase in expatriate hiring and a sharp decrease in Saudi employment. I do this by flagging firms that were non-compliant (i.e. in the Yellow or Red bands) for most of the period, but that had at one five-week or longer stretch of being included in the Platinum band. This would give the firm access to the expedited recruiting and visa renewal for sufficient time to make use of these services. I restricted attention to firms that had at least one week-to-week increase and decrease in Saudi employment of more than 30 percent. Flagged firms also increased their expatriate workforce on average over the period and did not significantly increase their Saudi workforce, (i.e. all firms had an average increase in Saudi employment of less than 0.5 workers). Of the 113 firms that met these criteria, 18 showed evidence of these strategic temporary hiring booms (Figure 2-13), and 11 of these firms were in the construction industry. Altogether these firms created approximately 250 temporary jobs. This type of blatant manipulation does not appear to be common, although it is certainly possible that more subtle gaming of the system is more widespread. It is likely more common for firms to hire a small number of temporary Saudi workers to switch into the Green band for a longer period of time, for example. Because these changes are relatively small, they likely have little effect on the estimates based on the July 2011 to October 2012 comparisons.

2.6.6 Downsizing to Avoid Quotas

Another way that firms may avoid penalties is by reducing their size below the ten-employee cutoff for inclusion in the Nitaqat program. Because the Ministry re-codes firms when they leave the program, this will be indistinguishable from exit in the data. If firms in the Yellow and Red bands are more likely to downsize in this way, the above analysis will over-estimate the effect of the program on exit (and under-estimate the effect on firm size). To get a sense of the magnitude of this potential bias, Figure 2-14 panel (a) compares the distribution of firm sizes of all Nitaqat firms in July 2011 and in October 2012. There appears to be little change in the distribution of firm sizes, and there is no apparent decrease in the number of firms near the ten-employee cutoff for inclusion in the program. Panel (b) compares the changes in these distributions by starting color, restricting the sample to firms that appeared in the sample at baseline. For both initially compliant (Green or Platinum) and initially non-compliant (Red or Yellow) firms there is a large decrease in the number of firms with between ten and twenty employees. Because this figure categorizes firms based on their July 2011 color band assignment, new entrants are not included; these dips, therefore, may simply reflect a higher failure rate for smaller firms.[18] Indeed, the pattern is similar for both compliant and non-compliant firms, suggesting that the exit of small, non-compliant firms from the data is not driven by downsizing below the size cutoff. This interpretation is supported by panel (c); exit rates follow the same pattern for firms above and below the Yellow/Green cutoff. Interestingly, the increase in exit rates appears to be relatively homogeneous across firm sizes.

2.7 Conclusion

As growing unemployment has led to political pressure, national employment quota policies have become an increasingly attractive potential solution. While these programs promise a quick and visible remedy to citizen unemployment, however, these new labor market regulations are potentially quite costly for firms. The short-term benefits of increasing employment may come at significant cost to long-term economic growth. Recently, political events in many countries in the Middle East have tipped the political economy toward prioritizing short-term stability, and it is likely that these types of quota policies will become more widely enforced in the region. However, there is almost no empirical evidence to suggest what the magnitudes of the costs and benefits of such a program might be, even in the short term. There is a large literature on the effects of affirmative action policies in the United States, but these results have limited applicability to a broad nationalization policy. In particular, affirmative action policies have been applied on a relatively small scale, and have targeted traditionally disadvantaged groups. Nationalization policies differ from these

[18] This is consistent with previous observations of larger turnover among small firms, e.g. Dunne, Roberts & Samuelson (1989).

policies on both counts, and both features are likely to have significant implications for the program effects. Further, very little of the work on affirmative action has studied its effects on firms, and identification has been particulary challenging in this subset of the literature. For a large-scale nationalization policy, the effect on firms is critical, with serious consequences for the growth of the often fragile private sector.

This paper examines the short-term effects of a nationalization quota policy in Saudi Arabia using quasi-experimental variation generated by the program structure. On the one hand this context is quite specific: Saudi Arabia is unique in many ways, and the Nitaqat program is the first to be implemented on such a wide scale. However, there are many countries with similar labor market features to Saudi Arabia, and there are several features of this policy which make it a good case study. First, the Saudi government devoted significant resources to the program, and it was implemented quickly and uniformly applied to all private sector firms. Enforcement was strict, and the quality of the administrative data is very high. In contrast to all previously-studied quota policies, both in the United States and elsewhere, it was an economy-wide program, so the results are more relevant to other national-scale programs. The program was also designed with sharp quota cutoffs, which yields identifying variation in nationalization incentives across firms.

This paper finds that while the Nitaqat program program did increase native employment, it had a significant negative effect on firms. In particular, the policy is estimated to have increased the growth in Saudi employment by approximately 13 percent over a 16 month period, adding 52,000 positions for Saudis to the private sector labor force. The program also prevented some of the growth in the expatriate workforce, which grew by 250,000 less than it would have in the absence of the quotas. At the same time, the analysis suggests that the costs of constraining the labor market in this way were substantial; the program decreased total employment in the private sector by 198,000 workers and caused nearly 11,000 firms to exit. These costs were not borne equally across sectors, however, and there is some evidence that the increased costs were most damaging to industries in the secondary sector, including construction and manufacturing. This is particularly interesting given that sluggish growth in this sector is one of the typical symptoms of the resource curse.

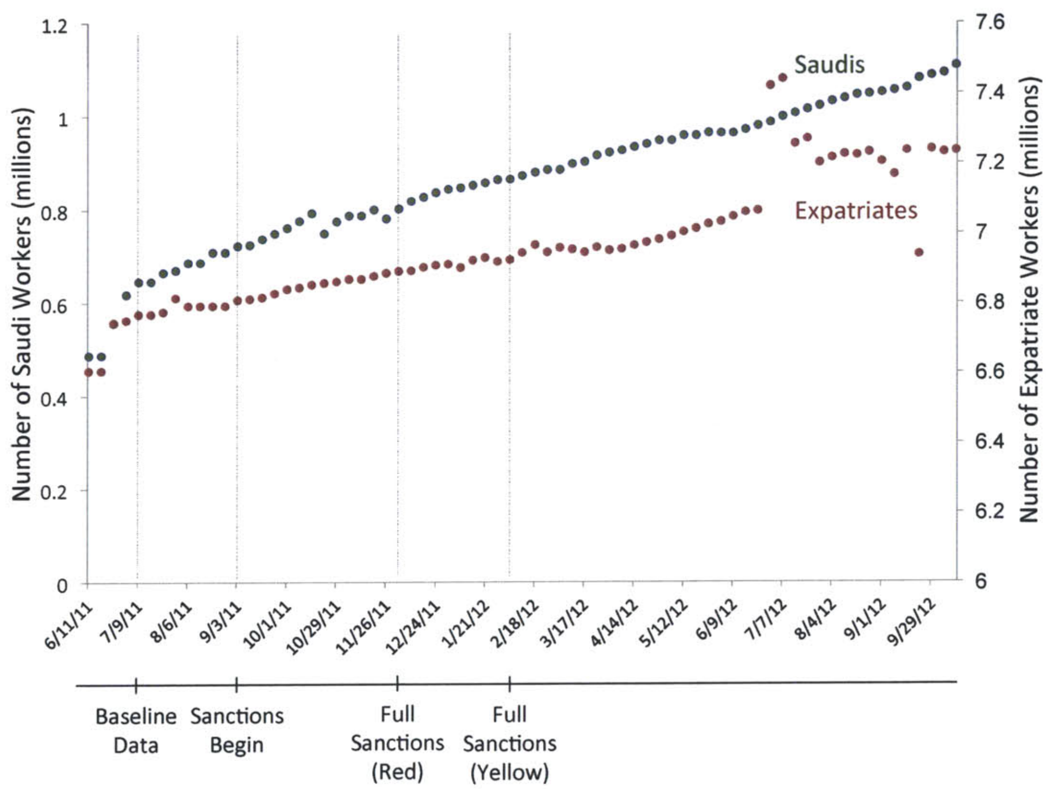
Taken together, the results indicate that the program's quick results in reducing Saudi unemployment have been created at significant costs to firms. However, the program is likely to have important long-term effects as well, which will mitigate some of the short-run costs. In the medium term, firms can adjust their capital investments to decrease the costs associated with employing more high-skilled Saudi labor. More experience and on the job training will also make Saudi workers more valuable to private-sector firms, decreasing the costs associated with employing Saudis instead of expatriates. Over the long-term, the presence of opportunities to work in the private sector will also likely affect the human capital investments of Saudi nationals. Until recently, the primary purpose of post-secondary education was to qualify Saudis for work in the public sector. Increased national participation in the private sector is likely to align education and other human capital investments with the demands of the private sector. The dynamic effects of the program will therefore be at least as important as the short-run impact, and this will be a critical area for future study.

Figures

Figure 2-1: Sample Color Bands for Medium-Sized Construction Entities

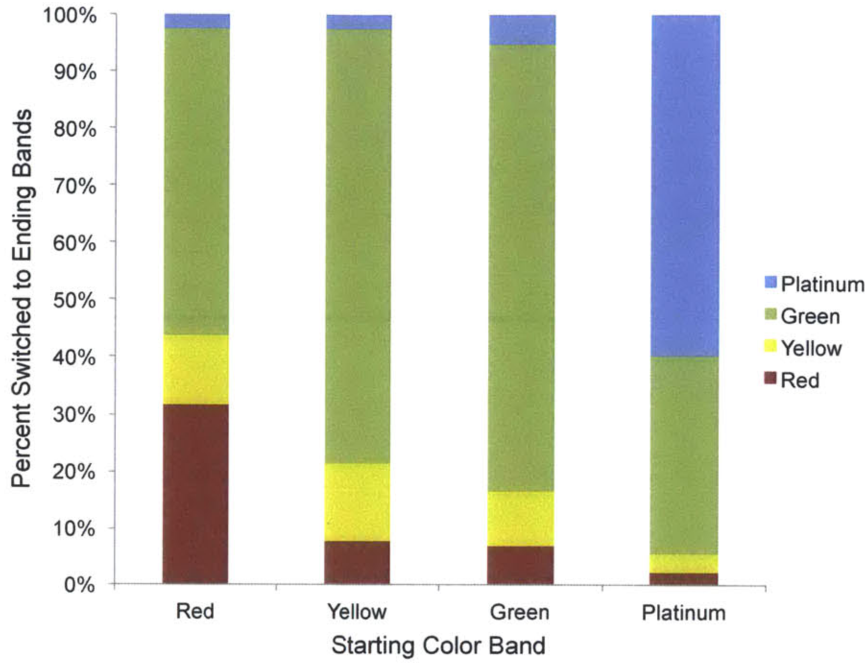
الممتاز	الأخضر	الأصفر	الأحمر	
% 25 ≤	% 24 - 5	% 4 - 2	صفر - 1 %	صغيرة (10-49)
% 28 ≤	% 27 - 6	% 5 - 2	صفر - 1 %	متوسطة (50-499)
% 31 ≤	% 30 - 7	% 6 - 4	صفر - 3 %	كبيرة (500-2999)
% 31 ≤	% 30 - 8	% 7 - 5	صفر - 4 %	عملاقة (3000 فأكثر)

Figure 2-2: Weekly Totals of Saudi and Expatriate Private-Sector Employees



Notes: This figure shows the weekly totals of Saudis and expatriate workers in the Nitaqat data. Vertical lines indicate important dates in program enforcement.

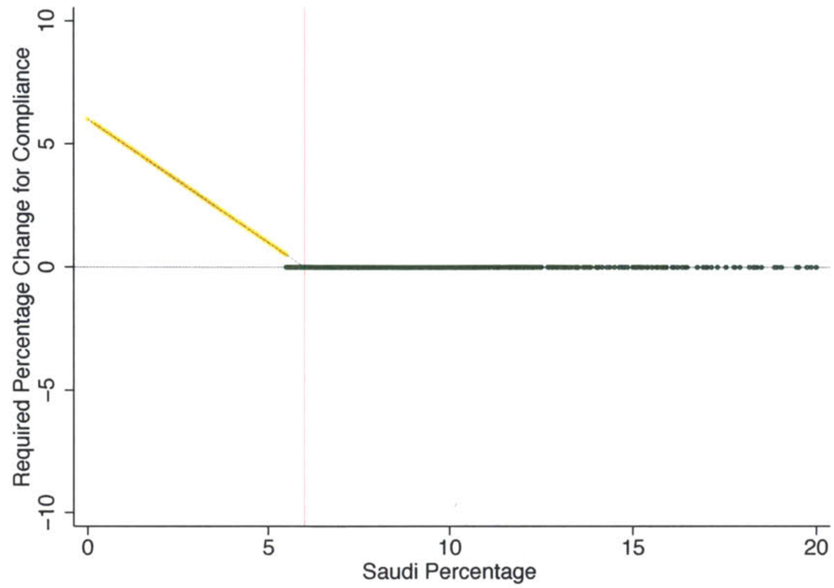
Figure 2-3: Movements Between Color Bands (July 2011 to October 2012)



Notes: This figure shows the proportion of firms in each starting category (x-axis) that transitioned into different color bands. For example, most firms in the yellow starting color band moved to the green category, and less than ten percent moved into the red category by October of the following year.

Figure 2-4: Saudization Compliance Requirement – Required Change vs. Initial Saudi Percentage

(a) Medium Construction Firms



(b) All firms

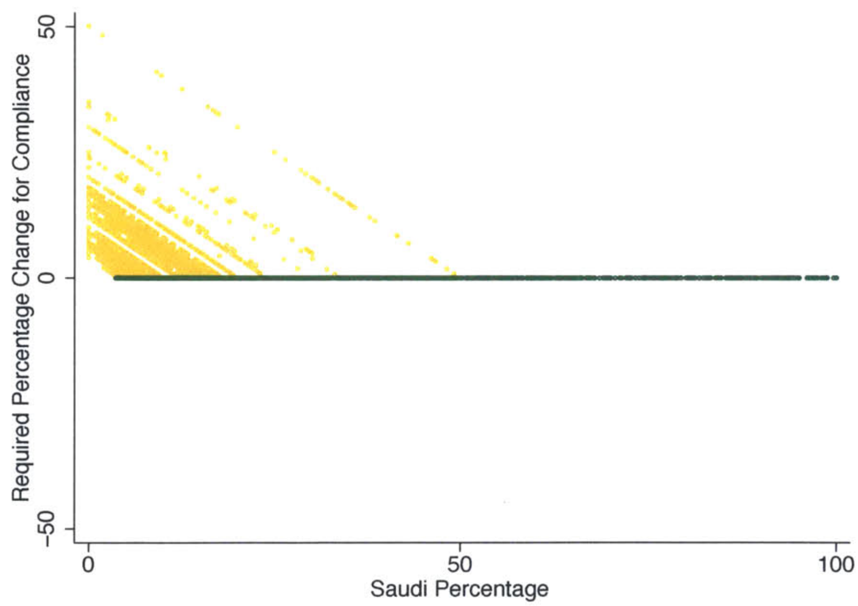


Figure 2-5: Normalized Saudization Compliance Requirement: Required Change vs. Initial Distance from Cutoff

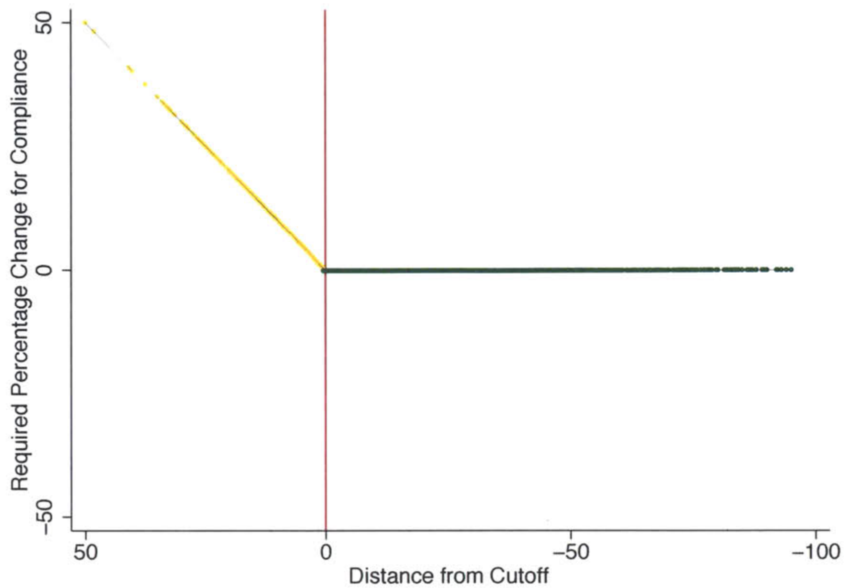


Figure 2-6: Normalized Compliance Requirement: Required Change vs. Initial Distance from Cutoff

(a) Saudis

(b) Expatriates

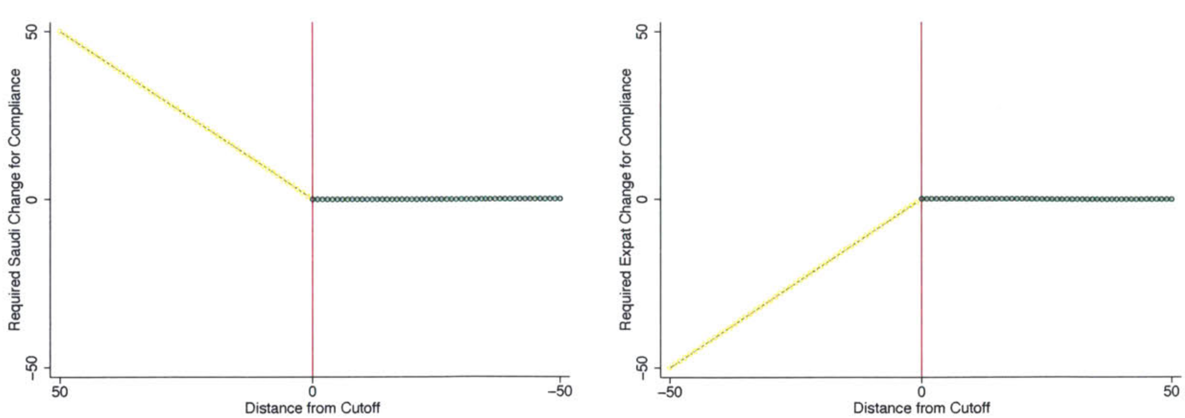
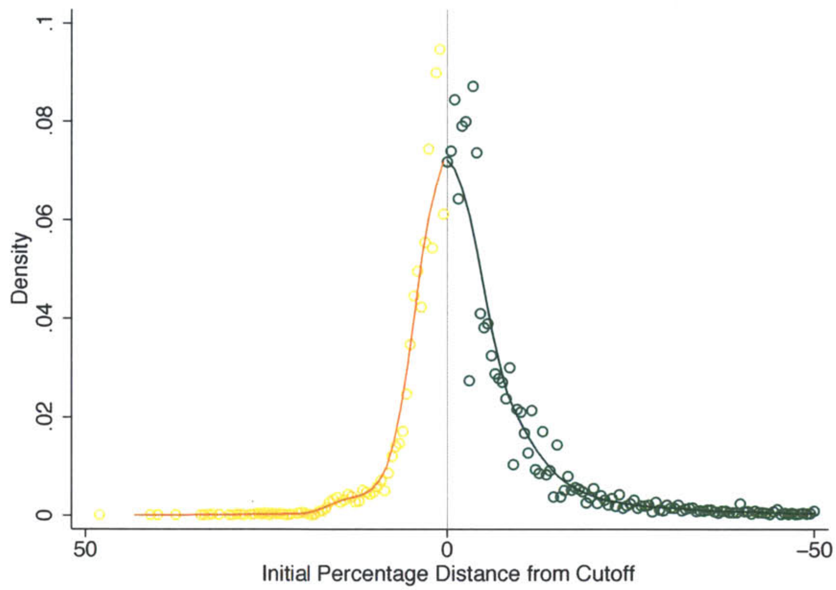


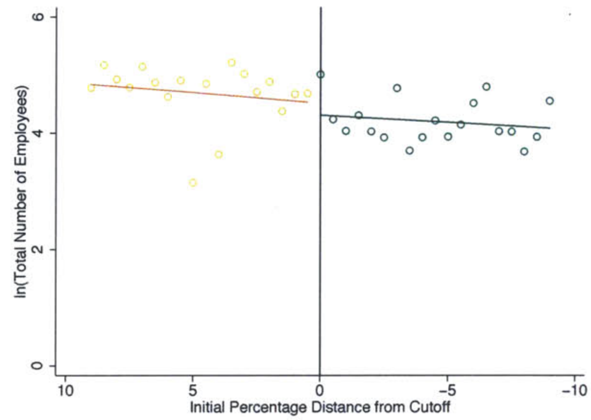
Figure 2-7: Density of Baseline Saudization Percentages Relative to Cutoff



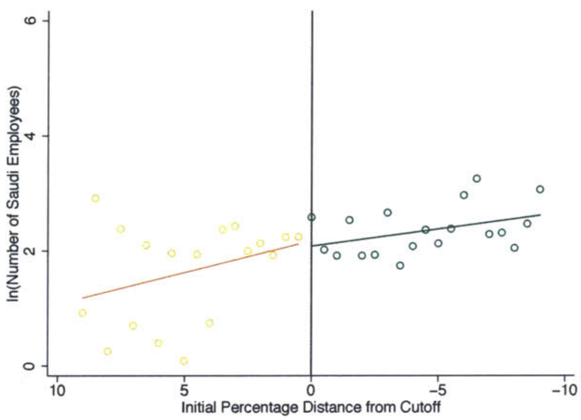
Notes: Firms with zero Saudization percentage at baseline are excluded from this figure. Bin size on is 0.5 percentage point. This figure corresponds to a McCrary test for a break in the baseline Saudization percentage for Green and Yellow firms at the compliance cutoff. The corresponding McCrary test statistic is 0.94.

Figure 2-8: Baseline Employment Relative to Initial Distance from the Cutoff

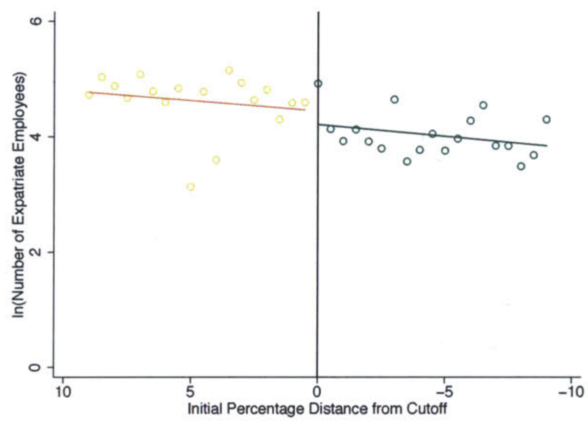
(a) Firm Size



(b) Saudi Employees



(c) Expatriate Employees

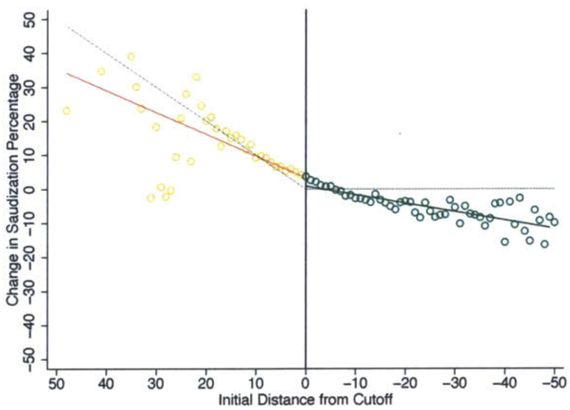


Notes: Parametric tests for a kink in these baseline employment figures fail to reject the null of no change in the slope at all conventional significant levels. There is no evidence of a kink in either the linear fit or in the local quadratic polynomial fit.

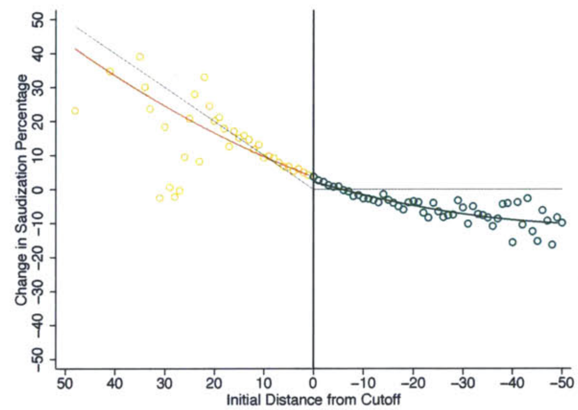
Figure 2-9: RKD Figures: Saudization, Saudi Employees, and Expatriate Employees

(a) Saudization Percentage

(i) Linear

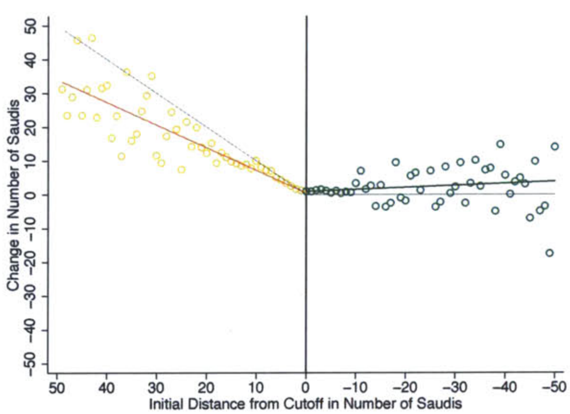


(ii) Quadratic

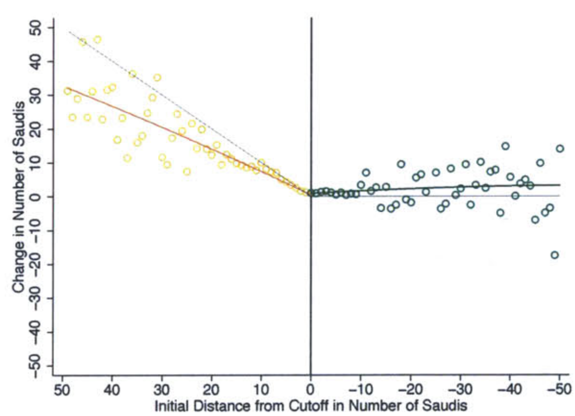


(b) Saudi Employees

(i) Linear

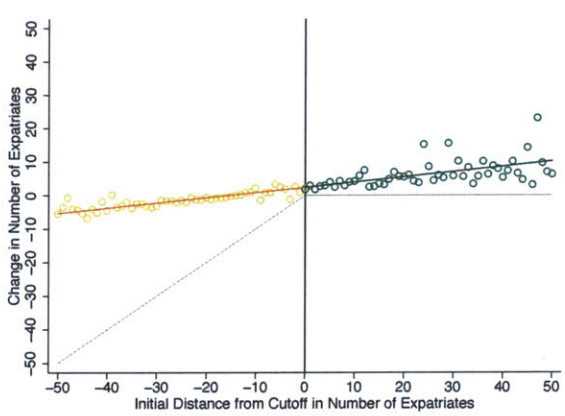


(ii) Quadratic

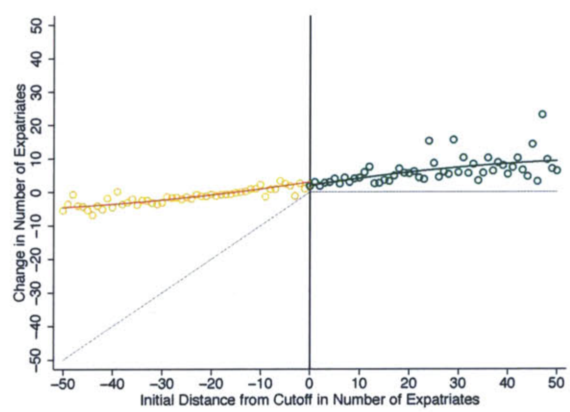


(c) Expatriate Employees

(i) Linear



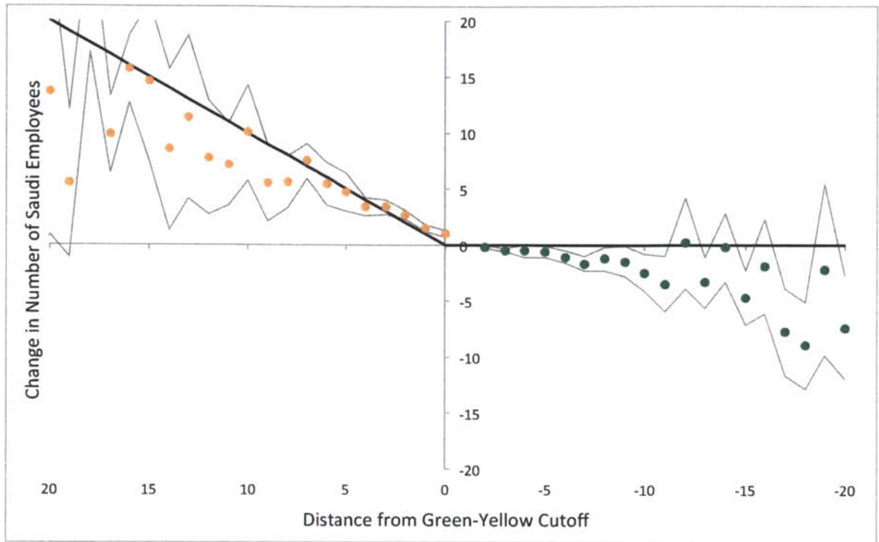
(ii) Quadratic



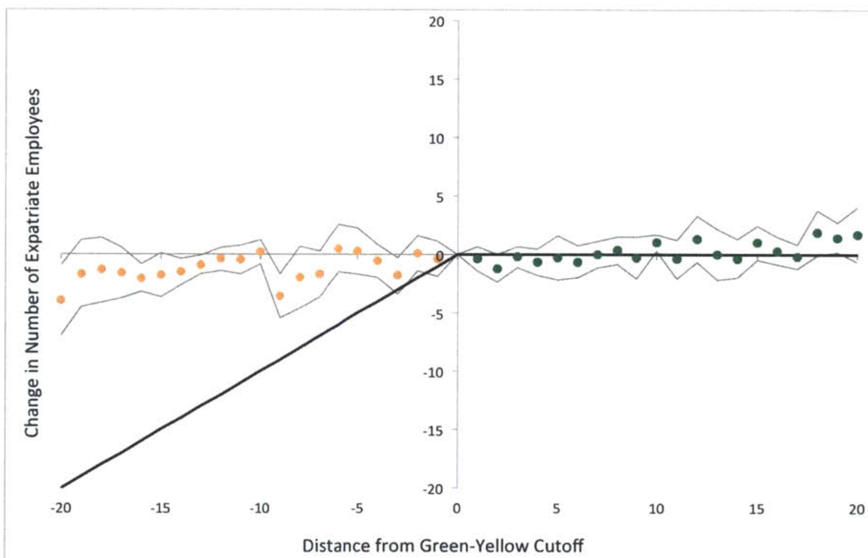
Notes: Panel (a) of this figure plots the coefficients of the regression of the change in the number of Saudi

Figure 2-10: DD Regression Coefficients

(a) Change in Saudi Employees vs. Distance from Green Cutoff



(b) Change in Expatriate Employees vs. Distance from Green Cutoff

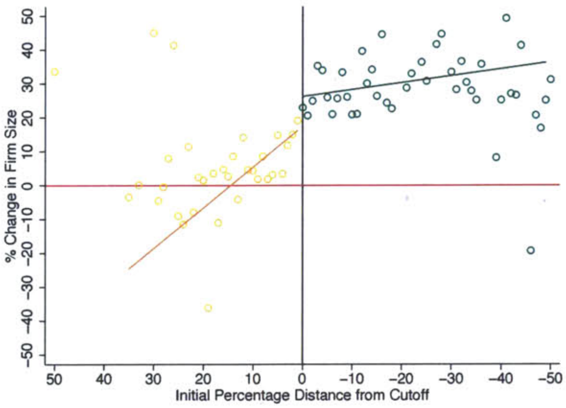


employees on distance (in terms of number of Saudi employees needed) from the green color band cutoff. Panel (b) plots the coefficients of the regression of the change in the number of expatriate employees on distance (in terms of number of surplus expatriate employees) from the green color band cutoff. Bounds for the 95% confidence intervals are marked in grey and are based on standard errors clustered at the industry by size group level. Regressions include a full set of cell fixed effects, and differences are the changes between July 2011 and October 2012. Omitted category is zero.

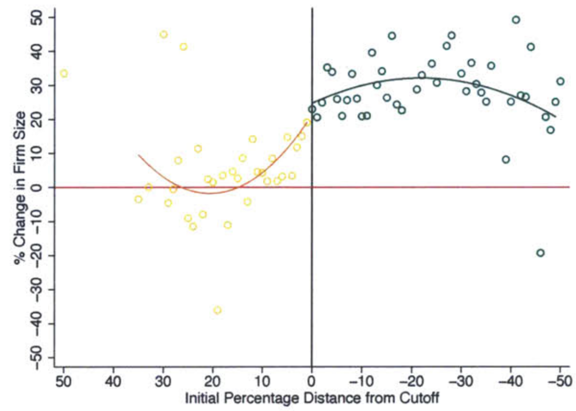
Figure 2-11: RKD Figures: Firm Size, Exit, and Value

(a) Firm Size

(i) Linear

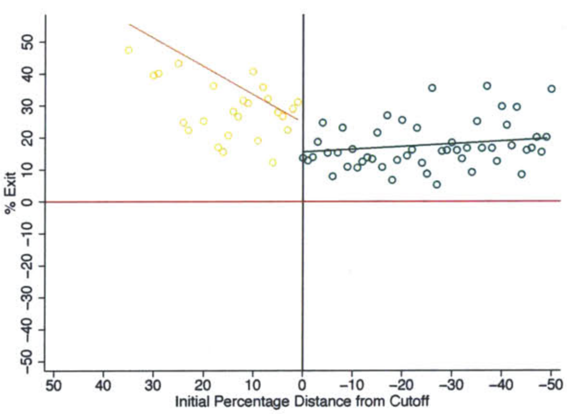


(ii) Quadratic

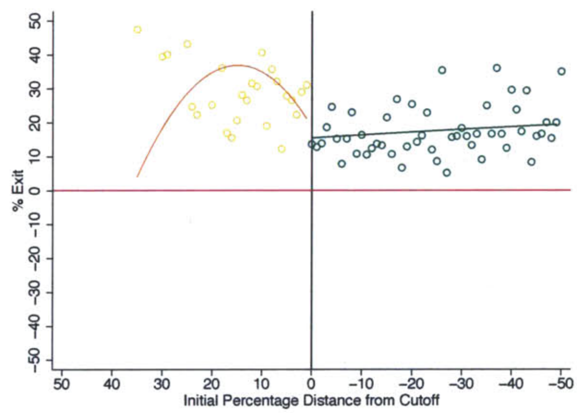


(b) Exit Rates

(i) Linear



(ii) Quadratic



(c) Market Value

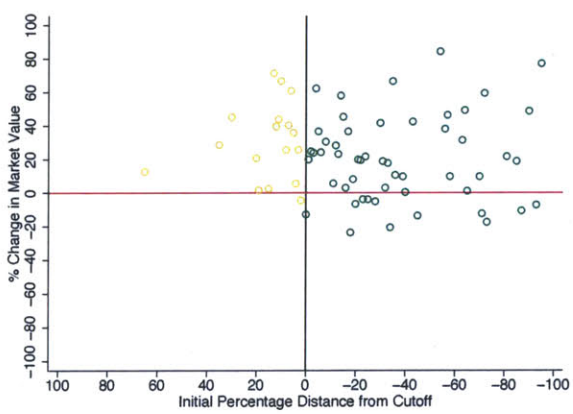


Figure 2-12: RKD Results on Industry Subsamples

Subsample	(i) Change in Number of Saudis	(ii) % Change in Firm Size	(iii) % Exit
(a) Primary (Agriculture, Extraction)			
(b) Secondary (Production and Construction)			
(c) Tertiary (Services)			

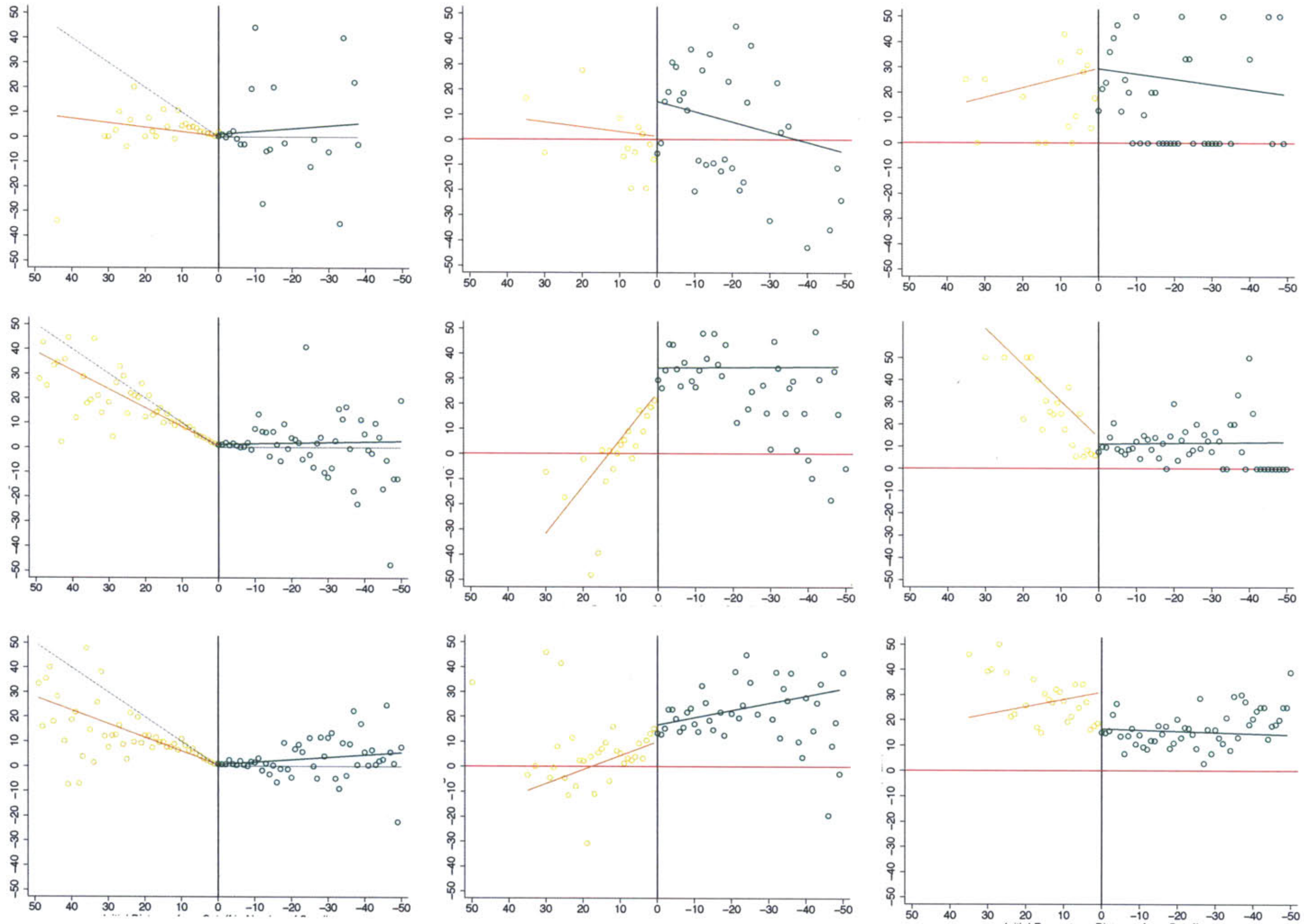


Figure 2-12: RKD Results on Industry Subsamples

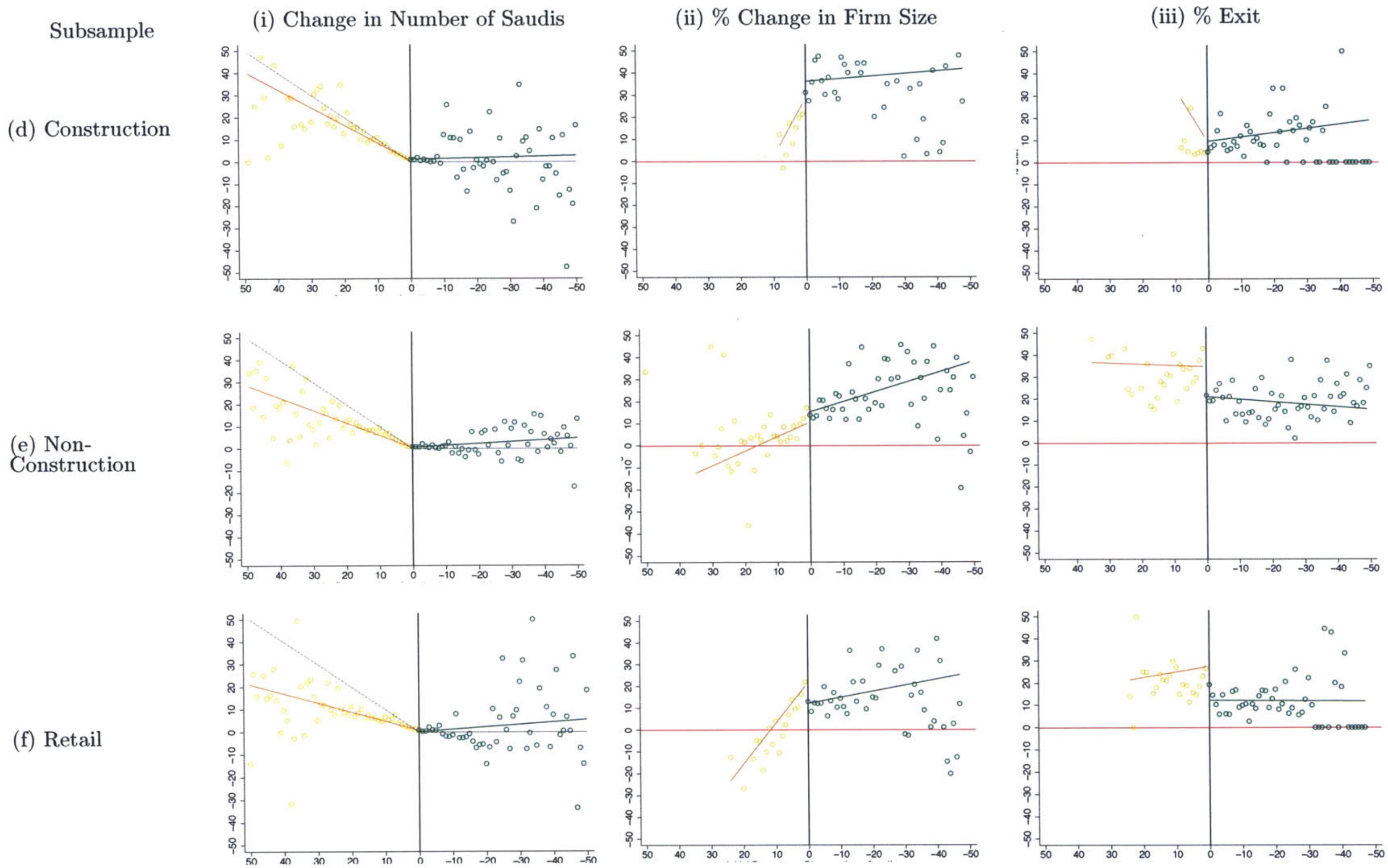
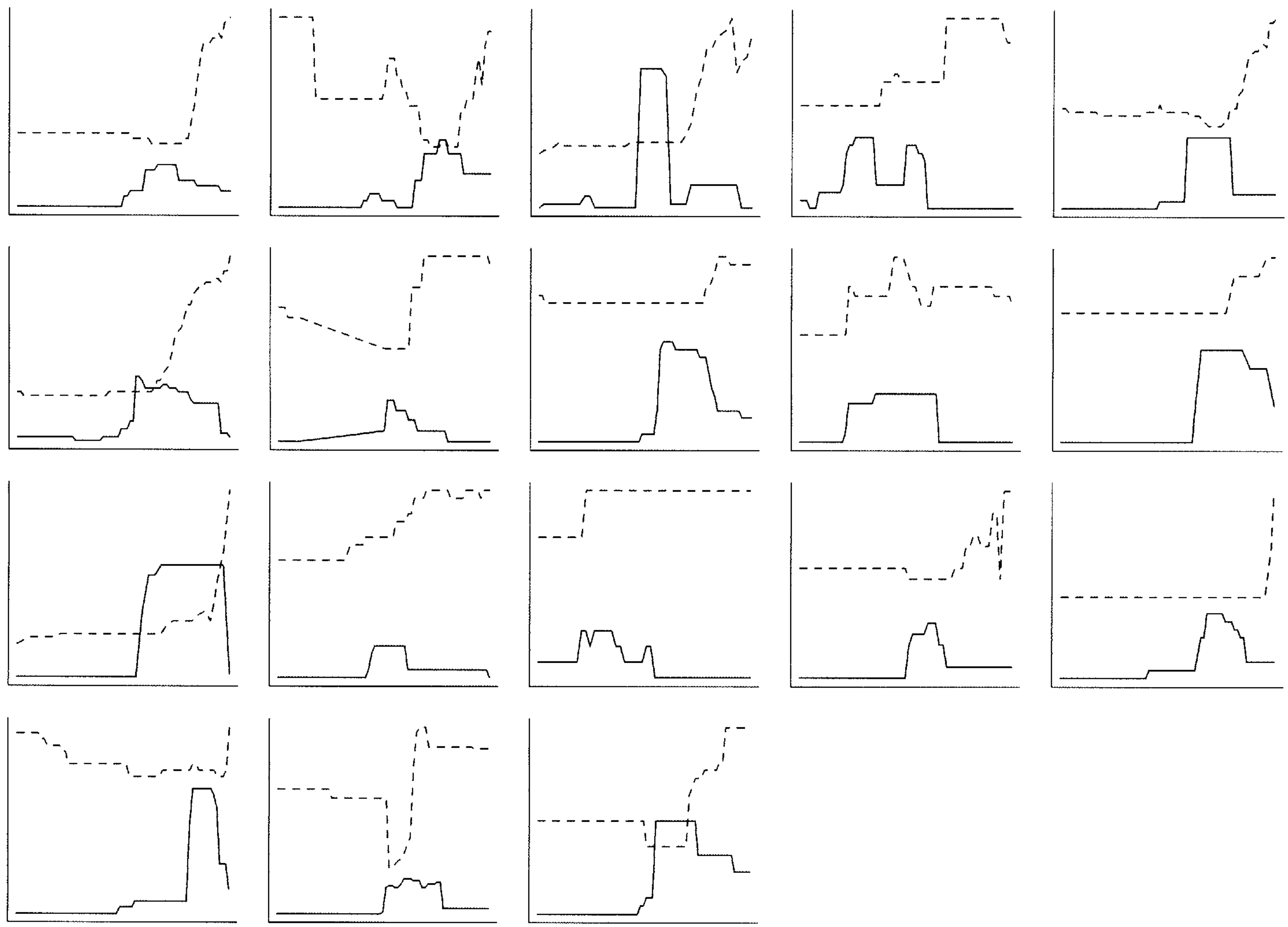


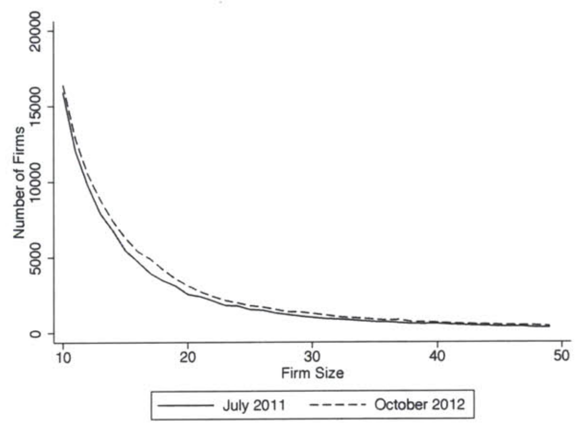
Figure 2-13: Strategic Firm-Level Hiring Patterns: Employment of Saudis and Expatriates over the Nitaqat Period



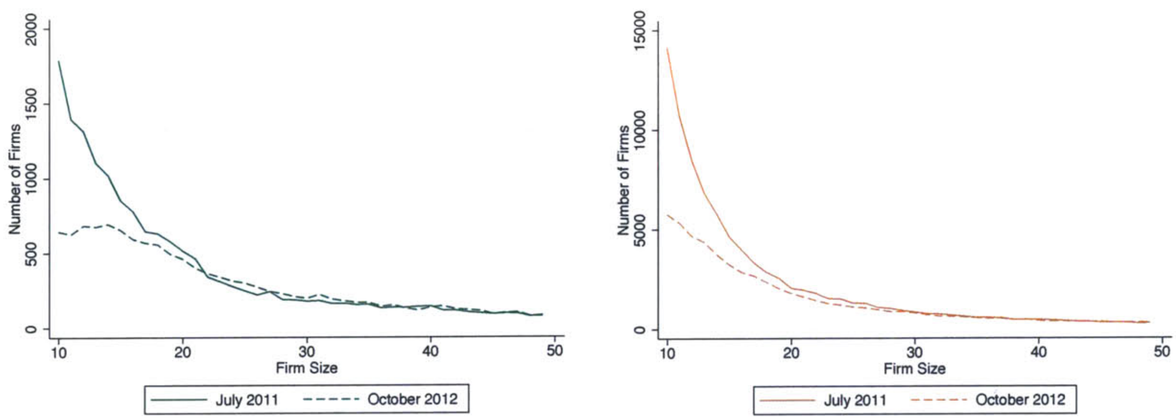
Notes: Solid lines show employment of Saudis and dashed lines show expatriate employment over the 71-week period beginning in July 2011. Scale of the y-axes suppressed for privacy reasons.

Figure 2-14: Strategic Firm Exit

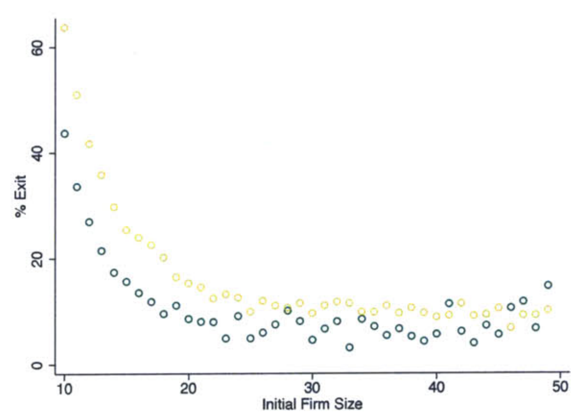
(a) Change in Size Distribution of all Firms



(b) Change in Size Distribution of Matched Green/Platinum and Yellow/Red Firms



(c) Exit Rate from Sample by Initial Firm Size



Tables

Table 2.1: Nitaqat Sanctions and Benefits by Color Band and Date

Red Firms	
September 11, 2011	Existing visas cannot be renewed for longer than three months
	Job descriptions for foreign workers cannot be changed
	No hiring of expatriate workers from other firms
	No new visas issued
	Firms cannot open any new facilities or branches
November 27, 2011	Existing work visas can no longer be renewed
	Expatriate employees may freely transfer their employment to Green or Platinum band companies without the consent of their current employer

Yellow Firms	
September 11, 2011	Existing visas cannot be renewed for longer than three months
	Job descriptions for foreign workers cannot be changed
	No hiring of expatriate workers from other firms
	No applications for new temporary or seasonal visas accepted
	Firms are entitled to one new visa for every two workers departing the country on a final exit visa
February 24, 2012	Existing work visas can no longer be renewed
	Workers who have been in the Kingdom for more than six years cannot renew their visas
	Expatriate employees may freely transfer their employment to Green or Platinum band companies without the consent of their current employer

Green Firms	
September 11, 2012	Visa applications can be submitted as usual
	Job descriptions for foreign workers can be updated as necessary
	Firms are entitled to one new visa for every two workers departing the country on a final exit visa
	Firms receive a six-month extension for the submission of the Certificate of Zakat and Income Tax
November 27, 2011	Expatriate workers may be hired from Red firms
February 24, 2012	Expatriate workers may be hired from Yellow firms

Platinum Firms	
September 11, 2012	Unrestricted approval of new visas
	Job descriptions for foreign workers can be updated as necessary
	Firms are entitled to one new visa for every two workers departing the country on a final exit visa
	Firms receive a six-month extension for the submission of the Certificate of Zakat and Income Tax
November 27, 2011	Expatriate workers may be hired from Red firms
	Firms receive a one-year extension for the submission of all MOL documents
February 24, 2012	Expatriate workers may be hired from Yellow firms
	Existing visas may be renewed for any employee with less than three months remaining on their visa

Notes: List compiled from http://www.emol.gov.sa/nitaqat/pages/ServiceExtrs.aspx and the Ministry of Labor Nitaqat Manual

Table 2.2: Number of Firms by Industry and Size Classification (July 2011)

Industry	Small (10-49)	Medium (50-499)	Large (500-2999)	Giant (3000+)	Total
Building and construction	34,179	5,351	578	39	40,147
Wholesale and retail trade	17,677	2,717	197	6	20,597
Multiple economic activities	16,050	.	.	.	16,050
Manufacturing	5,512	1,348	120	1	6,981
Workshops and maintenance services	6,481	194	4	.	6,679
Farmers, fishermen and shepherds	6,206	220	9	.	6,435
Restaurants and catering services	4,537	301	8	1	4,847
Personal services	2,364	170	10	1	2,545
Social and communal services	2,011	278	31	1	2,321
Passenger transportation (inter-city)	1,207	230	9	1	1,447
Maintenance and cleaning services	971	300	56	4	1,331
Health services	863	396	33	.	1,292
Lodging and tourism	1,085	185	19	.	1,289
Insurance and business services	493	135	9	.	637
Consulting services	400	145	6	.	551
Passenger transportation (intra-city)	351	140	10	.	501
Agriculture and livestock	343	61	12	2	418
Governmental and private schools	224	180	2	.	406
Foreign schools	171	109	1	.	281
Printing, publishing and media	238	33	2	.	273
Pharmacies	219	47	2	.	268
Collection offices and real estate	173	55	5	.	233
Institutes and colleges	144	73	5	.	222
Agriculture, fishing, grazing, horses	194	20	3	.	217
Electricity, gas and water	76	30	7	1	114
Gold and jewelry trade	76	16	.	.	92
Air transportation	69	20	3	.	92
Mining and quarrying	54	25	6	.	85
Petrochemicals, coal and rubber	50	29	6	.	85
Cement	44	28	11	.	83
Financial institutions (banks)	54	15	11	.	80
Private labor recruitment agencies	41	36	.	.	77
Petroleum and gas extraction	36	26	10	1	73
Shipping	45	14	.	.	59
General office services	29	2	.	.	31
Storage	19	2	1	.	22
Communications	7	4	1	.	12
Total	102,693	12,935	1,187	58	116,873

Notes: This table provides sample statistics on the number of firms in each of 37 industries and 4 size categories at baseline (July 9, 2011). Of the firms in the baseline sample, 1,027,017 were too small to be included in the Nitaqat program (fewer than ten employees). The fifteen industry classifications that were added in later versions of Nitaqat were road transport of goods within cities; road transport of goods between cities; laboratories; governmental and private schools (boys; mixed gender); security escorts; private employment offices; kindergarten; bakeries; ready-mixed concrete; information technology; governmental construction contractors; governmental hygiene contractors; petrol stations; and stone, granite and brick.

Table 2.3: Number of Employees by Industry and Type (July 2011)

Industry	Number of Firms	Total Workers	% Total Workforce	Saudi Workers	% Saudi Workforce	Industry Share Saudi
Building and construction	40,147	2,627,940	46.66	152,046	24.35	5.79
Wholesale and retail trade	20,597	927,861	16.47	127,711	20.45	13.76
Manufacturing	6,981	418,025	7.42	69,096	11.06	16.53
Multiple economic activities	16,050	199,166	3.54	4,795	0.77	2.41
Maintenance and cleaning services	1,331	167,817	2.98	12,791	2.05	7.62
Farmers, fishermen and shepherds	6,435	128,447	2.28	1,532	0.25	1.19
Restaurants and catering services	4,847	128,118	2.27	7,961	1.27	6.21
Health services	1,292	124,640	2.21	20,358	3.26	16.33
Social and communal services	2,321	123,849	2.20	39,229	6.28	31.67
Workshops and maintenance services	6,679	122,235	2.17	3,196	0.51	2.61
Personal services	2,545	82,198	1.46	11,923	1.91	14.51
Petroleum and gas extraction	73	70,720	1.26	53,699	8.60	75.93
Passenger transportation (inter-city)	1,447	65,567	1.16	4,929	0.79	7.52
Lodging and tourism	1,289	62,190	1.10	8,185	1.31	13.16
Agriculture and livestock	418	42,124	0.75	4,878	0.78	11.58
Consulting services	551	38,015	0.67	5,691	0.91	14.97
Passenger transportation (intra-city)	501	35,215	0.63	3,654	0.59	10.38
Insurance and business services	637	33,701	0.60	8,251	1.32	24.48
Governmental and private schools	406	30,045	0.53	11,390	1.82	37.91
Financial institutions (banks)	80	28,777	0.51	23,040	3.69	80.06
Electricity, gas and water	114	23,330	0.41	8,329	1.33	35.70
Cement	83	20,292	0.36	4,584	0.73	22.59
Institutes and colleges	222	20,292	0.36	8,607	1.38	42.42
Foreign schools	281	17,794	0.32	6,776	1.09	38.08
Collection offices and real estate	233	14,599	0.26	2,172	0.35	14.88
Mining and quarrying	85	12,111	0.22	4,808	0.77	39.70
Petrochemicals, coal and rubber	85	11,735	0.21	5,298	0.85	45.15
Pharmacies	268	11,316	0.20	1,907	0.31	16.85
Printing, publishing and media	273	10,922	0.19	2,127	0.34	19.47
Agriculture, fishing, grazing, horses	217	9,731	0.17	835	0.13	8.58
Gold and jewelry trade	92	8,847	0.16	2,750	0.44	31.08
Private labor recruitment agencies	77	5,391	0.10	234	0.04	4.34
Air transportation	92	2,897	0.05	352	0.06	12.15
Shipping	59	2,376	0.04	518	0.08	21.80
Communications	12	1,661	0.03	198	0.03	11.92
Storage	22	1,602	0.03	428	0.07	26.72
General office services	31	644	0.01	188	0.03	29.19
Total	116,873	5,632,190		624,466		11.09
Non-Nitaqat Firms	1,027,017	1,780,937	31.62	21,250	3.40	1.19

Notes: This table provides sample statistics on the composition of the workforce by industry at baseline (July 9, 2011). Column 1 counts the number of firms in each industry category, and column 2 the number of employees at firms in those industries. Column 3 sorts industries by their share of the total private-sector workforce. Columns 4 and 5 report the number of Saudi workers in each industry and the share of workers in that industry in the total Saudi private sector workforce. Column 6 calculates the share of workers in each industry that are Saudi nationals, i.e. the overall industry Saudization rate. The last line reports the same statistics for the firms that were too small to be included in the Nitaqat program (less than ten employees).

Table 2.4: Number of Employees by Size and Type (July 2011)

Size Group	Number of Firms	Number of Workers	% Total Workforce	Saudi Workers	% Saudi Workforce	Share Saudi
Tiny (<10)	1,027,017	1,780,937	24.02	21,250	3.29	1.19
Small (10-49)	102,693	1,823,386	24.60	74,759	11.58	4.10
Medium (50-499)	12,935	1,582,555	21.35	190,263	29.47	12.02
Large (500-2999)	1,187	1,428,220	19.27	237,851	36.84	16.65
Giant (3000+)	58	798,029	10.77	121,593	18.83	15.24
Total	1,143,890	7,413,127		645,716		8.71

Notes: This table provides sample statistics on the composition of the workforce by size group at baseline (July 9, 2011). Column 1 counts the number of firms in each size category, and column 2 the number of employees at firms in those categories. Column 3 lists the category share of the total private-sector workforce. Columns 4 and 5 report the number of Saudi workers in each size group and the share of workers in that group in the total Saudi private sector workforce. Column 6 calculates the share of workers in each size category that are Saudi nationals, i.e. the overall category Saudization rate.

Table 2.5: Movements Between Color Bands (July 2011 to October 2012)

Oct 2012 / July 2011	White	Red	Yellow	Green	Platinum	Total
			Panel A: Number of Firms			
White	981,267	0	0	0	0	981,267
Red	20	19,154	7,334	32,521	1,421	60,450
Yellow	0	570	1,013	5,595	166	7,344
Green	1	996	1,411	11,260	718	14,386
Platinum	0	33	43	483	829	1,388
Total	981,288	20,753	9,801	49,859	3,134	1,064,835
			Panel B: Percentage of Starting Firms			
White	100	0	0	0	0	
Red	0.03	31.69	12.13	53.80	2.35	
Yellow	0	7.76	13.79	76.18	2.26	
Green	0.01	6.92	9.81	78.27	4.99	
Platinum	0	2.38	3.10	34.80	59.73	

Notes: Panel A displays the number of firms that moved between color bands between July 2011 and October 2012. Rows indicate the starting color band of the firm, and columns the ending color band. Panel B gives the share of firms in each starting color band that moved to each of the ending color bands. This sample includes only firms that were in both the baseline (July 2011) and follow-up sample (October 2012). Firm count is smaller than in the baseline summary statistics due to firm entry and exit.

Table 2.6: RKD Estimates

Outcome	Bandwidth	Polynomial	Estimated Kink	t-statistic	N
Percentage	5	1	0.20***	5.61	48,241
		2	0.48***	3.47	48,241
	10	1	0.23***	8.99	76,425
		2	0.19***	2.92	76,425
	20	1	0.20***	7.60	81,958
		2	0.31***	4.35	81,958
	50	1	0.19***	7.10	83,215
		2	0.32***	5.06	83,215
Saudi Employees	5	1	0.34***	6.10	75,073
		2	-0.03	-0.38	75,073
	10	1	0.51***	7.78	78,461
		2	0.15	1.32	78,461
	20	1	0.49***	7.69	81,126
		2	0.20	1.46	81,126
	50	1	0.59***	10.59	82,633
		2	0.47***	5.00	82,633
Expatriate Employees	5	1	-0.04	0.13	7,099
		2	-0.01	0.04	7,099
	10	1	-0.05	0.97	17,637
		2	-0.01	0.22	17,637
	20	1	0.07***	3.93	52,612
		2	-0.01	0.36	52,612
	50	1	0.02	0.85	73,470
		2	0.06**	2.35	73,470
Firm Size	5	1	3.07***	3.93	48,241
		2	-12.52***	3.94	48,241
	10	1	-0.61**	1.98	76,425
		2	2.35*	1.90	76,425
	20	1	-0.52**	2.11	81,958
		2	-1.31*	1.75	81,958
	50	1	-0.52***	3.02	83,215
		2	-1.21***	3.44	83,215
Exit Rate	5	1	1.15***	3.90	65,038
		2	2.82***	2.65	65,038
	10	1	2.17***	17.68	107,602
		2	-1.59***	3.43	107,602
	20	1	0.72***	9.28	114,527
		2	4.48***	18.14	114,527
	50	1	0.98***	18.67	116,362
		2	0.97***	8.39	116,362

*** p<0.01, ** p<0.05, * p<0.1

Table 2.7: Average Effects by Color Band (DD Estimates)

	Saudization Percentage		Saudi Employees		Expatriate Employees		Total Employees		% Exit		Number of Firms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
D(Red)	4.03***	3.44***	1.97**	1.01*	-9.60***	-5.29***	-7.63***	-4.29***	11.85***	11.67***	60,450
	(0.61)	(0.48)	(0.85)	(0.39)	(2.95)	(0.94)	(2.46)	(0.83)	(1.18)	(1.16)	
D(Yellow)	4.20***	3.45***	2.03***	0.81*	-4.88**	0.56	-2.85	1.37	4.54**	4.31**	7,344
	(0.81)	(0.78)	(0.69)	(0.46)	(2.07)	(1.80)	(2.86)	(1.90)	(1.88)	(1.81)	
D(Green > 5)		-5.45***		-8.81**		39.36***		30.55***		-1.84	1,692
		(0.89)		(3.86)		(8.51)		(9.04)		(2.20)	
N	82,180	82,180	82,180	82,180	82,180	82,180	82,180	82,180	115,159	115,159	
Total Est. Effect	3.34	2.73	133,995	52,097	-616,159	-249,071	-482,164	-197,579	10,880	10,665	
Full Compliance Benchmark	5.76	3.22	211,433	57,373	-1,865,842	-769,653	.	.	.	.	

Notes: This table reports the average change in Saudi percentage, number of Saudi employees, number of expatriate employees, total number of employees, and exit rates between July 2011 and October 2012 based on initial color band assignment. Comparisons are based on firms in the same industry and size category that were assigned to the Green band. For odd-numbered columns, the omitted comparison group is all firms that were initially in the Green color band. In even-numbered columns the comparison group is Green firms that were just above the quota cutoff, with no more than five Saudi employees more than were needed to meet the quota. Average changes for firms that were in the Green band but which were well-above the quota are reported as coefficients on D(Green>5). All regressions include industry by size fixed effects. Standard errors are clustered at the industry by size level. The last column lists the number of matched firms in each category for the sample used in the first eight columns. The last two rows compare the implied total estimated effect on the relevant outcome variable with the full-compliance benchmark. In columns 1 and 2 this is the average change in private-sector Saudization; in columns 3 and 4 the increase in Saudi employees; in columns 5 and 6 the decrease in expatriate employees; in columns 7 and 8 the total change in the number of private sector workers, and in 9 and 10 the number of firms that exited as a result of the program.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Chapter 3

The Direct Costs of Conflict-Related Supply Disruptions on the U.S. Downstream Oil Industry

3.1 Introduction

> "And here we have a serious problem. America is addicted to oil, which is often imported from unstable parts of the world."
> *George W. Bush, 2006 State of the Union Address*

The security of petroleum supplies is a major issue in U.S. domestic and foreign policy. Concerns about energy security and exposure to political volatility through the oil market have long been at the center of policy discussions in the United States. Many strategies to address this issue have focused on increasing North American oil supply, and there has been ongoing debate over whether restrictions on domestic oil extraction should be eased, permitting drilling both offshore and in the Arctic National Wildlife Refuge (ANWR).[1] At the same time, opponents of drilling have cited serious environmental costs and questioned the benefits of increasing domestic production. Because of this, it is essential to understand how the U.S. downstream industry is affected by conflict in oil supplier countries.

There are two major types of costs associated with conflict in oil-exporting countries: the indirect costs of disruptions in exports, usually captured by changes in the world oil price, and the direct costs of supply disruptions to refiners and markets that were reliant on that particular crude stream. The indirect costs are the most visible and draw the most attention, as export disruptions cause sudden changes to the world oil price. These price changes quickly pass through into gasoline prices, and oil price surges make newspaper headlines. The costs of these conflict-related supply shocks and subsequent surges in the world oil price are

I am grateful to the George and Obie Shultz fund for providing financial support to acquire the data for this project.

[1]Former President George W. Bush notably supported opening ANWR for drilling, claiming that the supplies would make the United States less dependent on foreign sources of energy (Bush 2008). He also removed an executive prohibition on offshore exploration.

of first-order importance to refiners and consumers. At the same time, however, it is unlikely that increasing U.S. domestic oil production will protect the downstream industry from these price shocks. Many in the industry have pointed out that the potential additional production will not be sufficient either to change world oil prices or to displace all U.S. oil imports.[2]

In addition to these highly visible effects on the global downstream industry, however, conflict-related supply disruptions may also affect refiners and consumers by interrupting refinery-level supplies of particular imported crude streams. Oil refineries in the U.S. tend to be very specialized and process set shares of specific types of crude oil. While refineries can be converted to accept a different input mix, the process is costly and requires significant adjustment of the physical capital. Because of this, oil from different countries is far from perfectly substitutable, and supply interruptions of particular crude types may have a significant effect on the refineries that depend on them. If refiners are not able to find substitutes for the lost crude, these import disruptions may further decrease refining profits for these firms and increase retail product prices in the markets that they serve.

This paper uses a comprehensive dataset linking refinery-level crude imports to international conflict to quantify these direct effects of conflict-related supply disruptions on domestic refined product markets. This exercise provides some evidence on how effectively firms are able to adjust to unexpected supply shortfalls in the short run. In particular, the analysis first asks how conflict in oil-producing countries affects U.S. petroleum imports, and what these direct supply disruptions cost refiners and consumers in terms of reduced profits and increased product prices. I first use data on conflict intensity to identify exogenous disruptions to oil imports from particular countries. I then identify the refineries that were likely to be affected by these supply disruptions using historical refinery-level imports to determine which refineries were set up to process crude from each country. I use this panel variation in the exposure to conflict-related supply disruptions to examine the effect of the lost supplies on refining profits and on gasoline prices in the markets served by the affected refineries. This research design allows the analysis to separate the direct effects of conflict-related supply disruptions from the general effects of shocks to global oil markets.

There are several key results. First, I find that conflicts in oil-exporting countries are associated with supply disruptions to U.S. refineries. The magnitude of these disruptions is increasing with conflict severity. On average, conflicts are associated with a 265,000 barrel disruption per conflict-year to importing refineries, a total loss of approximately 2 billion barrels from 1991-2011, 3.5 percent of total oil imports to operating refineries during the period. Second, the effect of these disruptions on profits and prices is very small.

[2]The EIA, for example, estimates that the total production of ANWR would be far too small to have any significant effect on world oil prices (EIA 2008), and most economists agree that drilling in the Arctic would have no effect on the price of oil (e.g. Borenstein (2005)). A recent poll of energy experts found that most do not consider energy independence to be a sensible goal, asserting that the United States would always be linked to global oil markets even with increased domestic production (Yergin 2012).

Estimates for the effect on profits are mostly precisely-estimated zeros; the only statistically significant estimate indicates that a 10 percent decrease in imports due to conflict would decrease profits by 0.3 percent. The estimates for the effect on prices are also quite small; on average conflicts raise prices by up to 0.006 percent, and a 10 percent decrease in imports due to conflict is associated with a 0.6 percent increase in the retail gasoline price. On average, then, refineries appear to adjust quickly to unexpected changes in their supplies, and the impact on refiner costs seems to be small.

There are several important points to be made about these results. First, as mentioned above the most significant costs of conflict will not be captured by this analysis. The costs estimated here are the differential effect on refiners and markets that are directly affected by supply interruptions relative to those that are not. Even though these differential effects are small, the indirect effects on the whole industry are likely quite large. These effects will be felt by refiners and consumers whether or not they actually import oil from fragile states.[3] Second, all of the analysis in this paper uses non-importers as a comparison group for importers when estimating the effect of conflicts in particular countries. These estimates will therefore only be valid to the extent that these companies and local markets provide a relevant counterfactual both in terms of their response to global oil shocks as well as whether they experience spillovers from import shocks to their competitors. Most of these issues will tend to bias the analysis toward larger estimates of the costs, which is less of a concern given that the results suggest only very small effects.

This paper is the first to examine the direct impact of global conflict on refinery-level supply disruptions. There has been very little academic work done on the costs to importers of conflict in oil-exporting countries, and much of the debate has occurred in the popular press rather than in the academic literature. For the most part, academics have focused on the fact that domestic production will have little effect on global oil prices, and that increasing imports from North American sources will not shield the U.S. from global price shocks (Borenstein 2008, Borenstein 2012). On the other hand, there has been a great deal of work on how oil price shocks, often due to conflict-related oil production interruptions in OPEC countries, have affected U.S. macroeconomic indicators such as GDP growth, inflation, wages, and employment (see for example Hamilton (1983), Hamilton (1996), Keane & Prasad (1996), Bernanke, Gertler & Watson (1997), Davis & Haltiwanger (2001), Lee & Ni (2002), Barsky & Kilian (2004), and Kilian (2008). A relatively recent paper by Blomberg, Hess & Jackson (2009), for example, looks at how the stock prices of oil companies respond to acts of terrorism. They find that terrorist activity was associated with an increase in stock returns in the 1968-1973 period, with the relationship disappearing post-1974. They attribute this to the decline of market power of these companies in the more recent period. This paper complements this literature by examining the

[3] Even if no U.S. refiner had ever used crude from Libya, for example, the huge export disruption during the Arab Spring uprising and subsequent surge in world oil prices would have increased input prices for refineries across the U.S. and raised gasoline prices for consumers.

direct effect of supply disruptions on the U.S. downstream industry rather than the indirect effects through oil prices. This paper also adds to the literature on whether conflict in oil-producing countries disrupts oil production.[4] Recent work by Toft (2011), for example, finds that less than half of conflicts in oil-producing countries result in production declines. Luciani (2011) examines several case studies and similarly concludes that oil and gas installations tend to be quite resilient to armed conflict. This paper provides estimates on how conflicts disrupt U.S. imports rather than overall supply. Although other work by Lee & Ni (2002) finds some evidence that U.S. petroleum refineries reduce their outputs in response to oil price shocks, this paper examines the direct link through decreases in refinery-level imports rather than overall changes in input quantities.

Finally, this paper takes a first step toward understanding what types of conflicts are likely to be the most costly for the downstream industry. While the analysis finds conflict-related supply disruptions do not have significant effects on average, there is some evidence that large conflicts are more likely to cause serious supply disruptions, decrease profits, and raise retail gasoline prices. It is likely that there also are other characteristics that make certain supply disruptions more serious than others. Shocks may be particularly difficult for refiners to smooth when the lost crude is heavily used by a particular refiner or in a particular market, requiring the refinery to secure a large amount of replacement crude on short notice. Supply interruptions could also be particularly serious when the crude type itself is difficult to replace, whether because it has unusual characteristics or because there are no other countries providing close substitutes. Future work is needed to understand how these factors affect the impact of conflict-related supply disruptions.

The rest of the paper proceeds as follows. Section 2 provides some background on how supply disruptions might be expected to affect U.S. refiners and discusses some important features of the U.S. refining market. Section 3 describes the data used in the analysis, and section 4 describes the empirical strategy in more detail. Section 5 presents the results, and section 6 concludes.

3.2 Background

3.2.1 Conflict-Related Supply Disruptions

On December 18, 2010, a protest in Tunisia kicked off a wave of revolutionary demonstrations, riots, and civil wars that would sweep the Arab world. In Libya, the Arab Spring movement became a bloody civil war between forces loyal to President Muammar Gaddafi and rebels from across the country. The main fighting began in February 2011 and lasted for about nine months, causing thousands of casualties and bringing oil

[4]There has also been a great deal of work trying to establish whether oil resources increase the likelihood of conflict. For more on this, see for example the comprehensive survey by Ross (2004) and the recent paper by Cotet & Tsui (2013).

exports to a halt.

Before the civil war, Libya had been one of the world's top oil producers, exporting just over 1.7 million barrels of oil per day in 2008. Some of this was sold to the United States, which received an average of 22 million barrels per year from 2005 to 2010. The violence of the civil war brought Libya's oil industry to a standstill, destroying export ports, drilling stations and refineries. Es Sider and Marsa el Brega, two of Libya's largest marine terminals, were heavily damaged in the fighting (Bahgat 2012). Overall petroleum production fell by 70 percent between 2010 and 2011, and monthly U.S. imports dropped from an average of over 2 million barrels per month in 2010 to as little as 145,000 barrels in October 2011 (Figures 3-1 and 3-2). Reports of supply disruptions to refiners in Europe started as early as March 2011 (PIW 2011*c*). Libya's oil is a high-quality, low-sulfur, or "light sweet" crude, one of the easiest and cheapest crudes to process (EIA 2011*c*). Because of this, the loss of light sweet crudes is the most difficult to adjust to, since refineries that process these crudes tend to be the simplest and least flexible in their inputs. Refiners responded to the disruption in Libyan supplies by drawing down inventories, cutting runs, and turning to alternative suppliers, and price differentials quickly rose for close substitutes like Azeri Light and Nigerian Qua Iboe (PIW 2011*b*). Nonetheless, even in Europe, which was hit hardest by the loss of Libyan supplies, refiners reported that the main problem they faced was the increase in overall oil prices rather than the loss of Libyan crude in particular (PIW 2011*a*). Substitute crudes were also available in the U.S. market, which remained well-supplied with light sweet crude out of Cushing, Oklahoma. Libyan crude production began to come back online by the end of 2011, and by March of 2012 was back up to 1.4 million barrels per day, 85 percent of its pre-war level.

Crude supply disruptions like this affect petroleum markets in several ways. First, these events tend to raise world oil prices, which can cut into refining profit margins. Prices for Brent, a widely-traded European marker crude, rose by 20 USD per barrel between February and April of 2011 at the outbreak of the Libyan civil war. This affects refiners regardless of where they actually buy their crude, and any country that imports oil will pay higher import prices when the world crude price increases. For refiners that actually import crude from these countries, however, conflict can also have direct effects through unexpected supply interruptions. The degree to which this affects refiner profits and retail prices will depend on how these cuts affect input costs and refinery output. Refiners can respond to delivery shortfalls by turning to spot markets for substitute crudes, drawing down inventories, or by temporarily cutting their runs. If refiners are able to fully smooth shocks using inventories or find comparably-priced substitutes, then supply disruptions may have no differential effect on profits or prices. If supply disruptions drive up the price of substitute crudes, then cost increases will either appear in reduced profits to refiners or as increased retail product prices. In the most extreme case when substitutes are not available, refiners may be forced to cut their output, decreasing profits and raising retail prices. This paper looks for these changes in refining profits and product prices to estimate the cost of these conflict-related supply interruptions.

3.2.2 Market Details

The empirical strategy relies on comparing refiners and markets that are directly affected by supply disruptions with those that are not. There are two main features of the U.S. downstream industry that make this possible.

First, refineries tend to be calibrated to process set shares of specific types of crude, and purchase a fairly consistent mix of crudes over time. Because of this, refineries that purchased crude from Iran in the past, for example, are likely to continue to be customers for Iranian crude. When a conflict disrupts these supplies, these refineries are the ones that are the most likely to experience the shortfall. This persistence in oil purchases is due to the fact that a refinery's crude inputs are constrained by its physical capital in the short run. Most refineries require a fairly specific blend of input crudes to operate, and large adjustments to the input mix require significant capital investments. Fundamentally, petroleum refining consists of blending input crudes and then distilling the mix into its constituent hydrocarbons, isolating the molecules and then blending them into end products such as gasoline, diesel, propane and asphalt. Although all refineries perform this same process, they differ in their complexity and in what sorts of crude oil they can process and what outputs they produce. Refineries require special units to handle particularly corrosive crude inputs, for example, or to create high-value outputs out of heavy, low-priced inputs. Figure 3-3 shows sample configurations of two different refinery types. The most basic type of refinery is a topping refinery, which includes only distillation units and produces mainly unfinished oils. Hydroskimming refineries add a hydrotreating and reforming unit to the basic topping refinery configuration, allowing the refinery to remove sulfur from more sour crudes so that outputs conform to environmental standards and to prevent corrosion to the rest of the refining units. The most versatile (and most expensive) refinery type are catalytic cracking or coking refineries, which also feature gas-oil conversion plants, olefin conversion plants, and coking units to reduce or eliminate the production of residual fuels. These refineries are able to break larger (and less valuable) molecules and reform them into lighter, more valuable products like gasoline and jet fuel. The product mix is determined both by the blend of molecules in the input crude mix as well as the sophistication of the refinery.

Most refineries blend different crude oils before distillation begins. This allows them to maintain consistent processing conditions and mitigate the corrosive effects of cheaper sour crudes. Although crudes differ in a variety of ways, the most important characteristics are a crude's sulfur content and its specific gravity, or API. Figure 3-4 plots most major crudes according to these two characteristics. The combination of tight product specifications in the U.S. and increasing refinery sophistication has left refiners with less flexibility to change the characteristics of their crude mix on short notice. Because of this, refiners tend to secure most of their inputs under term contracts and turn to spot markets to balance out the rest of their crude slate. Although crudes from the same region tend to have similar characteristics, there is a great deal of overlap between regions, and refiners can often find suitable substitute crudes if a particular stream becomes unavailable. The degree to which supply disruptions will affect refiner profits or be passed along into refined product prices will depend on the degree to which refiners are able to quickly obtain substitute inputs.

The second key feature of the downstream industry is that refined product markets tend to be very geographically segmented due to transport costs. Once the crude oil has been processed by a refinery, refined products are transported to wholesale storage facilities by either pipeline, barge, truck or occasionally by railroad (Association of Oil Pipelines 2009). Pipelines are the least expensive way to move products,[5] and mainly connect areas of high refining output with those of high demand. There is a major pipeline that delivers products from refineries along the Gulf coast to population centers on the east coast. Trucks usually make only local trips, and most trips by petroleum tank trucks are no longer than 50 miles (Untiet 1984). Refiners sell products to retailers out of these local wholesale racks, who then distribute these products to local consumers. Because refineries are so closely linked to their product markets, disruptions in crude supplies at the refinery level should be visible in price shocks in the markets they serve. The markets that are not served by affected refineries should not experience retail price increases due to direct supply disruptions.

3.3 Data

3.3.1 Conflict Data

The analysis uses annual data on conflicts that indicate both the location of the conflict and the severity of the encounter as measured in battle-related deaths. This data is provided by the Uppsala Conflict Data Program (UCDP) and the Centre for the Study of Civil War at the International Peace Research Institute, Oslo (PRIO) (Thémner 2012; Gleditsch et al., 2002). The UCDP / PRIO Armed Conflict Dataset v4-2012 and the PRIO Battle deaths Dataset v5 2012 give conflict-year level data on state-based armed conflicts beginning in 1989. One of the main benefits of this data is the relatively low inclusion threshold of 25 soldier and civilian fatalities per year. This allows the analysis to examine the effects of low-intensity conflicts and to estimate how disruptions change with increasing intensity. The analysis uses these conflict-level battle-deaths to create three different conflict indicators for the analysis. First, total annual battle-related deaths are calculated for each country-year pair by adding up the fatalities that occurred in all conflicts that listed

[5]Transportation costs by pipeline, barge and truck are estimated at 2, 4.5 and 35 cents per gallon per thousand miles of transportation (Jacobs 2002).

that country as a location of fighting. For country c in year t:

$$BRD_{ct} = \sum_{c \in C(w)} BRD_{wt}$$

where $C(w)$ lists the countries where any fighting took place in conflict w. This yields a continuous indicator of conflict severity in each oil-exporting country in every year. These counts are also used to create an indicator variable of whether any conflict. Because major disruptions in oil exports are most likely to occur when conflict severity crosses some threshold, conflict severity is also captured by a set of dummy variables indicating the intensity of conflict in that year. Country-year pairs are coded as low-intensity if they fall in the lowest quartile of conflict fatalities, with between 25 and 62 battle-related deaths. Medium-intensity conflicts correspond to the second quartile, with 63-268 fatalities, and high-intensity corresponds with 269-989 fatalities. Very high conflict years are those with over 990 fatalities. This corresponds with the PRIO definition of a war as a conflict with at least 1000 battle-related fatalities in a single year. It should be noted that these estimates are much lower than most estimates of the human cost of conflict, since these figures do not include indirect deaths as a result of war and conflict.

The set of conflicts that occur in supplier countries is listed in Table 3.1. Most conflicts are either civil wars or violent conflicts between governments and a non-governmental group, indicated in the table as an insurgency. About 17% of U.S. supplies came from countries that had at least one incident in the dataset.

3.3.2 Refinery-Level Imports

In order to estimate the effects of conflict-related disruptions on refinery profits and local retail prices, it is critical to identify which refineries received crude shipments from each country. This information comes from the Energy Information Administration (EIA), which monitors domestic petroleum refining and which collects data on all foreign crude imports through the EIA-814 Monthly Imports Report. This data is publicly available at the refinery level from the EIA starting in 1986. I match this data to a list of all operating refineries in each year constructed using the EIA Refinery Capacity Report (from EIA-820), which lists all operating U.S. refineries in each year for 1994, 1995, 1997, and 1999-2011 and reports capacity, owner, and state for each refinery. There are 181 refineries listed in the report. When matched with the importer data, this lists all refineries operating in a given year and how much crude each refinery imported from each country.

Of the 181 operating refineries, 116 imported at least some crude from countries that experienced some conflict during the 1991 to 2011 period. Figure 3-5 shows the locations of all of the refineries in the sample, with the size of the empty circles indicating each refinery's total refining capacity over the period, and the purple circles showing the amount of crude imported from countries listed in Table 3.1. There is a great deal of variation in how exposed refineries were to conflict; the Ergon refinery in Vicksburg, Mississippi got more than three quarters of its crude from these countries, and several Citgo refineries imported nearly all of their crude from Venezuela. At the same time, there were many refineries that got very little or no crude from countries that experienced conflict. This yields considerable variation in conflict exposure among refinery owners and across states.

While the sources of crude vary a great deal across refineries, they are fairly persistent within refineries over time. Figure 3-6 plots annual country by refinery imports against imports in the previous period. The correlation between the two is 0.95, and most observations fall very close to the 45-degree line in the figure. As discussed above, this is likely due to the specific mix of input crudes required by different types of refineries.

Refiner Profits

To estimate the impact of conflict-related supply disruptions on refiner profits, I use data on annual profits from refining operations for the 40 publicly-traded companies that owned at least one U.S. refinery during the sample period. These data come from Standard and Poor's Compustat North America dataset. Because U.S. refineries are often owned by large corporations with multiple business lines, I use refining profits data from the Business Segments Dataset. This dataset includes companies' self-reported balance sheet data by business type, and usually lists petroleum refining and marketing operations separately. This is particularly important since some of these companies are also involved in exploration and production activities in the countries that were disrupted by conflict. Using overall (rather than just refining) profits could therefore generate a spurious relationship between profits and conflict. While it is still possible that reported refining profits may be contaminated by profits from other business lines, focusing on refining profits will minimize this problem. The relevant segments were identified using the segment-specific NAICS classification for petroleum refining and the segment name as reported by the company. The analysis focuses on operating profits, which represents sales of the refining business segment less its allocated share of operating costs and expenses.

In order to link company profits to refinery imports, it is also necessary to determine annual corporate ownership of each refinery. Ownership of individual refineries was established using the EIA Refinery Capacity Reports and supplemented using corporate profiles from the Moody's/Mergent Industrial Manuals. Refineries owned through a join enterprise were assigned to either the U.S.-listed corporation or to the majority stakeholder. Refineries that changed ownership mid-year were assigned to the company that owned the refinery for the majority of the year. Table 3.2 provides some summary statistics on the publicly-traded refinery owner companies that appear in the profits analysis. There is large amount of variation in how exposed companies were to conflict-related supply disruptions. The fairly small Lyondell received almost 80 percent of its total inputs from countries listed in Table 3.1, while many others received very little. Although some received most of this from a single source (PDV, for example, imported most of its crude from Venezuela), others were exposed to conflict through several supply streams. Premcor, for example, imported a significant amount of its crude from Venezuela, Mexico, Colombia, Iraq and Angola.

3.3.3 Retail Gasoline Prices

In addition to examining the effect of conflicts on refining profits, I also look at the impact on consumers though changes in the retail price of gasoline in local product markets. In this part of the analysis, refineries were first matched to the largest city within an hour travel time by road. Monthly retail price averages for the 75 cities with nearby refineries were provided by the Oil Price Information Service (OPIS). OPIS uses data from credit card receipts to capture daily station-specific retail gasoline prices for up to 120,000 stations throughout the United States, and their data include prices for most major retailers regardless of ownership. This daily station data for regular unleaded gasoline is aggregated up to the city-year level for this analysis and covers the period from 1998-2011.

I link this price data for each city to refining capacity and petroleum imports in its wholesale market. I define a city's corresponding market in two ways. In the first, local markets are defined using the assumption that refineries serve only cities within an hour travel time by truck. Under this definition, refineries are assigned to markets that correspond with the city they were closest to. I alternatively define a refinery's market as any city that is "down-pipe" of the refinery using directional product pipeline information from 2004 (Figure 3-7).[6] Under the first definition, for example, retail prices in St. Paul and Chicago are only affected by import disruptions to refineries operating in their local area. The second market definition takes into account that there is a product pipeline going from Bismarck to St. Paul, and from St. Paul to Chicago. Prices in Bismarck are still only affected by refineries in the local area, but St. Paul prices may now also be affected by refineries in Bismarck as well as in St. Paul, and prices in Chicago by refineries in Bismarck and St. Paul. Crude supply disruptions that affect a refinery in Bismarck would therefore be allowed to affect prices under the second market definition but not the first.

[6] Muehlegger (2006) uses product pipelines in a similar way to calculate transportation costs for a refinery to serve markets in each state.

3.4 Empirical Strategy

The objective of this analysis is to estimate the direct costs to U.S. refiners and consumers of supply interruptions caused by conflict in oil exporting countries. More specifically, how do conflicts in exporter countries disrupt U.S. imports from these countries, and how do these disruptions affect refiner profits and retail gasoline prices? To answer these questions, I estimate the effect of conflict on imports, profits, and gasoline prices. The basic empirical strategy is to compare refineries that had been importing crude from a country where a conflict occurred to refineries that were not importing from that country. To this end, the analysis uses a panel of annual country by refinery imports matched to panels of country-level conflict measures, company profits, and city-level gasoline prices. For the profits analysis, the comparison will be between companies that owned refineries that were potentially affected by the conflict, (i.e. refineries that had previously imported crude from that country) and all other companies. For the price analysis, the comparison is between markets that were served by refineries whose supplies were potentially affected by the conflict and markets that weren't connected to any of these refineries.

The main empirical issue is to what extent the non-importers provide a good comparison group for the importers. First, refineries that import from countries listed in Table 3.1 may be different from refineries that did not import from these places. It is clear from Table 3.2 that most importers obtained at least some of their supplies from countries that experienced conflict. Those that did not receive any imports at all from these sources tend to be smaller, own fewer refineries, and have lower total imports. This pattern is less pronounced but also broadly true for imports from specific countries; companies that imported oil from Iran, for example, tended to have higher capacity, imports and profits than those that did not. To a large extent these average differences between refiners will be captured in the regressions by company fixed effects and conflict controls. However, it may also be the case that there are additional features of these companies that cause them to respond differently to changes in world market conditions. If a conflict in Libya raises the world oil price, this may have a larger effect on a large, importing refiner than it would on a refinery that processes only U.S. crude. In this case, the comparison group will be less affected by conflict than the treatment group would have even if it had not actually been importing from that source country. This will generate an over-estimate of the costs of conflict. Similarly, markets that are not served by importer refineries are likely different from those that are. As shown in Figure 3-5, for example, many of the refineries that import crude from these countries are coastal and tend to import more of their source crude. Again, this may bias the estimates of the effect on retail prices upward.

Another important challenge to the identification are spillover effects of the direct effects of conflict to the comparison group. First, conflicts in an exporter country may affect the profits of refiners that do not import from that country. Note, however, that this is not always a problem. In particular, if the effect comes through an increase in the world oil price, then this is fine; even if no U.S. refiners experienced supply disruptions, changes in the world price caused by conflicts will always affect the U.S. downstream industry. The problem arises when non-importers are affected by a conflict because the conflict affects importing refineries. For example, a conflict that disrupted a light, sweet crude stream would put additional pressure on the market for a local substitute crude. This would differentially raise the price of the substitute crude in the U.S. market, potentially driving down profits or raising prices even for non-importing refiners and markets. To the extent that this is the case, estimating the costs by comparing importers and non-importers will underestimate the true costs of conflict to importers. Future work will examine this possibility by estimating the effect of supply disruptions on the prices of close substitutes in the U.S. market. Another way that conflicts may impact non-importers is by affecting competition between refiners. In particular, raising input costs for importers may increase the market power of non-importers. In this case, the estimates generated by the comparison will over-estimate the costs of conflict for the U.S. market as a whole.

In the price analysis, bias in the results could similarly be caused by spillovers to non-importer cities. This might be the case if consumers drive to non-affected cities when there is a supply shock to an importing city or if refineries change their distribution to wholesale racks in response to conflict-generated supply shocks. Because most crude travels by pipeline and only moves short distances by trucks, however, the analysis addresses this directly using the definitions of the markets, with refineries connected to the cities that they can easily serve by truck as well as all cities down-pipe. This issue may still be present, but the magnitude of the bias is likely to be relatively small.

3.4.1 Conflict and Imports

I use two main specifications to estimate the effect of conflict on imports. The first uses a panel of total annual U.S. imports by country of origin regressed on a measure of conflict in country c in year t. Country fixed effects are used to control for average differences in imports across countries, and year fixed effects control for trends in the overall amount of imports. If conflicts decrease the total amount of imports, however, these year fixed effects will remove some of the effect of imports on conflict. Because of this, estimates are reported for regressions both with and without year fixed effect. Because disruptions that affect overall supply are likely to be more costly, the regression without year fixed effects is the preferred specification.

$$Imports_{ct} = \beta \cdot Conflict_{ct} + \alpha_c + \gamma_t + \epsilon_{ct}$$

As described in the data section, the conflict measures used are a continuous measure of battle-related deaths over 25 in a year, an indicator for whether any conflict occurred, and a set of indicators for conflict severity.

These include an indicator for a country-year pair of low conflict (25-62 fatalities), medium conflict (63-268 fatalities), high conflict (269-989) and very high conflict (990+ fatalities). These cutoffs correspond with the quartiles of violence in country-year pairs.

This regression is also run at the refinery by country level. This allows us to examine the effect of conflict on refinery-level imports and yields increased precision. To identify the refineries (r) that are potentially affected by supply disruptions I define an indicator variable for whether that refinery ever imported crude from that country. This identifies all refineries that may be directly affected by a supply disruption due to conflict in a supplier country. I interact this indicator with the same conflict variables used in the aggregate imports regressions to identify the effect of conflict on potential importers while controlling for the general effects of conflict on non-importers.

$$Imports_{rct} = \tilde{\beta} \cdot Conflict_{ct} \cdot \mathbb{1}\{EverImported_{rc}\} + \tilde{\alpha}_{rc} + \tilde{\gamma}_t + \tilde{\epsilon}_{rct}$$

This specification includes a country by refinery fixed effect, and again results are reported both with and without the year fixed effects. Standard errors are clustered at the refinery by country level.

3.4.2 Conflict and Profits

To examine the effect of conflict on refiner profits I estimate both the direct effect of conflict as well as the effect through supply disruptions using a two-stage least squares procedure. Both specifications use the panel of company-level annual refining profits matched to company by country imports and country-level conflict measures. As in the imports regressions, I use an indicator variable for whether that company (i) owned a refinery that had ever imported crude from that country. I interact this indicator with the conflict variables to identify the effect of conflict on potential importers while controlling for the general effects of conflict on non-importing companies. The coefficient of interest is therefore β in the regression

$$\log (Profits_{it}) = \beta \cdot Conflict_{ct} \cdot \mathbb{1}\{EverImported_{ict}\} + \delta \cdot Conflict_{ct} + \alpha_{ic} + \gamma_t + \epsilon_{ict}.$$

Here a country by company fixed effect controls for company-level heterogeneity in profits, and a time fixed effect controls for changes in profitability over time that are not related to conflicts. This includes changes in overall oil prices due to demand shocks and other types of supply shocks as well as overall trends in refiner profitability. In these regressions the year fixed effect is not as problematic as it may be in the imports regressions, and the inclusion of these fixed effects should not have a significant impact on the estimates of β.

To make the magnitude of β easier to interpret, this relationship is also estimated using the conflict interaction term as an instrument for log imports in a two-stage least squares estimation procedure. This yields an estimate of the effect of supply lost due to conflict on refining profits. Again, all regressions will include company by country fixed effects and will be reported both with and without year fixed effects.

3.4.3 Conflict and Prices

Supply disruptions may also affect U.S. consumers by increasing retail prices in markets served by the affected refineries. This may be the case if refiners are forced to cut runs because of supply shortfalls or if the supply shocks increase their marginal costs. The analysis of the effect of conflict on prices is similar to the analysis of the effect on profits. These specifications use a panel of market-level average annual gasoline prices matched to market by country imports and measures of country-level conflict intensity. As in the profits analysis, an indicator variable identifies all markets served by a refinery that has ever imported crude from county c. This indicator is interacted with the conflict variables to identify markets that may have been directly affected by conflict-related supply disruptions. The main specification is therefore

$$\log\left(RetailPrice_{mt}\right) = \beta \cdot Conflict_{ct} \cdot \mathbb{1}\{EverImported_{mct}\} + \delta \cdot Conflict_{ct} + \alpha_{mc} + \gamma_{st} + \epsilon_{mct}.$$

Here market by country fixed effects control for market level heterogeneity in retail gasoline prices. I also include controls for state by year fixed effects to capture time-varying factors like overall crude prices and state-level taxes. As discussed above, the set of refiners serving market m is defined in two ways. In the first, refineries are linked only to "local" markets, i.e. cities within an hour travel by truck. In the second, they are also linked to cities that are "down-pipe" on a product pipeline. The second definition therefore allows more cities to be directly affected by supply disruptions by including more refineries when calculating $\mathbb{1}\{EverImported_{mct}\}$.

This relationship is also estimated using the conflict interaction term as an instrument for import quantities in the regression of prices on imports. Here the market definition will also affect the calculation of country-level imports associated with a market.

3.5 Results

The results from the regression of aggregate imports on conflict measures are presented in Table 3.3. Column (1) shows the relationship between aggregate imports (in thousands) and battle-related deaths in supplier countries. The coefficient indicates that each death above 25 is associated with a 2,630 barrel decrease in total annual imports from that country. For context, the median number of deaths per year when conflict occurred was 337; this would be associated with a 886,000 barrel decrease in imports, a two percent decrease relative to the average import quantity. As discussed above, the coefficient in column (2) shows the relationship between conflict and imports taking out year fixed effects. Because this removes the effect of an overall decrease in imports caused by conflict, this point estimate is slightly lower, indicating a loss of 2,160 barrels for each fatality, or 728,000 barrels at the median conflict level. The point estimates for the coefficients on the coarser conflict measures are consistent with the estimates in columns (2) and (3), but are estimated with large standard errors and not statistically significant in the aggregate regressions.

The refinery-level import effects are presented in Table 3.4. The results here are consistent with the aggregate results above, but the richer panel yields increased precision. Again, the point estimate on the linear measure of conflict severity indicates that refineries lose 47 barrels for each battle-related death, or 16,000 barrels for the median conflict. Controlling for the overall level of imports (column (2)) has no effect on the point estimate. On average, conflicts are associated with a 264,000 barrel reduction in imports. When this is broken up by severity category (column (5)) the results suggest that large conflicts are more likely to cause a significant supply disruption, with high-fatality conflicts (269 to 989 fatalities) associated with an average of 356,000 barrels lost. Again, the inclusion of year fixed effects has very little effect on the point estimates.

Table 3.5 reports the estimates of the relationship between refining profits and conflict in supplier countries.[7] Most of the point estimates on the interaction term are not statistically significant, and all are very small. The point estimate on battle-related deaths in column (1), for example, indicates that every thousand battle-related deaths are associated with a 0.0003 percent reduction in refining profits for companies that owned refineries that were supplied by the affected country. For the largest conflict in the sample, with 23,000 deaths in a single year, the associated decrease in profits is 0.007 percent. The only statistically significant estimates in panel A actually indicate a small positive relationship between conflict and profits, with low to medium intensity conflicts associated with a 0.04 to 0.06 percent increase in profits in that year. Panel B reports the estimates from the two-stage regressions using the conflict interaction terms as instruments for log imports. Again the point estimates are quite small and most are not statistically significant. The largest point estimates come from the estimates using the conflict dummy instrument. These estimates indicate that a 1 percent decrease in imports due to conflict-related supply disruptions are associated with a 0.03 percent decrease in profits.

The results for the regressions of retail gasoline prices on conflict indicators are presented in Tables 3.6 and 3.7, with Table 3.6 showing the results restricting the impacts to local markets, and 3.7 allowing supply disruptions to have effects in pipeline-connected markets as well. Again, the point estimates are very small and quite precisely estimated. In column (1), panel A of Table 3.6, the estimate suggests a 0.003 percent

[7] To make this table easier to read, deaths here are in thousands.

increase in retail gasoline price for every thousand battle-related fatalities in supplier countries. In panel B, the corresponding two-stage estimate suggests that a supply disruption of 10 percent of total imports would be associated with a 0.6 percent increase in the gasoline price. The statistical significance of this relationship does not survive the inclusion of year fixed effects, which decreases both the point estimate and the standard errors. The reduced-form relationship is similar when the conflict indicator is used, though the sign flips for the two-stage estimate in panel B. Again, including year fixed effects in this specification both decreases the point estimate and increases the precision of the estimate. The results for the specification using intensity dummies (columns (5) and (6)) are similar to those for the specification in columns (1) and (2) with a small positive effect of very high-intensity conflicts on prices that disappears when year fixed effects are added.

Altogether, the results indicate that, although conflicts do disrupt supplies, these direct supply disruptions have very little effect on refiner profits or on the prices that consumers pay for gasoline. On average, refiners seem to be very effective at replacing supply shortfalls with substitute inputs.

3.6 Conclusion

Political disruptions in oil-exporting countries affect the global downstream oil industry in many ways. When conflicts damage oil production and export facilities, supply interruptions can cause the world oil price to jump, raising product prices and putting pressure on refining margins. Even worries about potential export disruptions can lead to volatility in global spot and futures prices. As long as it continues to import oil, the U.S. downstream industry will feel the effects of this volatility in global oil markets.

Because U.S. refineries are so specialized, however, it is also possible that refiners who import oil from unstable areas are more exposed to the effects of conflict-related supply disruptions. These supply disruptions may increase input costs or even slow production for refineries that depend on these crude streams. To examine these potential costs, this paper examines the direct impacts of conflict-related supply disruptions on refiner profits and retail gasoline prices. There are three main results that emerge. First, conflict in countries that supply oil to U.S. refiners has a significant effect on aggregate and refinery-level imports. These supply disruptions, however, do not translate into large differential effects on profits or gasoline prices for the companies and markets associated with these refineries. There is little evidence that these disruptions affect refining profits at all, and the estimates of price increases are also quite small. This suggests that refiners are able to quickly replace unexpected supply interruptions large increases in input costs.

This paper provides evidence that, on average, conflict-related supply interruptions do not impose significant differential costs to refiners and markets that are directly affected by these import disruptions. However, further work is needed to identify what types of supply shocks are likely to be the most costly. There is some evidence in this paper that certain types of conflict may have larger impacts, and high-fatality conflicts seem to have the largest effects on supplies as well as profits and prices. It is also possible that there are certain characteristics of markets that will make them more vulnerable to supply disruptions. In particular, it may be difficult to replace supplies when the lost crude is particularly important either because it is heavily used or difficult to replace. As discussed in the paper, there are several refineries that got a substantial portion of their crude from countries that experienced conflicts. There are also types of crude that may be particularly hard to replace on short notice. These are likely to be high-quality crudes (e.g. light sweet Libyan crude), or crudes that have an unusual mix of characteristics. In Figure 3-4, for example, there are many crude types that are very similar to one another in terms of their API and sulfur content, reflected by their location in a dense part of the plot. Others are outliers without close substitutes: there are several condensates (e.g. Algerian condensate, Indian condensate) that are extremely light but have a moderate amount of sulfur. These may be difficult to replace on short notice. Future work will use the observable characteristics of these crude streams to identify refineries and markets that are particularly vulnerable to supply disruptions.

Figures

Figure 3-1: Libya Crude Oil Production, million bbl per day: 1980-2013 (Source: EIA)

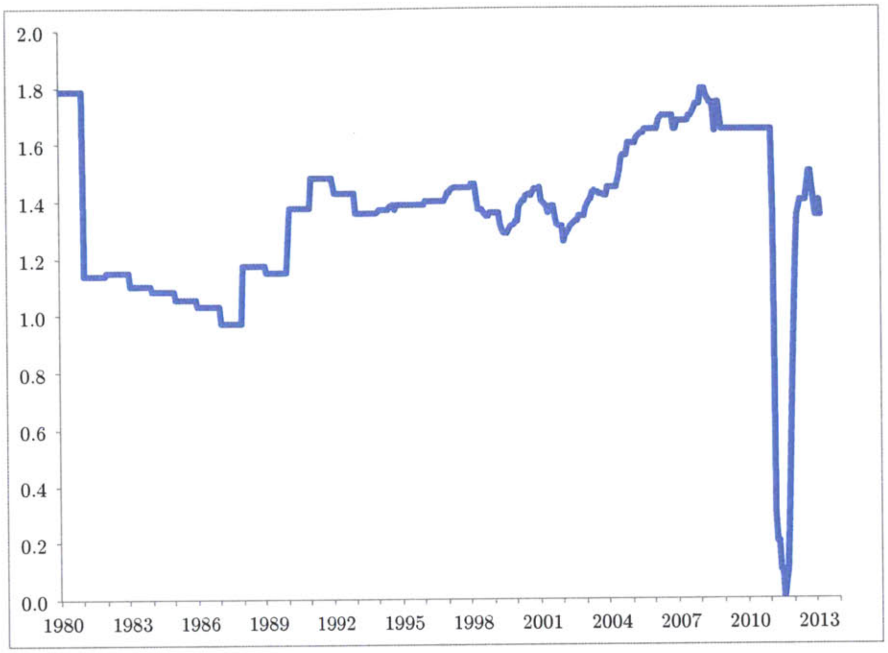


Figure 3-2: U.S. Crude Oil Imports from Libya, thousand bbl per month, 3mma (Source: EIA)

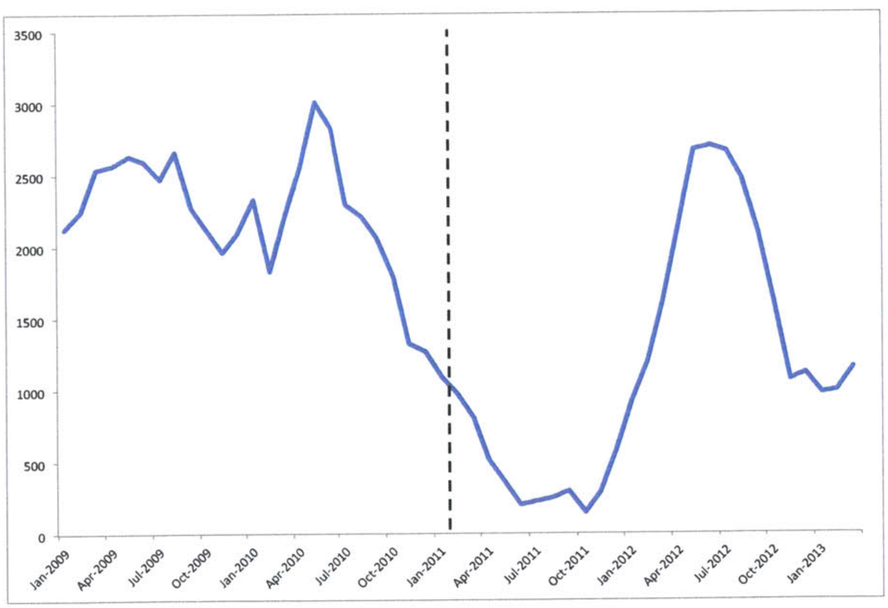
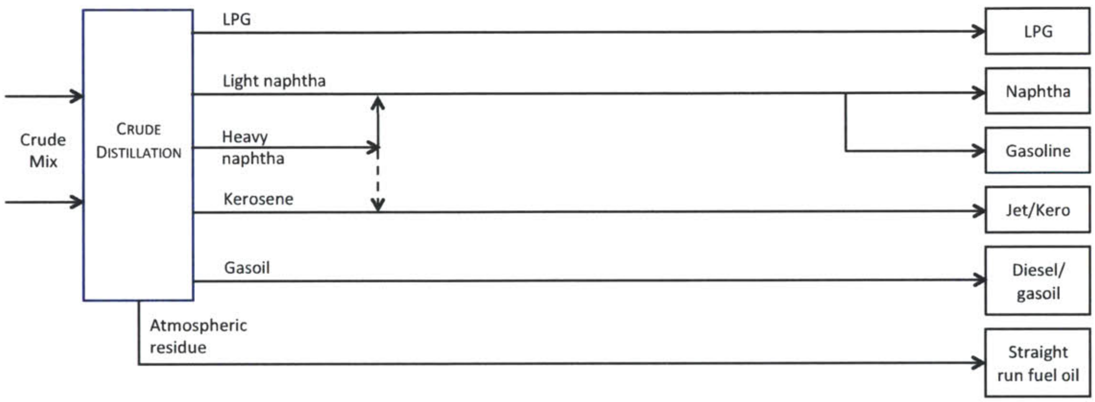


Figure 3-3: Sample Refinery Schematics (Source: Speight (2010)

(a) Simple Configuration: Topping Refinery



(b) Complex Configuration: Coking Refinery

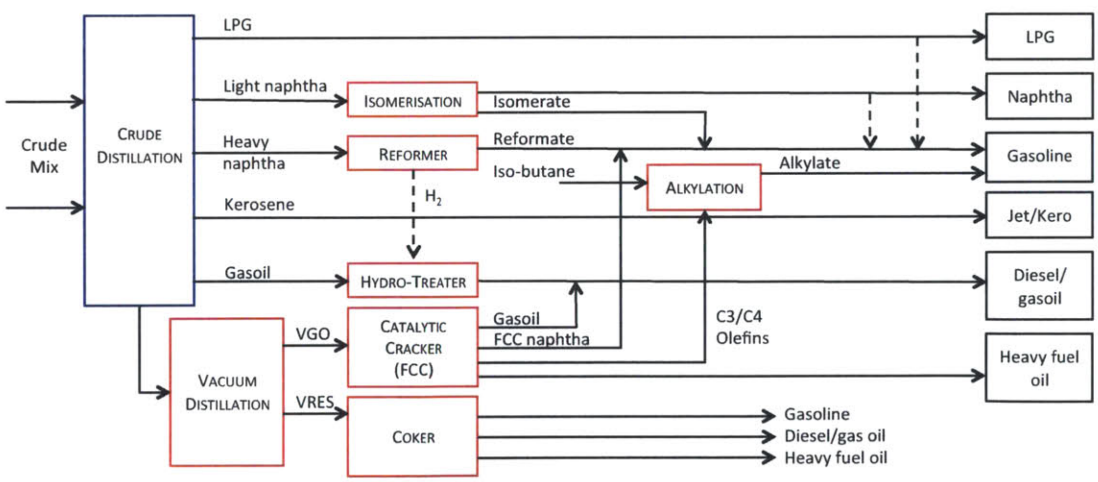
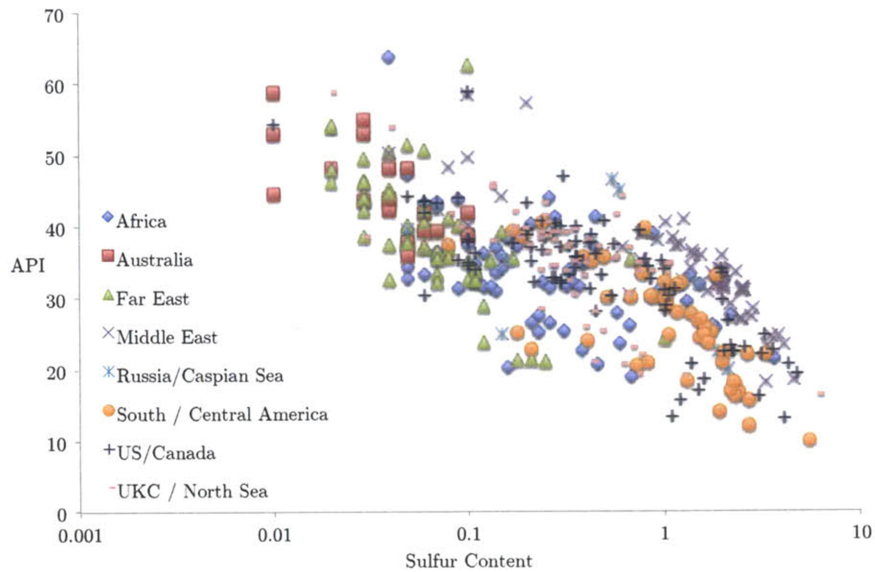


Figure 3-4: Crude API and Sulfur Content by Region of Origin



Source: `meglobaloil.com`

Figure 3-5: Refinery Capacity and Imports from Countries that Experienced Conflict, 1991-2011

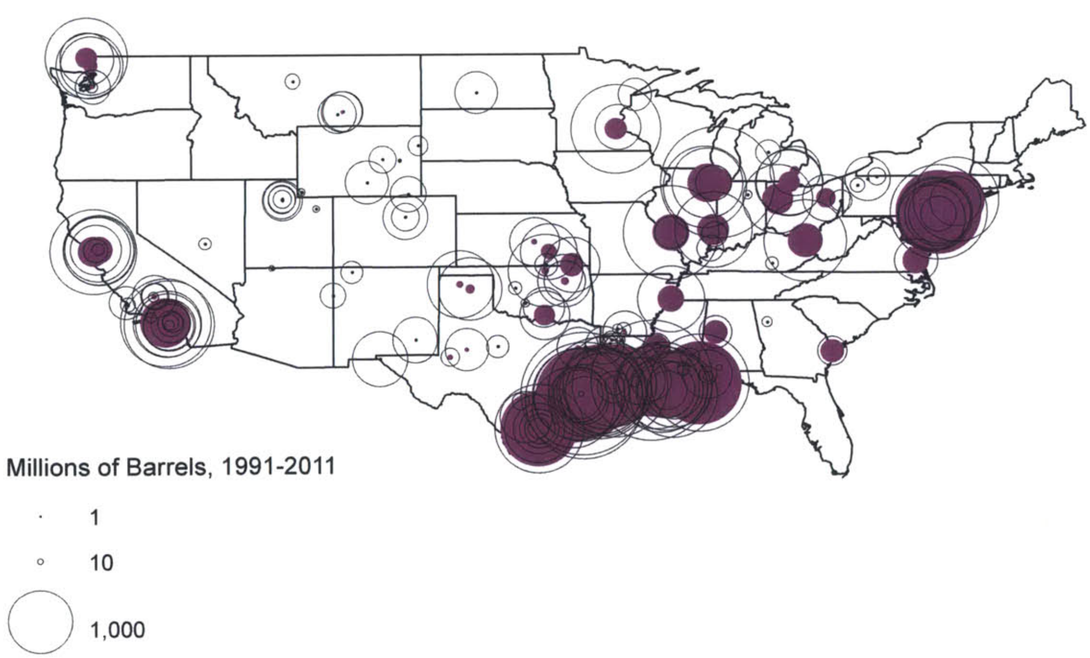
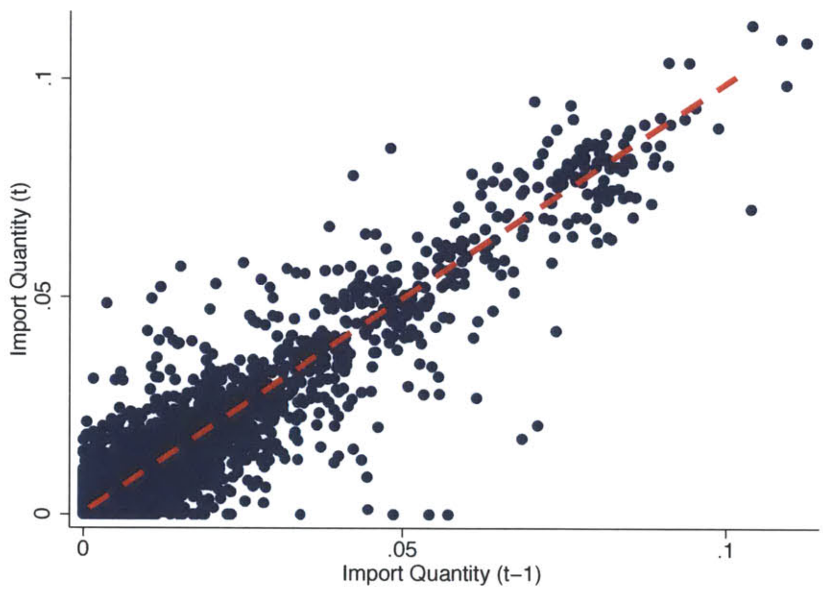


Figure 3-6: Import Persistence



Notes: Figure shows the plot of refinery by country level imports on imports from the previous year, both in billions of barrels. The red dashed line marks the 45-degree line. The correlation between imports and lagged imports is 0.95.

Figure 3-7: Product Pipelines, 2004

Notes: The pipelines in this map were used to construct the markets in panel B of Table 3.5.
Source: `http://www.theodora.com/pipelines/united_states_pipelines.html#map`

Tables

Table 3.1: List of Conflicts in Supplier Countries, 1991-2011

Supplier	Imports (mil bbl)	Major Conflicts	Years	Deaths	Intensity
Venezuela	9,371	Coup d'état	1992	145	Moderate
Mexico	9,368	Zapatista Insurgency, EPR Insurgency	1994, 1996	182	Low/Moderate
Nigeria	5,702	Niger Delta Conflict, Boko Haram Insurgency	1996, 2004, 2009, 2011	914	Low/Moderate/High
Iraq	2,656	Gulf War, PUK Conflict, Iraq War, Civil War	1990-1996, 2003-2011	49,359	Moderate/High/VHigh
Angola	2,597	Civil War; Cabinda Conflict	1975-1995, 1998-2002, 2004, 2007, 2009	25,184	Low/Moderate/High/VHigh
Colombia	1,690	FARC Insurgency	1964-2011	15,741	Moderate/High/VHigh
Kuwait	1,582	Gulf War	1990-1991	21,790	VHigh
UK	1,551	Northern Ireland Conflict, Iraq War	1991, 1998, 2003	8,258	Low/VHigh
Ecuador	1,049	Cenepa War	1995	212	Moderate
Algeria	834	Civil War; AQIM Insurgency	1991-2011	18,098	Low/Moderate/High/VHigh
Russia / Soviet Union	561	Nagorno-Karabakh War, Chechen Wars	1991, 1993-1996, 1999-2011	19,956	Moderate/High/VHigh
Indonesia	316	East Timor Conflict, Aceh Insurgency	1990-1992, 1997-2005	2,304	Low/Moderate/High
Congo (Brazzaville)	312	Civil War	1993, 1997-1999, 2002	14,176	Low/Moderate/High/VHigh
Chad	189	Civil War	1991-1994, 1997-2002, 2005-2010	6,013	Low/Moderate/High/VHigh
Australia	162	Iraq War	2003	8,202	High
Libya	154	Civil War	2011	1,928	VHigh
Azerbaijan	145	Civil War, Nagorno-Karabakh War	1988-1994, 1995, 2005	4,767	Low/VHigh
Egypt	126	Al-Gama'a al-Islamiya Insurgency	1993-1998	616	Low/Moderate
Guatemala	96	Civil War	1988-1995	247	Low/Moderate
Peru	86	MRTA, Sendero Luminoso Insurgency	1989-1999, 2007-2010	3,916	Low/Moderate/High/VHigh
Yemen	70	Civil War, AQAP Insurgency	1994, 2009-2011	2,869	Moderate/VHigh
Cameroon	69	Bakassi Border Dispute	1996	56	Low
Papua New Guinea	25	Bougainville Independence Conflict	1992-1996	198	Low/Moderate
Ivory Coast	22	Civil War	2002-2004, 2011	844	Low/Moderate/High
Syria	17	Civil War	2011	842	High
Thailand	16	Pattani Insurgency	2003-2011	1,312	Low/Moderate
Iran	12	KDPI, MEK, Jundallah Insurgencies, Iran-PJAK Conflict	1991-1993, 1996-1997, 1999-2001, 2005-2011	1,212	Low/Moderate
Guinea	4	RFDG Insurgency	2000-2001	649	Moderate/High
Mauritania	3	AQIM Insurgency	2010-2011	63	Low
Georgia	1	Insurgency, Georgian–Abkhazian Conflict, Georgian-Ossetian Conflict	1991-1993, 2004, 2008	3,272	Low/High/VHigh
Spain	0.7	Basque Conflict	1991-1992	68	Low
Philippines	0.3	MNLF, MILF, CPP, ASG Insurgency	1991-2011	11,091	Moderate/High/VHigh

Note: This table lists all U.S. oil supplier countries that experienced at least 25 battle-related deaths in a conflict located within their territory during the 1991-2011 period. The last column indicates all intensity categories associated with the listed country-years.

Table 3.2: Refinery owner characteristics and receipts, 1991-2011

Owner	Refining Capacity (bil bbl)	No. Refs	Total Imports (bil bbl)	Share of inputs from listed countries	Refining Profits (bil USD)
Lyondell	2.05	1	1.68	79.28	1.31
Citgo / PDV America	4.99	5	4.03	63.75	3.36
Petrobras	0.25	1	0.18	62.25	-0.20
Premcor	1.96	6	1.35	54.85	1.93
Fina	0.78	3	0.42	49.60	0.05
Sunoco	5.91	6	4.05	48.91	3.73
Crown Central Petrol	0.51	1	0.29	42.85	-0.04
Murphy	1.07	2	0.66	41.63	1.11
Valero	7.46	19	4.40	40.64	30.75
UnoCal	0.67	3	0.30	39.60	0.57
Royal Dutch Shell	6.90	15	3.05	37.39	73.51
ExxonMobil	14.46	10	8.76	36.12	73.85
Total	1.29	4	0.51	33.01	35.61
Amerada Hess	3.92	2	1.67	32.37	0.99
ConocoPhillips	11.52	17	5.69	31.66	1.16
Alon USA	0.84	5	0.27	28.52	0.71
Chevron / Texaco	15.17	18	9.01	24.28	48.76
UDS	1.27	4	0.33	22.91	3.30
Marathon	7.38	7	3.53	20.39	18.69
Tosco	2.53	10	1.10	18.17	3.21
BP / Amoco	13.43	15	5.00	17.39	68.58
Tesoro	2.73	7	0.83	12.53	6.83
Farmland Industries	0.78	2	0.12	11.08	0.07
Pennzoil - Quaker State	0.28	4	0.00	1.69	0.83
Frontier	0.82	2	0.16	1.67	2.06
Giant Industries	0.31	3	0.10	0.60	0.73
Western Refining	0.50	4	0.06	0.26	1.96
United Refining	0.48	1	0.47	0.07	0.39
Holly	0.75	4	0.04	0	3.53
Mapco	0.56	2	0	0	0.64
Calumet	0.30	3	0	0	0.55
Suncor	0.28	2	0.06	0	9.01
Huntway Refining	0.06	2	0	0	0.06
Greka Energy	0.04	1	0	0	0.02
AIPC	0.03	1	0	0	-0.06

Notes: This table provides sample statistics on the refinery-owners that are publicly-listed. Columns 1, 3, and 4 are calculated using refinery-level observations on monthly imports and refinery capacity reports from the EIA. Column 4 reports the imports from countries that experienced conflict during the period as a share of total refining capacity. Column 2 indicates the number of unique refineries that were owned by the company during the period. Total refining profits is the sum of the annual operating profits variable for all refining operations from the Compustat Business Segments data. All dollar values are billions of real 2000 USD.

Table 3.3: Conflict and Overall Import Quantity

	(1)	(2)	(3)	(4)	(5)	(6)
Battle-Related Deaths	-2.63***	-2.16***				
	(0.65)	(0.61)				
D(Conflict)			-8,094	-4,347		
			(4,970)	(4,337)		
D(LowFatality)					-4,305	609
					(2,881)	(2,879)
D(MedFatality)					-6,327	-2,930
					(6,584)	(5,858)
D(HighFatality)					-12,196	-10,203
					(10,274)	(9,519)
D(VHighFatality)					-6,689	-4,244
					(6,486)	(5,735)
Year FE		x		x		x
Countries	66	66	66	66	66	66
N	1386	1386	1386	1386	1386	1386

Notes: This table shows the results from the regression of annual country-level imports on conflict measures for the 1991-2011 period. Imports are aggregated from refinery-level receipts reported in the EIA-814 Month Imports Report, and battle deaths come from the UCDP/PRIO Armed Conflict Dataset. Import quantities are in thousands of barrels per year, and battle deaths are the number of fatalities per year above 25. Fatality dummies cutoffs are set at the quartiles of battle-related deaths in country-year pairs. All regressions include country fixed effects, and standard errors are clustered at the country level.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.4: Conflict and Refinery-Level Imports

	(1)	(2)	(3)	(4)	(5)	(6)
BRD · D(Importer)	-0.047***	-0.047***				
	(0.010)	(0.010)				
D(Conflict) · D(Importer)			-263.90***	-266.24***		
			(85.13)	(85.25)		
D(LowIntensity)· D(Importer)					-272.02***	-275.75***
					(85.67)	(85.20)
D(MedIntensity)· D(Importer)					-239.18**	-233.80**
					(110.85)	(110.13)
D(HighIntensity)· D(Importer)					-355.96***	-354.33***
					(119.57)	(119.24)
D(VHighIntensity)· D(Importer)					-222.07*	-228.23*
					(124.72)	(124.95)
Year FE		x		x		x
Countries	66	66	66	66	66	66
N	215,028	215,028	215,028	215,028	215,028	215,028

Notes: This table shows the results from the regression of annual country by refinery-level imports on conflict measures for the 1991-2011 period. Imports are reported in the EIA-814 Month Imports Report, and battle deaths come from the UCDP/PRIO Armed Conflict Dataset. Import quantities are in thousands of barrels per year, and battle deaths are the number of fatalities per year above 25. Fatality dummies cutoffs are set at the quartiles of battle-related deaths in country-year pairs. All regressions include country by refinery fixed effects, and standard errors are clustered at the country by refinery level.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.5: Impact of Conflict on Log Refining Profits

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Reduced Form (Log Profits on Conflict)					
BRD · D(Importer)	-0.0003	0.001				
	(0.004)	(0.004)				
D(Conflict) · D(Importer)			0.021	0.020		
			(0.021)	(0.019)		
D(LowIntensity)· D(Importer)					0.042	0.045*
					(0.027)	(0.025)
D(MedIntensity)· D(Importer)					0.058*	0.051*
					(0.032)	(0.030)
D(HighIntensity)· D(Importer)					-0.022	-0.020
					(0.030)	(0.029)
D(VHighIntensity)· D(Importer)					0.002	0.008
					(0.028)	(0.027)
	Panel B: 2SLS Estimates (Log Profits on Log Imports)					
BRD	-0.004	0.016				
	(0.046)	(0.045)				
Conflict Dummy			0.032	0.030*		
			(0.020)	(0.017)		
Intensity Dummies					-0.004	-0.005
					(0.015)	(0.013)
Year FE		x		x		x
Companies	43	43	43	43	43	43
N	30,492	30,492	30,492	30,492	30,492	30,492

Notes: This table shows the results from the regression of annual refining operating profits on conflict measures for the 1991-2011 period. Imports are reported in the EIA-814 Month Imports Report, and battle deaths come from the UCDP/PRIO Armed Conflict Dataset. Import quantities are in thousands of barrels per year, and battle deaths are in thousands of fatalities per year above 25. Fatality dummies cutoffs are set at the quartiles of battle-related deaths in country-year pairs. All regressions include country by refinery fixed effects, and standard errors are clustered at the country by refinery level.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.6: Impact of Conflict on Log Retail Gasoline Price (Local Markets)

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Reduced Form (Log Price on Conflict)					
BRD · D(Importer)	0.003***	0.0001				
	(0.001)	(0.0002)				
D(Conflict) · D(Importer)			0.006**	-0.001		
			(0.002)	(0.001)		
D(LowIntensity)· D(Importer)					-0.001	-0.001
					(0.005)	(0.001)
D(MedIntensity)· D(Importer)					0.005	-0.001
					(0.004)	(0.001)
D(HighIntensity)· D(Importer)					0.002	-0.001
					(0.003)	(0.001)
D(VHighIntensity)· D(Importer)					0.012***	0.000
					(0.003)	(0.001)
	Panel B: 2SLS Estimates (Log Price on Log Imports)					
BRD	0.061**	0.002				
	(0.024)	(0.004)				
Conflict Dummy			-0.060*	0.009		
			(0.035)	(0.008)		
Intensity Dummies					0.006	0.002
					(0.007)	(0.002)
Marker Price Controls	x		x		x	
State by Year FE		x		x		x
Cities	75	75	75	75	75	75
N	68,376	68,376	68,376	68,376	68,376	68,376

Notes: This table shows the results from the regression of annual average retail gasoline price on conflict measures for the 1998-2011 period. Imports are reported in the EIA-814 Month Imports Report, and battle deaths come from the UCDP/PRIO Armed Conflict Dataset. Import quantities are in thousands of barrels per year, and battle deaths are in thousands of fatalities per year above 25. Fatality dummies cutoffs are set at the quartiles of battle-related deaths in country-year pairs. All regressions include country by refinery fixed effects, and standard errors are clustered at the country by market level. Odd numbered columns contain controls for WTI and Brent prices. Even numbered columns contain state by year fixed effects. Refineries are linked to cities within an hour travel by truck.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.7: Impact of Conflict on Log Retail Gasoline Price (Pipeline-Connected Markets)

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Reduced Form (Log Price on Conflict)					
BRD · D(Importer)	0.003***	-0.000				
	(0.001)	(0.0002)				
D(Conflict) · D(Importer)			0.005**	-0.000		
			(0.002)	(0.001)		
D(LowIntensity)· D(Importer)					-0.005	0.000
					(0.004)	(0.001)
D(MedIntensity)· D(Importer)					0.006*	-0.001
					(0.004)	(0.001)
D(HighIntensity)· D(Importer)					0.002	-0.001
					(0.003)	(0.001)
D(VHighIntensity)· D(Importer)					0.010***	-0.001
					(0.003)	(0.001)
	Panel B: 2SLS Estimates (Log Price on Log Imports)					
BRD	0.034***	-0.000				
	(0.011)	(0.002)				
Conflict Dummy			-0.065	0.006		
			(0.046)	(0.008)		
Intensity Dummies					0.009	0.001
					(0.005)	(0.001)
Marker Price Controls	x		x		x	
State by Year FE		x		x		x
Cities	75	75	75	75	75	75
N	68,376	68,376	68,376	68,376	68,376	68,376

Notes: This table shows the results from the regression of annual average retail gasoline price on conflict measures for the 1998-2011 period. Imports are reported in the EIA-814 Month Imports Report, and battle deaths come from the UCDP/PRIO Armed Conflict Dataset. Import quantities are in thousands of barrels per year, and battle deaths are in thousands of fatalities per year above 25. Fatality dummies cutoffs are set at the quartiles of battle-related deaths in country-year pairs. All regressions include country by refinery fixed effects, and standard errors are clustered at the country by market level. Odd numbered columns contain controls for WTI and Brent prices. Even numbered columns contain state by year fixed effects. Refineries are linked to cities within an hour travel by truck and cities down-pipe.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

References

Abuzaid, J. (2012), 'Saudis find salary for truckers low', *Arab News* . August 7, 2012.

Adelman, M. A. (1993), 'The Cartel in Retreat', Working paper, MIT Center for Energy and Environmental Policy Research. MIT-CEEPR 93-005WP.

Adelman, M. A. (1995), *The Genie out of the Bottle: World Oil since 1970*, MIT Press.

Al-Dosary, A. S. (2004), 'HRD or manpower policy? options for government intervention in the local labour market that depends upon a foreign labour force: The Saudi Arabian perspective', *Human Resource Development International* **7**(1), 123–135.

Al-Lamki, S. M. (1998), 'Barriers to Omanization in the private sector: The perceptions of Omani graduates', *International Journal of Human Resource Management* **9**(2), 377400.

Ansolabehere, S., de Figueiredo, J. M. & Snyder, James M., J. (2003), 'Why is there so little money in U.S. politics?', *Journal of Economic Perspectives* **17**(1), 105 – 130.

Association of Oil Pipelines (2009), *Annual Report on Shifts in Petroleum Transportation: Statistics.* Available at `http://www.aopl.org/pdf/Shift_Report_Posted_September_2_20091.pdf`.

Bachmeier, L. J. & Griffin, J. M. (2003), 'New evidence on asymmetric gasoline price responses', *Review of Economics and Statistics* **85**(3), 772–776.

Bacon, R. W. (1991), 'Rockets and feathers: the asymmetric speed of adjustment of UK retail gasoline prices to cost changes', *Energy Economics* **13**(3), 211–218.

Bahgat, G. (2012), 'Preliminary assessment of Arab Spring's impact on oil and gas in Egypt, Libya', *Oil and Gas Journal* . January 9, 2012.

Bard, M. (2010), *The Arab Lobby : The invisible alliance that undermines America's interests in the Middle East*, Harper, New York.

Barsky, R. B. & Kilian, L. (2004), 'Oil and the macroeconomy since the 1970s', *Journal of Economic Perspectives* **18**(4), 115–134.

Bernanke, B. S., Gertler, M. & Watson, M. (1997), 'Systematic monetary policy and the effects of oil price shocks', *Brookings Papers on Economic Activity* **28**(1), 91–157.

Blomberg, B., Hess, G. & Jackson, J. H. (2009), 'Terrorism and the returns to oil', *Economics and Politics* **29**(3), 409–432.

Borenstein, S. (2005), 'Mere drops in the worlds oil barrel', *San Jose Mercury News* . June 2, 2005.

Borenstein, S. (2008), Cost, conflict and climate: U.S. challenges in the world oil market, Center for the study of energy markets working paper, University of California Energy Institute. #177.

Borenstein, S. (2012), 'The U.S. cant control the world oil markets', *U.S. News and World Report, Debate Club* . March 2, 2012.

Borenstein, S., Cameron, A. C. & Gilbert, R. (1997), 'Do gasoline prices respond asymmetrically to crude oil price changes?', *The Quarterly Journal of Economics* **112**(1), 305–39.

Borenstein, S. & Kellogg, R. (2012), 'The incidence of an oil glut: Who benefits from cheap crude oil in the Midwest?', NBER Working Paper No. 18127.

Borenstein, S. & Shepard, A. (1996), 'Dynamic pricing in retail gasoline markets', *RAND Journal of Economics* **27**(3), 429–451.

Borenstein, S. & Shepard, A. (2002), 'Sticky prices, inventories, and market power in wholesale gasoline markets', *RAND Journal of Economics* **33**(1), 116–139.

Brown, A. C. (1999), *Oil, God and Gold: The Story of Aramco and the Saudi Kings*, Houghton Mifflin, Boston.

Bush, G. W. (2006), Remarks by the President in the State of the Union Address, Washington, DC, The White House, Office of the Press Secretary.

Bush, G. W. (2008), Energy for Americas future, Whitehouse.gov.

Card, D., Lee, D., Pei, Z. & Weber, A. (2012), Nonlinear policy rules and the identification and estimation of causal effects in a generalized regression kink design, NBER Working Papers 18564, National Bureau of Economic Research, Inc.

Carter, J. (1980), Remarks by the President in the State of the Union Address, Washington, DC, The White House, Office of the Press Secretary.

Center for Responsive Politics (2012), 'Federal Campaign Finance'. Data retrieved May 1, 2012 from `http://data.influenceexplorer.com/docs/contributions/`.

Chin, A. & Prakash, N. (2011), 'The redistributive effects of political reservation for minorities: Evidence from India', *Journal of Development Economics* **96**(2), 265–277.

Cotet, A. M. & Tsui, K. K. (2013), 'Oil and conflict: What does the cross country evidence really show?', *American Economic Journal: Macroeconomics* **5**(1), 49–80.

Dahlberg, M., Mörk, E., Rattsø, J. & Ågren, H. (2008), 'Using a discontinuous grant rule to identify the effect of grants on local taxes and spending', *Journal of Public Economics* **92**(12), 2320–2335.

Daniels, L. A. (1986), 'Yamani Ousted as Oil Minister of Saudi Arabia', *New York Times* . October 30, 1986.

Davis, S. J. & Haltiwanger, J. (2001), 'Sectoral job creation and destruction responses to oil price changes', *Journal of Monetary Economics* **48**(3), 465–512.

de Figueiredo, Rui J. P., J. & Edwards, G. (2007), 'Does private money buy public policy? campaign contributions and regulatory outcomes in telecommunications.', *Journal of Economics and Management Strategy* **16**(3), 547 – 576.

Dunne, T., Roberts, M. J. & Samuelson, L. (1989), 'The growth and failure of U.S. manufacturing plants', *The Quarterly Journal of Economics* **104**(4), 671–98.

EIA (2006), *The Impact of Tropical Cyclones on Gulf of Mexico Crude Oil and Natural Gas Production*, U.S. Energy Information Administration.

EIA (2008), *Analysis of Crude Oil Production in the Arctic National Wildlife Refuge, SR/OIAF/2008-03*, U.S. Energy Information Administration.

EIA (2011*a*), *EIA-814 Monthly Imports Report*, U.S. Energy Information Administration.

EIA (2011*b*), *EIA-820 Annual Refinery Report*, U.S. Energy Information Administration.

EIA (2011*c*), *Performance Profiles of Major Energy Producers, 2009*, U.S. Energy Information Administration. `http://205.254.135.24/finance/performanceprofiles/pdf/020609.pdf`.

El-Katiri, L., Fattouh, B. & Segal, P. (2011), 'Anatomy of an oil-based welfare state: Rent distribution in kuwait', *Research Paper, Kuwait Programme on Development, Governance and Globalisation in the Gulf States* .

Federal Trade Commission (1952), 'The international petroleum cartel', Staff report; released through the Subcommittee on Monopoly of Select Committee on Small Business, U.S. Senate, 83rd Congress, 2nd Session.

Fink, J. D., Fink, K. E. & Russell, A. (2010), 'When and how do tropical storms affect markets? the case of refined petroleum', *Energy Economics* **32**(6), 1283–1290.

Forstenlechner, I., Madi, M. T., Selim, H. M. & Rutledge, E. (2012), 'Emiratisation: determining the factors that inuence the recruitment decisions of employers in the UAE', *The International Journal of Human Resource Management* **23**(2), 406–421.

Forstenlechner, I. & Rutledge, E. (2010), 'Growing levels of national unemployment in the Arab Gulf: Time to update the 'social contract'', *Middle East Policy* **17**(2), 38–51.

Gleditsch, N. P., Wallensteen, P., Eriksson, M., Sollenberg, M. & Strand, H. (2002), 'Armed conflict, 1946-2001: A new dataset', *Journal of Peace Research* **39**(5).

Griffin, P. (1992), 'The impact of affirmative action on labor demand: A test of some implications of the LeChatelier principle', *Review of Economics and Statistics* **72**(2), 251–60.

Guryan, J. (2001), Does money matter? Regression-discontinuity estimates from education finance reform in Massachusetts, NBER Working Papers 8269, National Bureau of Economic Research, Inc.

Hamilton, J. D. (1983), 'Oil and the macroeconomy since world war ii', *Journal of Political Economy* **91**(2), 228–48.

Hamilton, J. D. (1996), 'This is what happened to the oil-macroeconomy relationship', *Journal of Monetary Economics* **38**(2), 215–20.

Holland, S. P., Hughes, J. E., Knittel, C. R., & Parker, N. C. (2011), 'Some inconvenient truths about climate change policy: The distributional impacts of transportation policies', NBER Working Paper No. 17386.

Holzer, H. & Neumark, D. (2000), 'Assessing affirmative action', *Journal of Economic Literature* **38**(3), 483–568.

Horsnell, P. (1997), *Oil in Asia: Markets, Trading, Refining, and Deregulation*, Oxford University Press, Oxford.

Howard, L. L. & Prakash, N. (2012), 'Do employment quotas explain the occupational choices of disadvantaged minorities in india?', *International Review of Applied Economics* **26**(4), 489–513.

Imbens, G. & Kalyanaraman, K. (2012), 'Optimal bandwidth choice for the regression discontinuity estimator', *Review of Economic Studies* **79**(3), 933–959.

International Energy Agency (1998-2003), *Oil Market Report*. `http://omrpublic.iea.org/`.

Jablonski, W. (1986), 'The 'Inside Story' of Why Yamani Was Actually Dismissed', *Petroleum Intelligence Weekly* . November 24, 1986.

Jacobs, S. (2002), 'Pipeline factors affecting gasoline prices', Colonial Pipeline Presentation to the FTC, May 8, 2002. Available at `http://www.ftc.gov/bc/gasconf/comments2/jacobsstevee.pdf`.

Jaffe, A. M. & Elass, J. (2007), 'Saudi Aramco: National flagship with global responsibilities', Working paper, Rice University, James A. Baker III Institute for Public Policy.

Jaffe, A. M. & Soligo, R. (2004), 'The future of Saudi Price Discrimination', Working paper, Rice University, James A. Baker III Institute for Public Policy.

Jayachandran, S. (2006), 'The Jeffords effect', *Journal of Law and Economics* **49**(2), 397–425.

Jones, M. R. (2011), The EITC and labor supply: evidence from a regression kink design, Working paper.

Jones, R. (1986), 'OPEC After Yamani, Discount in the Kingdom Forces Sacking of Stylish Servant', *The Financial Times* . October 31, 1986.

Kaiser, M. J., Dismukes, D. E. & Yu, Y. (2009), 'The value of lost production from the 2004-2005 hurricane seasons in the gulf of mexico', *Journal of Business Valuation and Economic Loss Analysis* **4**(2), 4.

Kasolowsky, R. (2013), 'UAE mulls new labor law to attract Emiratis to private sector', *Reuters* . February 16, 2013.

Keane, M. P. & Prasad, E. S. (1996), 'The employment and wage effects of oil price changes: A sectoral analysis', *The Review of Economics and Statistics* **78**(3), 389–400.

Kilian, L. (2008), 'Exogenous oil supply shocks: How big are they and how much do they matter for the u.s. economy?', *The Review of Economics and Statistics* **90**(2), 216–240.

Lee, D. S. & Lemieux, T. (2010), 'Regression discontinuity designs in economics', *Journal of Economic Literature* **48**(2), 281–355.

Lee, K. & Ni, S. (2002), 'On the dynamic effects of oil price shocks: A study using industry level data', *Journal of Monetary Economics* **49**(4), 823–52.

Lewis, M. S. (2009), 'Temporary wholesale gasoline price spikes have long-lasting retail effects: The aftermath of hurricane Rita', *Journal of Law and Economics* **52**(3), 581–605.
URL: *http://ideas.repec.org/a/ucp/jlawec/v52y2009i3p581-605.html*

Looney, R. (2004), 'Saudization and sound economic reforms: Are the two compatible?', *Strategic Insights* **3**(2), 1–9.

Luciani, G. (2011), Armed conflicts and security of oil and gas supplies, CEPS working document. No. 352.

McCrary, J. (2008), 'Manipulation of the running variable in the regression discontinuity design: A density test', *Journal of Econometrics* **142**(2), 698–714.

Memorandum for the Record (May 24, 1967), *Foreign Relations of the United States, 1964-1968, Volume XIX, Arab-Israeli Crisis and War, 1967, Document 56* . Accessed January 15, 2012 at `http://history.state.gov/historicaldocuments/frus1964-68v19/d56`.

Mergent (2011), 'The North American retailing sectors'. Retrieved August 15, 2011, from Mergent WebReports database.

Mobil Oil Corporation (1973), 'The U.S. stake in Middle East peace: I', *New York Times* . June 21, 1973.

Mobil Oil Corporation (1980), 'A New Fairy Tale', *New York Times* . May 8, 1980.

Moran, T. H. (1981), 'Modeling OPEC behavior: economic and political alternatives', *International Organization* **35**(2), 241–272.

Mouawad, J. & Romero, S. (2005), 'Saudis in strategy to export more oil to India and China', *New York Times* . February 18, 2005.

Muehlegger, E. (2006), Gasoline price spikes and regional gasoline content regulation: A structural approach, Working Paper Series rwp06-015, Harvard University, John F. Kennedy School of Government.

Nelson, G. (2012), 'Committees in the U.S. Congress, 1947-1992 Senate and House'. Data retrieved Feb 7, 2012 from `http://web.mit.edu/17.251/www/data_page.html#0`.

Nielsen, H. S., Sorensen, T. & Taber, C. (2010), 'Estimating the effect of student aid on college enrollment: Evidence from a government grant policy reform', *American Economic Journal: Economic Policy* **2**(2), 185–215.

NOAA (2006), *Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005*, National Oceanic and Atmospheric Administration: Atlantic Oceanographic and Meterological Laboratory.

Ogawa, Y. (2003), Proposals on measures for reducing Asian premium of crude oil: Changes in pricing, utility among consuming countries and preparation of oil market, Working paper, Institute of Energy Economics, Japan.

Parsons, C. & Brown, J. (2003), The 'Asian premium' and dependency on Gulf oil, Working Paper Series CITS WP 2003-02, Center for International Trade Studies.

Perlez, J. (2001), 'U.S. Gingerly Discusses Taking More Active Role', *New York Times* . May 17, 2001.

PIW (2011*a*), 'No spring bounce for Europe's refiners'. *Petroleum Intelligence Weekly.* April 25, 2011.

PIW (2011*b*), 'Refiners take Libyan loss in their stride'. *Petroleum Intelligence Weekly.* March 7, 2011.

PIW (2011*c*), 'Saudi action driven by price and demand'. *Petroleum Intelligence Weekly.* March 7, 2011.

Prakash, N. (2009), Improving the labor market outcomes of minorities: The role of employment quota, IZA Discussion Papers 4386, Institute for the Study of Labor (IZA).

Randeree, K. (2009), 'Strategy, policy, and practice in the nationalization of human capital: 'Project Emiratization'', *Research and Practice in Human Resource Management* **17**(1), 71–91.

Randeree, K. (2012), Workforce nationalization in the Gulf Cooperation Council states, Occasional paper no. 9, Center for International and Regional Studies, Georgetown University School of Foreign Service in Qatar.

Rokkanen, M. (2013), 'Adaptive bandwidth estimation for the regression discontinuity and kink designs', *Working Paper* .

Ross, M. (2004), 'What do we know about natural resources and civil war?', *Journal of Peace Research* **41**(3), 337356.

Sampson, A. (1975), *The Seven Sisters: The Great Oil Companies and the World They Made*, Viking Press, New York.

Sciolino, E. & Tyler, P. E. (2001), 'Saudi Charges Bush with Failure to Broker Mideast Peace', *New York Times* . November 9, 2001.

Simonsen, M., Skipper, L. & Skipper, N. (2010), Price sensitivity of demand for prescription drugs: Exploiting a regression kink design, Working Papers 10-1, University of Aarhus, Aarhus School of Business, Department of Economics.

Simpson, R. H. & Saffir, H. (1974), 'The hurricane disaster-potential scale', *Weatherwise, American Meteorological Society* **27**(4), 169.

Soligo, R. & Jaffe, A. M. (2000), 'A note on Saudi Arabian price discrimination', *The Energy Journal* **21**(1), 121–134.

Speight, J. (2010), *The Refinery of the Future*, Elsevier Science.

Standard & Poor's (2011), 'Complete Financial Statements 2004-2009'. Retrieved August 22, 2011 from Compustat database.

Stewart, C. & Woon, J. (2012), 'Congressional Committee Assignments, 103rd to 112th Congresses, 1993-2011: Senate and House'. Data retrieved Feb 7, 2012 from `http://web.mit.edu/17.251/www/data_page.html#0`.

Stockholm International Peace Research Institute (2011), 'SIPRI military expenditures database'. Accessed October 15, 2011 at `http://www.sipri.org/contents/milap/milex/mex_database1.html`.

Themnér, L. & Wallensteen, P. (2012), 'Armed conflict, 1946-2011', *Journal of Peace Research* **49**(4).

Toft, P. (2011), 'Intrastate conflict in oil producing states: A threat to global oil supply?', *Energy Policy* **39**(11), 7265–7274.

UCDP (2012), 'UCDP battle-related deaths dataset v.5-2012'. Uppsala Conflict Data Program, www.ucdp.uu.se, Uppsala University.

Untiet, C. J. (1984), *Competition in the Oil Pipeline Industry: A Preliminary Report*, Antitrust Division, U.S. Department of Justice.

Yergin, D. (1991), *The Prize: The Epic Quest for Oil, Money, and Power*, Simon and Schuster, New York.

Yergin, D. (2012), 'How is energy remaking the world', *Foreign Policy* p. 61.