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Diamonds Are Forever, Wars Are Not. Is Conflict Bad for Private Firms?*

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Abstract

This paper studies the relationship between civil war and the value of firms in a poor, resource abundant country using microeconomic data for Angola. We focus on diamond mining firms and conduct an event study on the sudden end of the conflict, marked by the death of the rebel movement leader in 2002. We find that the stock market perceived this event as “bad news” rather than “good news” for companies holding concessions in Angola, as their abnormal returns declined by 4 percentage points. The event had no effect on a control portfolio of otherwise similar diamond mining companies. This finding is corroborated by other events and by the adoption of alternative methodologies. We interpret our findings in the light of conflict-generated entry barriers, government bargaining power and transparency in the licensing process.

JEL codes: G14, O12, O16

Keywords: Angola, civil war, rent seeking, event studies

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Introduction

Civil wars have come to the forefront of the economic debate due to an increased number of conflicts in recent years and to the dismal economic performance of many countries plagued by internal wars, most notably in Africa. It is recognized that political instability discourages private investment and that firms operating in war-torn economies face increased uncertainty in production and higher operating costs. Yet many businesses thrive on war, not just the defense industry. Despite being the object of vocal NGO advocacy and recent UN scrutiny, this point has been overlooked in much of the economic debate. Our paper is an attempt to provide evidence that under some circumstances violent conflict may be perceived by investors as *beneficial*, not detrimental, to incumbent firms.

We focus on the Angolan civil war and on one of the sectors most affected by the war, diamond production, to explore investors' reactions to conflict-related events. The Angolan conflict is an interesting case-study for at least two reasons. First, it is a typical "resource war", as both the government and the rebel movement financed the war by exploiting natural resources (oil and diamonds, respectively). Secondly, and most relevant from a methodological point of view, the Angolan civil war suddenly ended with the death of the rebels' leader, Jonas Savimbi, on February 22, 2002. This allows us to conduct an event study to assess investors' reactions to an exogenous conflict-related event, and one in which one party gained an unambiguous victory over the other. Restricting our analysis to the diamond mining sector is useful because, differently from oil production sites that are located offshore and were removed from the fighting in the mainland, the activities of diamond extracting firms were located in areas very much at the heart of the conflict. A priori, one would therefore expect the (negative) impact of the war to be maximal for these firms.

Our main finding is that the cumulative abnormal returns of "Angolan" stocks experienced a significant drop in correspondence to the end of the conflict, while those of a control portfolio made of otherwise similar companies *not* holding concessions in Angola did not. In other words, international stock markets perceived Savimbi's death (and later the cease-fire) as "bad news" for the companies operating in Angola, but not for others. On the event date, the (abnormal) returns of the "Angolan" portfolio declined by 4 percentage points, and the difference between "Angolan" and control abnormal returns was -7 percentage points. This suggests that, no matter how high the costs to be borne by diamond mining firms in Angola during the conflict, the war appears to have generated some counterbalancing "benefits" that in the eye of investors more than outweighed these costs. Although our result is based on a small sample of firms which were operating in Angola and were also listed on major international stock exchanges, this is a (sad and) striking result which suggests that much of the received wisdom on the incentives of the private sector to end conflict may need closer scrutiny. We offer a number of interpretations for our finding, including the fact that during the conflict: (i) entry barriers for new diamond producers were higher; (ii) the bargaining power of Angolan authorities was lower, hence licensing (and rent seeking) costs for incumbent firms were lower; and (iii) the lower transparency standards permitted by the ongoing war allowed for relatively profitable unofficial dealings.

This paper is related to two strands of literature. The first is a growing body of political event studies – e.g. Roberts (1990), Fisman (2001), and Johnson and Mitton (2003) – which examine events that affected specific political figures to estimate their impact on companies that had different degrees of political connections with those figures. Our analysis differs from these papers because we have no prior on which companies had links with government or rebel forces and because our goal is *not* to quantify the extent of corruption but to understand the consequences of civil conflict. Within the event study approach, the closest work to ours is the paper by Abadie and Gardeazabal (2003). The authors compare the per capita GDP in the Basque region with that of a 'synthetic' control region that had similar characteristics at the onset of the conflict, and find that the Basque region has performed significantly worse after the start of the conflict. Furthermore, they find that the stocks of firms with significant business activities in the Basque Country showed a positive response to the cease-fire announced by ETA in 1998. The main difference between Abadie and Gardeazabal's study and ours lies in the economic environment under consideration. An analysis of the Angolan war (and of many African conflicts, as a matter of fact) requires political economy considerations that may explain a *negative* stock price response to peace, rather than *a* positive one. We think it is important to call attention to this fact, as the existing empirical evidence on conflict and financial markets mainly comes from studies on industrialized regions. Most contemporary conflicts occur in poor regions, and the role played by uncertainty in rich, market-oriented economies is likely to differ from that played in poor, highly regulated countries.

The second branch of literature concerns the role of natural resources in civil wars. This literature, started by the work of Collier and Hoeffler (1998), investigates whether natural resource abundance increases the likelihood of conflict onset, as well as conflict duration.[1] Our paper has nothing to say about whether diamond wealth triggered or not civil war in Angola. Our focus is on the *effects* of war, rather than on its determinants. However, natural resources come into play because, as we argue, conflict and political instability in resource abundant economies play a different role than it is generally assumed, due to the particular governance structure that such economies may develop. In an interesting case study of Angola, Le Billon (2000) argues that narrow and mostly foreign-dominated resource industries, such as the oil and the diamond sectors, generate huge economic rents that are appropriated by the political elite. We claim that this is an important element to consider when assessing how the Angolan war was perceived by investors, and we try to provide empirical evidence in support of this claim.

The remainder of the paper is organized as follows. In Section 1 we briefly sketch the key features of the Angolan civil conflict and the way in which the diamond industry is organized in Angola. Section 2 presents our estimation strategy and data. Section 3 contains our main empirical results, while Section 4 offers additional findings and robustness checks. Section 5 concludes.

[1] For a comprehensive review of these studies, see Ross (2004). Miguel, Satyanath and Sergenti (2004) investigate the role of poverty as a determinant of conflict onset.

1. **Civil war and the diamond industry in Angola**

Following its independence from Portugal in 1974, Angola was plagued by a long and cruel civil war between the Movimento Popular de Libertaçao de Angola (MPLA) and the Uniao Nacional para a Independencia Total de Angola (UNITA). In September 1992, national elections were held and José Eduardo dos Santos, leader of the MPLA, won by a slight margin. This victory was never recognized by UNITA's leader, Jonas Savimbi, who initiated a civil war that was perceived by many as driven by his own desire of political power as much as by ideology. Throughout the war, UNITA's military strategy was aimed at occupying the areas of highest concentration of diamond mines and at using diamond sales to finance weapons purchases. On the other hand, the MPLA mostly relied on oil for financing its military operations through the Fuerzas Armadas de Angola (FAA), while also earning money from official diamond concessions. As part of the Lusaka Peace Protocol, in 1994 UNITA was given legal rights to mine and to form partnerships with foreign companies. The peace process collapsed in the Summer of 1998, however, when the rebels returned to massive attacks against military and civilians. The years between 1998 and February 2002 marked the last phase of the Angolan conflict and constitute the sample period on which our empirical analysis focuses. During these years, many commentators talked about a "military stalemate" between governmental and rebel forces. However, on February 22 Jonas Savimbi died in an ambush 100 kilometers from the Zambian border. Six weeks later, on April 4, the cease-fire had officially been signed.

Since the beginning of the war, there was a close link between conflict and the diamond industry in Angola. Angolan diamonds have traditionally been mined in alluvial deposits, where capital investments take the form of light machinery and river diversions, and production was relatively easy to control by rebel forces. The key role of diamond sales in financing UNITA's operations has brought the problem of "conflict diamonds" to the attention of the public. To give an idea of the importance of the sector, Angola is the fourth largest diamond producer by value in the world, largely because most of its production is of gem quality. Angolan diamond sales in 2000 reached $1.1 billion, i.e. 15 percent of the world production of rough. This amount was almost equally split between official industrial production, official artisanal production, and illegal production. It is estimated that between 1992 and 1997, when UNITA controlled most deposits in the Cuango valley, the rebel movement supplied between 8 and 10 percent by value of the rough diamonds on the world market (Hodges (2004), pp.174-177).

Diamond production and marketing in Angola has traditionally been controlled by the state-owned company Endiama through joint ventures. In particular, the diamond law passed in 1994 established that in order to obtain mining rights, foreign companies must form a partnership with Endiama and with at least one other Angolan company, and get approval of the Ministry of Geology and Mines. This led to the proliferation of local mining companies owned by well-connected Angolans, who obtained concession rights for nominal fees and then sought lucrative partnerships with foreign companies.[2] Many army

[2] Hodges (2004) cites the example of one contract under which "the foreign partner is responsible for all mining activities

generals also benefited from the situation by establishing private security firms that were contracted by the mining company being awarded the concession, sometimes as an implicit part of the deal. These high hidden costs restricted participation into diamond mining in Angola to a relatively small number of industrial companies and a large number of artisanal miners (*garimpeiros*).

Between December 1999 and February 2000, the Angolan diamond industry underwent further restructuring. First, the government created a marketing monopoly in which all Angolan diamond production would be bought and re-sold by the Angola Selling Corporation (Ascorp). This was a joint venture between the state-owned Sodiam (51%) and two foreign companies with strong political connections, Welox and Tais. The creation of Ascorp was perceived as a serious blow to major international companies operating in Angola, first of all to De Beers. Another reform in early 2000 suspended all contracts that had been signed between Endiama and other mining companies and expropriated prospecting concessions exceeding 3,000 square kilometers. Needless to say, these reforms were not welcomed by existing companies who saw their contracts unilaterally renegotiated. After the end of the war the situation has not changed significantly. Partnerships with local companies remain a cornerstone of the Angolan diamond industry, and the government has established a security body that has been seen by many as an attempt to centralize control of diamond production under domestic intelligence services.

2. **Empirical strategy and data**

2.1. *Methodology*

In our event study, we follow the standard methodology presented, among others, by Campbell, Lo and MacKinlay (1997). We take as a benchmark an augmented market model:

$$r_t = \alpha + \beta r_t^M + \theta S_t + e_t \tag{1}$$

where r_t is the daily rate of return on a stock, r_t^M is the return on the market portfolio, S_t is a set of dummies for company-specific events unrelated to our Angolan political events, and e_t is an unexplained residual called the *abnormal return*. The inclusion of S_t in the market model ensures that our abnormal returns do not reflect concurrent information released by our companies on earnings, mergers, dividends, etc.[3] Our objective is to study the relationship between the estimated abnormal return e_t and salient political events. For each event, we use several *event windows* (i.e. intervals around the event date over which markets are likely to have incorporated changing expectations) and *estimation windows* (i.e. pre-event days during which model (1) can be estimated). In what follows we shall report results for symmetric and asymmetric event windows of 0 to 3 days around the date and for an *estimation window*

and, after deduction of costs and fiscal obligations, shares the rest of the production with the Angolan concessionaires on a 50-50 basis" (ibidem, p.193).

[3]For each company we retrieved company specific events contained in S_t through the Bloomberg database selecting the following Corporate Action Types: "Corporate Events", "Capital Change" and "Distributions".

of 24 trading days. The relatively short estimation window is due to the high frequency of salient political events in Angola during the period under consideration. Results with longer estimation windows were very similar (see Guidolin and La Ferrara, 2004). From the estimated residuals in (1) we generate the series of *cumulative abnormal returns* $\{CAR_t\}$ as $CAR_t = \sum_{j=t_0}^{t} e_j$, where t_0 is the first day of the event window.

We aggregate the cumulative returns for the various companies by constructing two portfolios: an "Angolan" portfolio constituted by diamond mining companies holding concessions in Angola, and a "control" portfolio of diamond mining companies that do *not* have interests in Angola. We use the control portfolio to make sure that the effects we find for "Angolan" companies are not due to shocks in the market where they trade (and not captured by the market index r_t^M), nor to events affecting the diamond industry as a whole. The weights assigned to companies in the control are chosen endogenously so that the resulting portfolio matches as closely as possible three natural properties of the Angolan portfolio in the period January 2, 1998 - January 31, 2002, i.e. before Savimbi's death. Specifically, our weights minimize the Euclidean distance between two vectors containing: (i) the mean of abnormal returns; (ii) the variance of abnormal returns; and (iii) the OLS beta of a world market portfolio model that regresses daily control returns on world market index returns.[4] As can be seen in Figure 1, the tracking between the two portfolios is quite satisfactory, in the sense that returns on the two portfolios seem to display similar properties. As for the estimated coefficients in (1), the mean (median) beta for the "Angolan" companies is .49 (.43) and for control companies the corresponding figures are .45 (.46). For the "Angolan" companies, all the estimated betas are positive and 86% are significant at the 5 percent level. For the control group, 95% of the betas are positive and 51% are significant at the 5 percent level.

[Insert Figure 1]

We then assess whether a political event has any cumulative impact on our portfolios in two ways. First, through visual inspection, i.e. plotting CAR_t over the event window. A downward (upward) sloping CAR indicates that the event had a negative (positive) impact on stock abnormal returns. Second, we formally test the null that the event has no impact on CAR_t through nonparametric rank and sign tests. We could report statistics based on standard t-tests (as in Guidolin and La Ferrara, 2004) and results would not change much, but nonparametric tests are much less influenced by departures from normality that characterize high frequency data and have better small sample properties.[5]

[4] A detailed description of our methodology, which is similar to that of Abadie and Gardezabal (2003), is provided in a Technical Appendix posted on the web.

[5] Corrado (1989) shows that even for cross-sectional dimensions below 10 securities nonparametric rank tests have an approximate Gaussian distribution while classical, parametric tests are significantly leptokurtic and display positive skewness. The power properties are far superior to standard tests. Campbell and Wasley (1993) report simulation experiments in which rank tests have excellent power in medium-sized samples even with less than 10 cross-sectional units. A Technical Appendix posted on the web provides further details.

Finally, to compare the effects of different types of events on firm value, we perform an OLS regression using the full sample daily observations for the period January 2, 1998 - June 28, 2002. We calculate the abnormal returns e_t^i for each of the "Angolan" companies and regress them on a set of dummies that take value zero in days when nothing occurs and one when a given type of event occurs (see Section 4.4 for an operational definition). We use the pooled sample with company fixed effects, clustering the residuals at the company level. We perform a similar exercise on the pooled sample of companies belonging to our control portfolio, weighting the individual observations with the (square root of the) estimated control weights described above.

2.2. *Data*

We conduct our analysis over the last phase of the conflict between UNITA and the MPLA government, namely the days from January 1st, 1998 to June 28th, 2002. For this period we collected financial data from Datastream and Bloomberg and indicators of political conflict from Lexis-Nexis and from several web sources.[6] To construct our Angolan and control portfolios we proceeded in the following way.

For the **"Angolan" portfolio** we started from the most comprehensive set of diamond mining companies holding concessions in Angola that we could assemble combining information from the Angolan Ministry of Mining and Geology, Cilliers and Dietrich (2000) and Global Witness (1998). Considering that a large number of companies are not publicly traded, the final set for which we have price data over the entire sample period consists of seven companies.[7] Our "Angolan" portfolio is an equally weighted average of these companies. We work with equally weighted returns because the companies under consideration have substantially different sizes and a more traditional value-weighted approach would essentially limit the analysis to De Beers, or to one or two additional companies at most. On the contrary, we are interested in detecting effects that are likely to have affected stock prices of all mining companies operating in Angola, presumably in homogeneous directions. Nonetheless, given the atypical position of De Beers compared to other players, we have replicated our results excluding De Beers from the Angolan portfolio, without noticing substantial qualitative changes.

[6] In Lexis-Nexis we performed a search in the category 'World News' from the news source 'Middle-East and Africa', using the following keywords: UNITA, FAA, Savimbi, rebels, and diamond(s). We also did a focused search on the same database including the term Angola together with (alternatively): deaths, dead, killed, wounded, injured, attack(s), victims, strike(s). We then complemented the search with web sources, including the Angola Peace Monitor by Action for Southern Africa (http://www.actsa.org/Angola/apm/), the Integrated Regional Information Networks Africa (http://www.irinnews.org), the UN Office for the Coordination of Humanitarian Affairs (http://www.reliefweb.int), and War News (http://www.warnews.it/ita/angola.html).

[7] These are: American Mineral Fields Inc (TSX), Ashton Mining Ltd (ASX), Caledonia Mining Corporation (TSX), De Beers Consolidated Mines Ltd (JSE), Diamondworks Ltd (TSX), SouthernEra Resources Ltd (TSX), Trans Hex Group Ltd (JSE), where TSX, ASX and JSE stand –respectively– for Toronto, Australia, and Johannseburg Stock Exchange. Two of these companies changed denomination during our sample period: Ashton Mining (Rio Tinto Plc) and De Beers Consolidated Mines (Anglo American). We dummied out these events and used the new series afterwards.

Our **control portfolio** is a weighted average of diamond mining companies that satisfy all the following criteria during our sample period: (a) to be listed in one of the markets where the "Angolan" companies are traded (i.e. Sydney, Johannesburg, Toronto); (b) to be continuously traded over the sample period; and (c) do not hold exploration or mining concessions in Angola. Criterion (a) is intended to lend plausibility to the assumption that the difference between the abnormal returns of Angolan and control companies may indeed be related to political events in Angola. To this purpose, our residuals are estimated conditioning on the same underlying common factors, chiefly the corresponding national stock market indices. Criterion (b) limits the analysis to a sample in which bankruptcy or listing events have no influence. As for criterion (c), it simply qualifies a company as belonging to the control sample. These three criteria leave us with a subset of 42 companies. The list of companies and their weights in the control portfolio are reported in an Appendix posted on the web.

3. **Results**

3.1. *Savimbi's death*

The natural starting point for our event study is the end of the conflict, as marked by Jonas Savimbi's death on February 22, 2002. While one can identify several other conflict episodes (e.g., particularly severe attacks by the government or by the rebels), on a priori grounds it would be difficult to know whether a given episode was perceived as an increase or a decrease in the likelihood of conflict resolution, and by how much. On the contrary, both the sign and the magnitude of the impact of Savimbi's death on the probability that the war would end are known with certainty. In fact, the rebel leader's death was unanimously perceived as the ending point of the conflict because Savimbi's personality, with its military and political acumen and its ambition for power, was seen as the key obstacle to the peace process.[8] Indeed, one and a half months after Savimbi's death, a formal cease-fire had already been signed putting an end to the Angolan conflict.

[Insert Figure 2]

Figure 2 contains our main result. It shows the evolution over time of the abnormal return (AR) and of the cumulative abnormal return (CAR) for the "Angolan" portfolio (top panel) and for the control portfolio (bottom panel) during the four trading days around Savimbi's death. The event date is indicated by a vertical line. Quite strikingly, for "Angolan" companies on average we do *not* observe an increase in cumulative abnormal returns, but rather a sizeable *decrease* leading to negative values. On February 22, our Angolan portfolio lost 4 percentage points. The evolution of the abnormal returns

[8]To quote one source among many, "(Savimbi) embarked on a 27-year long quest for power which eventually took on the character of an obsession. (...) UNITA's military power was progressively weakened (...). For a brilliant tactician, there was no way out. The only option left was peace on the government's terms and a role for himself as a private citizen. It was not one he was prepared to consider" (Economist Intelligence Unit Country Report, May 2002, pp.13-14).

shows that the shock was gradually absorbed over the following three trading days. It is noteworthy, though, that the abnormal returns remained consistently negative during that period. As a result, three days after Savimbi's death the CAR of the "Angolan" portfolio had declined by 7 percentage points in excess of what was justified by the underlying market dynamics. On the contrary, in the bottom panel of Figure 2 we see that the abnormal return of the control portfolio was +1.4 percentage points on the event date and subsequently became negative and then positive again. The overall effect on the CAR of the control portfolio after three days was an increase of over 4 percentage points. Notice that if the negative effect on the Angolan portfolio were the result of an extraneous event affecting the diamond industry or the stock markets where the companies are traded, we should have observed a similar trend in the CAR of the control portfolio, which is not the case. If we interpret the opposite sign in the trend of the CAR of the control portfolio as the result of unobserved factors that (positively) affect the whole diamond industry, the magnitude of our effect actually increases: on the event date the difference between the CAR of the "Angolan" portfolio and of its counterfactual is -5 percent. Alternatively, the increase in the abnormal returns of the control portfolio may be caused by the Angolan event if investors switched out of "Angolan" stocks in favor of (similar) competing stocks. In either case, our main finding is that *investors perceived Savimbi's death as "bad news" for the companies holding mining concessions in Angola, and as "no news" or "good news" for otherwise similar companies not operating in the country.*

[Insert Table 1]

In Table 1 we formally test whether the effects displayed in the graphs are statistically significant. Specifically, the table reports the results of the nonparametric tests of the null that the CAR of the Angolan (control) portfolio is zero in correspondence to the event, both against the alternative that it is different from zero and against the alternative that it is negative (positive). In the last two columns of the table we test the null that the difference between the CAR of the control portfolio and that of the Angolan one is zero against the null that it is positive. In the top part of the table we construct our test statistics using abnormal returns, while in the bottom part we employ raw returns to show that our effects are not driven by movements in the market index. Each row in the Table corresponds to a different event window, and we report results for a short asymmetric window (-0,+1) and for a longer symmetric one (-3,+3). For the Angolan portfolio, all the tests reject the null against the alternative of a negative effect at the 5 percent level, with one exception at the 10 percent level. For the control portfolio, the results point either to an insignificant or to a positive reaction. Anyway in all cases the difference between the two portfolios is significant at the 5 percent level.

To corroborate our finding, we look inside the Angolan portfolio to see if companies with greater involvement in Angola were particularly hit by the event. For this purpose we collected a breakdown of each company's assets and we constructed the variable *AssetShare*, equal to the ratio of assets *located in Angola* over total company assets at the time of Savimbi's death. If we compute the abnormal return of individual companies, AR_i, on February 22 and regress it on the asset share variable, we obtain the following:

$$AR_i = \underset{(.015)}{-.01} \quad \underset{(.088)}{-.24^{**}} \quad AssetShare_i$$

where numbers in parenthesis are standard errors and the adjusted R^2 is .52. To check for the possibility that this may be a spurious relationship, we conducted a "placebo" experiment by randomly selecting fifty *non-event* days and running the same regression.[9] None of the coefficients of the *AssetShare* variable was significant at the 5 percent level. Although these estimates should be taken with caution due to the small number of observations, they do suggest that the reaction of stock prices to Savimbi's death had to do with the companies' involvement in Angola.

3.2. *Can war be good for incumbent companies?*

How can we explain the apparently paradoxical reaction of investors to the end of the conflict? Our interpretation is that the positive effects of the resolution of uncertainty were counterbalanced by the expectation that the newly acquired stability of the government would shrink the profit margins of the companies already holding concessions. This could occur for several reasons.

The first, and most obvious, is an increase in the *competition* faced by incumbent firms due to the potential entry of new firms. The presence of a civil war limits participation in the private sector to firms that can work in high risk environments. This involves a number of aspects, including the willingness/ability to contract private security firms and strike deals with local armed forces, as well as the capability to sustain increased production costs due to the fact that road transportation becomes insecure and supplies may have to be brought in by air. One could therefore conceive that after the end of the war many more companies could afford or be willing to enter the Angolan mining sector, and this would limit the prospects for incumbents in acquiring new concessions. Judging from what happened *ex post*, this may not have been the sole explanation. Industry sources suggest that between February 2002 and today most incumbents reinforced, if anything, their position in the Angolan mining sector.[10] However, even if there was no turnover in those holding concessions, the *potential* entry of other firms

[9] These fifty dates were randomly drawn from the full sample after excluding days in which salient events related to the conflict or to diamond mining in Angola occurred. In particular, the dates excluded are the same used for the construction of event-type dummies in section 4.4 below.

[10] During 2002, Endiama established a joint venture with SouthernEra (in our portfolio) and the Israeli-owned Welox to develop the Camafuca kimberlite pipe. As for later years, according to a Mining Annual Review 2004 article by Paul Crankshaw, the three projects in which new production was to be expected were in Fucauma-Luarica, Alto Cuilo, and on the Chicapa River. The foreign partners in these projects were, respectively: TransHex, Petra Diamonds, and Alrosa, and all three were already present in Angola throughout our sample period. Overall, the largest player in the market was and remains an Israeli diamantaire, Lev Leviev, who already in 2000 had acquired the right to market the entire Angolan production through Ascorp.

is likely to have shrunk the profit margins of incumbents. Note that the role of war as a barrier to entry is not specific to Angola nor to the diamond sector.[11]

A second explanation has to do with the extent of *government control* over the mining sector, and its effect on regulation and rent seeking behavior. The concession of mining rights has traditionally been one of the chief forms of patronage for the Angolan government, as described in Section 1. The conflict with UNITA effectively thwarted the monopoly of the government over mining rights, as rebel forces controlled part of the diamond-rich territory. In the mid-1990s the UNITA company Sociedade General Mineiro (SGM) had legal mining rights and could form partnerships with foreign companies, auctioning its own licenses. In the last phase of the conflict, mining by UNITA had been declared illegal but underground activities were still known to occur. As late as October 2001, a UN expert panel was writing that "many of the diamond companies have a previous history of working with UNITA and the Mechanism has information that some companies continue to do so. However, direct proof of working with UNITA is extremely difficult to find" (UN Monitoring Mechanism report, October 2001, § 186). Once the "competitive force" of armed conflict disappeared, the management of the diamond industry became more centralized and fears of increased rent extraction likely prevailed in the mind of investors. It should be recalled that right after the signing of the Lusaka Peace Protocol in 1994 the government, expecting a bust in foreign investment, had tightened regulation in the diamond sector. An explicit quote along these lines comes from the Economist Intelligence Unit: "The end of the war will undoubtedly open up new areas to exploitation by foreign and Angolan mining companies. However, most foreign companies are wary of conditions in Angola following years of contract-breaking by the Angolan authorities" (EUI Country Report, May 2002, p. 27). A synthetic quote from a local source is possibly more explicit: "the end of the war in Angola means that right now the main institution in the country is corruption."[12] Again, the relationship between conflict, lack of government monopoly over natural resources, and regulation is not unique to the Angolan case.

Related to the above argument is a third explanation that has the flavor of a *price war* between the government and UNITA over the concession of mining rights. The length of the conflict, and the withdrawal of the external funding that had helped both sides during the Cold War, put increasing pressure on the two parties to obtain immediate revenue. This is likely to have shifted bargaining power in favor of firms and allowed them to strike better deals. This was particularly true in the case of UNITA after the imposition of UN sanctions that rendered dealing with rebel forces illegal and forced the latter to do business on terms very favorable to the buyers. Indeed, industry sources suggest that working

[11] To quote one reference on Congo, "Mining companies are condemned to operating wherever they find minerals. They can consequently find themselves in the middle of conflicts that have erupted around them. In some instances they also deliberately enter conflict zones as part of a high risk-high profit strategy to exploit areas lacking competitors, or to gain a toehold before competitors arrive." (Oxford Analytica, *Congo-Kinshasa: Resource sector brings political risks*, 20 July 2005).

[12] Quote by Rafael Marques, a dissident journalist from Luanda. Reported by Tim Butcher in "As guerrilla war ends, corruption now bleeds Angola to death", www.telegraph.co.uk, 30 July 2002.

under UNITA protection was a particularly cheap way to extract diamonds: "according to one former garimpeiro who worked in the twilight zone between UNITA and government control, foreign dealers paid $250 to UNITA for prospecting rights" (Pearce (2004), p. 4). The end of the war would dramatically decrease the demand for weapons (and for immediate revenue) by the two parties and thus increase firms' licensing costs. Through this channel, company profits would have decreased after Savimbi's death even if the extent of regulation and rent extraction by the government had not changed.

Finally, during the war the lack of *transparency* in the management of the resource sector allowed public officials and well connected companies to collude in extracting surplus at the expense of the citizens. Despite repeated attempts to denounce this system, the delay in reforming the country's institutions was typically blamed on the state of emergency created by the ongoing conflict. Investors may thus have expected that, after the end of the war, the government would have faced increasing pressure to make the licensing system more transparent, and this could have turned to the disadvantage of some incumbent firms. Indeed, after the end of the war the Angolan government endorsed the Extractive Industry Transparency Initiative and is currently considering its implementation.

Overall, the above explanations are all consistent with our findings, and certainly should not be considered mutually exclusive. Unfortunately, it is impossible to quantify the contribution of each channel to the estimated effect due to the intrinsic non-verifiability of UNITA's dealings with individual companies and to the lack of disclosure of licensing fees on both sides. In what follows, we provide further empirical results to test the robustness of our findings and to rule out some alternative interpretations.

4. **Robustness**

4.1. *Involvement in conflict zones*

Given that the above explanations hinge on the peculiar nature of production activities in "conflict economies", further insights can be obtained by considering the involvement of the different companies in *other* conflict zones. Together with Angola, Sierra Leone and – to a lesser extent – the Democratic Republic of Congo (DRC) are the countries in which illicit diamond mining has most contributed to financing civil war. Contemporaneous presence in at least two of these countries could then be interpreted as a signal that a company has a "comparative advantage" in a conflict environment. This feature would have two opposite effects in our event study: on the one hand, companies that specialize in conflict areas should have been the ones most negatively affected by Savimbi's death. On the other hand, presence in Sierra Leone or the DRC might have allowed the same companies to diversify into similar environments and thus better cushion the effects of the Angolan event.

Luckily for us, the conflict in Sierra Leone ended one month before Savimbi's death, as disarmament was declared officially complete on January 17, 2002. The DRC, however, was still a theatre of widespread conflict at the time of Savimbi's death. We can therefore create smaller portfolios of Angolan companies and perform two exercises in which we have unambiguous predictions on the relative size of the effect.

The first is a comparison among companies active in Angola and Sierra Leone, but not in the DRC, and the other remaining companies. We expect the former to be the ones taking the biggest hit in response to the news. In fact, with the situation in Sierra Leone evolving towards normality, the end of the war in Angola meant further reductions in the gains from "conflict operations" and no ongoing activity in other conflict environments. The second exercise is a comparison between companies working in Angola and DRC, and the remaining companies.[13] In this case we have no prior on the relative magnitude of the effect because of the two contrasting forces mentioned above. The results of these exercises are displayed in Figure 3.

[Insert Figure 3]

The bars of the histogram indicate the abnormal returns of the various sub-portfolios on the day of Savimbi's death. The estimate for the single day event window is -4.9 percentage points for companies working in Angola and Sierra Leone and -3.2 for the remaining ones.[14] Thus, our conjecture finds support in the data: the end of the Angolan conflict was bad news for both portfolios, but more so for the companies that also had concessions in what no longer was a conflict zone. On the other hand, the abnormal return for companies operating in Angola and DRC was -1.9 percentage points, compared to -4.4 for the remaining portfolio, suggesting that –if joint presence in more conflict areas was a signal of comparative advantage– holding concessions in areas were conflict was not yet over might have allowed companies to diversify their operations.

4.2. *Corruption*

Evidence that the management of government licenses was not perceived as particularly beneficial to foreign diamond companies can be obtained by looking at an earlier event: the unexpected suspension of Endiama's managing director, Jose Dias, on allegations of corruption mandated by the vice-minister of geology and mines on January 26, 1999. In correspondence to this event the abnormal returns of Angolan stocks were positive, 2 percent, while those of the control portfolio were -1 percent. In other words, this anti-corruption episode was perceived as good news for the mining companies directly interested by it, but not for other companies.

[13] Note that none of the companies in our sample was active in all three countries at the same time: two companies had concessions in Angola and Sierra Leone and two in Angola and DRC.

[14] Similarly, the standardized rank of a portfolio that invests in companies involved in both Sierra Leone and Angola is -2.33, vs. -1.01 for a portfolio of companies operating in Angola only. We also apply a nonparametric rank test to the cumulative abnormal returns of a portfolio that invests (with equal weights) a dollar in Angolan companies not involved in Sierra Leone, plus the proceedings from shorting (for another dollar) the portfolio composed of companies also active in Sierra Leone, for a total net investment of one dollar. The corresponding rank statistic is 1.44 for the (0,+1) event window, implying a rejection of the null of symmetric effect with a (one-tail) p-value of 0.074.

4.3. *Alternative interpretations*

A possible interpretation of our main result is that Savimbi's death might have *increased* the uncertainty over the end of the conflict, rather than decreased it, for example because there was no clear successor to UNITA's leadership. To rule out this interpretation we conduct an event study corresponding to the "official" end of the war, namely, the signing of a cease-fire agreement between the FAA and UNITA on April 4, 2002. The results are shown in Figure 4 and are very similar to those obtained for Savimbi's death.

[Insert Figure 4]

On the day of the cease-fire, the abnormal return on the Angolan portfolio was -4 percent. If we take March 30 – the day in which the cease-fire memorandum was presented – as the starting date of our event window, the cumulative abnormal return on April 4 was -9 percent. On the contrary, the control portfolio displays a weakly positive reaction to the signing of the cease-fire, as shown in the bottom panel of Figure 4. Nonparametric tests (unreported) indicate that the effect is negative and significant for the Angolan portfolio and insignificant for the control one. We can therefore conclude that the *unambiguous* end of the war was still bad news for diamond mining companies working in Angola.

Another interpretation is that peace might have damaged mining firms by causing a fall in *diamond prices* if Angola had decided to boost its production and flood the international market. We can rule out this explanation on three grounds. First, being a generalized effect on diamond prices, this should have affected firms in the control portfolio too. Second, if one looks at the evolution of diamond prices through 2003, they did not respond to the changed situation in Angola. Finally, the company that was threatened the most by the potential price effect was De Beers. However, when we exclude De Beers from the Angolan portfolio and re-estimate the weights for the control portfolio, the results remain virtually unchanged: the only difference is a slight increase in the size of the effect.[15]

4.4. *How different types of events affect firm value*

In addition to the above results on the end of the war, we conducted a more systematic analysis to take into account other conflict-related events and episodes of tightening in industry regulation. The relevant events were selected through the Lexis-Nexis search described in Section 3. On the basis of the number of casualties and/or of the relevance given to each episode by the media, we selected 19 events that we grouped under six categories: end of conflict, government victories over UNITA, UNITA attacks on civilians, UNITA attacks on industrial diamond mines, UNITA attacks on *garimpeiros* (artisanal miners), and tightened industry regulation. A detailed list of events can be found in Guidolin and La

[15] Detailed tests concerning these alternative interpretations are reported in the working paper version, Guidolin and La Ferrara (2004).

Ferrara (2004). We then regressed the daily abnormal returns of our “Angolan” and control companies on six dummies corresponding to the above categories of events. The results are reported in Table 2.

[Insert Table 2]

The first and most notable result is that, in correspondence to the “end of the conflict”, the abnormal returns of “Angolan” companies decreased by 3 percentage points, and this effect was statistically significant at the 1 percent level. This estimate is fairly close to the 4 percentage point decrease that we obtained in our event study (Section 3.1), the difference being due to the fact that the residual $e_{i,t}$ was estimated on the full sample here, and on a shorter pre-event window before. The coefficient for the companies in our control portfolio, on the other hand, is not significantly different from zero. The hypothesis that the difference between the two coefficients is zero is rejected at the 1 percent level. When we turn to attacks and military victories that occurred during the course of the conflict (“Government victories” and “UNITA attacks on civilians”) we do not find statistically significant differences between the two sets of coefficients, possibly because the protracted nature of these episodes is not well captured by one-day dummies, or because identifying the most salient episodes over the course of four years of intense fighting is not an uncontroversial task. UNITA attacks on industrial mines have instead a negative impact on “Angolan” companies and a positive effect on control companies, the difference being significant at the 5 percent level. The positive effect on our control portfolio can be due either to unobserved events affecting the whole diamond industry, or to the resulting competitive advantage of “non-Angolan” companies. In fact following an attack on an industrial mine rational investors may want to switch out of Angolan stocks that have become rebel targets in favor of similar non-Angolan companies. Attacks on unorganized artisanal miners (*garimpeiros*) had no impact on either group of companies. Finally, the dummy “Industry regulation” identifies episodes in which the Angolan government tightened its control on the diamond sector by centralizing the marketing process and imposing stricter regulation on joint ventures. These interventions had a negative and significant impact on the abnormal returns of our “Angolan” companies, corroborating the argument that investors did not perceive the management of the diamond industry by the Angolan government as particularly favorable to foreign companies. The effect on companies belonging to the control portfolio is not statistically significant, nor is the difference among the coefficients.

4.5. *Matched pairs*

A typical control design in the event study literature consists of matching each of the “target” companies to one control company, and investigating whether the event under consideration has a significantly different impact on their abnormal returns. To explore the robustness of our results to this alternative way of constructing the control group, we proceed in the following way. For each of the seven “Angolan” companies, we select out of the available 42 companies a matched control using two criteria: (a) the control has to be listed in the same stock exchange (this to net out the effect of the market index factor and of other common macroeconomic influences); and (b) the control has to be of the closest possible size, as measured by total assets in US dollars, vs. the Angolan company. We thus formed 7 pairs and proceeded to apply non-parametric tests concerning mean abnormal returns in correspondence to Savimbi's death, as well as Wilcoxon signed-rank tests of the null that the mean for the Angolan company exceeds the mean of the matched control.[16] The results were broadly consistent with our previous approach. Focussing for instance on the (-0,+1) event window, in five cases out of seven we find that the differences in mean are significantly lower for "Angolan" companies than for the matched control (with p-values below 0.10; the p-values are actually below 0.05 in four cases). One of the two remaining pairs reveals no significant difference, and the other has a positive signed-rank statistic.

4.6. *Statistical issues*

We also performed a number of robustness checks to make sure that our results continue to hold under different statistical methodologies. First, our findings do not depend on the choice of the underlying model for *expected* returns. When we estimate abnormal returns from a multi-factor model that includes a world market index among the regressors, our results are basically unchanged.[17] Additionally, Table 1 also presents results based on *raw* returns – i.e. when for simplicity expected returns are set to zero and we prevent the choice of the expected return model to affect our results – and finds that results are essentially unchanged.

Second, in constructing the control portfolio we experimented with alternative weighting matrices to aggregate means, variances and betas that are measured in different units. In addition to the weighting matrix proposed by Abadie and Gardeazabal (2003), which we employed for the results reported in this paper, we also used a diagonal matrix containing the inverse of the (asymptotic) standard deviations of the maximum likelihood estimators of the mean, the variance, and the market model beta. The results were very similar and can be found in Guidolin and La Ferrara (2004).

Third, we performed afresh our nonparametric rank and sign tests concerning the stock price reaction to Savimbi's death for estimation windows of 63 days and for a variety of symmetric and asymmetric event windows. Results were largely unchanged relative to Table 1.

Fourth, one may be concerned that – because a majority of the companies in our samples are small capitalization firms listed in stock exchanges outside the US – our event studies results might be plagued by *thin trading*-induced biases. As first recognized by Heinkel and Kraus (1988), thin trading – in the form of a high proportion of days with no change in closing prices and therefore artificially zero (raw) returns – may bias test statistics in favor of rejecting the null of no event-related impact by

[16]The pairs are as follows: American Mineral Fields-Tahera; Ashton-BHP Billiton; Caledonia-REX Diamond Mining; De Beers-African Gems Resources; Diamondworks-Golden Star Resources; Southernera-Etruscan Resources; Transhex-Thabex Exploration.

[17]The variable used is the MSCI total value-weighted World Index. All the results commented here are reported in Guidolin and La Ferrara (2004).

artificially reducing the standard deviations of returns and related statistics. The worst possible case would correspond to the existence of a structural difference between the impact of thin trading for our "Angolan" vs. control samples, in the sense of a stronger effect on the former portfolio. This is *not* the case in our data: over the entire sample, the incidence of days with zero raw returns is 19% for companies in the "Angolan" portfolio vs. 39% for our controls. If we use the 20% threshold employed among others by Maynes and Rumsey (1993), i.e. stocks with less than 20% incidence of zero raw returns are 'thickly' traded, our Angolan sample is (borderline-) free of strong thin trading issues, and the problem seems to mostly concern the average control company. Therefore, if anything, our tests on the differences between means would be biased *against* rejecting the null.[18]

Having said this, we re-run our event study of Savimbi's death adjusting daily returns to formally take into account the presence of thin trading, as suggested in the literature. In particular, instead of "lumping" returns in correspondence to dates in which a price change is recorded, we proceed to either "splice" realized returns over periods between successive tradings, or to compute trade-to-trade returns and drop all dates in which no trading activity is recorded.[19] In the former case (uniform returns), with reference to abnormal returns on the "Angolan" portfolio, we find rank statistics of -2.30 and -1.63 for windows of (-0,+1) and (-3,+3), respectively. The sign tests take instead values of -2.38 and -4.86. In the latter case, when trade-to-trade returns are employed, the rank statistics are -2.02 and -1.60 and the sign statistics are -2.01 and -3.02. Clearly all of these statistics imply (one-sided) p-values of 0.05 or less. Similarly, non-parametric tests of a significant difference in mean returns between "Angolan" and control portfolio yield p-values of 0.05 or less.

5. **Concluding remarks**

This paper has examined the relationship between civil war and the value of firms in a poor, resource abundant economy. We focus on the diamond sector in Angola and estimate stock returns for a sample of mining companies holding concessions in the country, and for a control portfolio of otherwise similar companies not operating in Angola. Using an event study approach, we find that the end of the conflict, as represented by the death of the rebel leader and by the official cease-fire, *decreased* rather than increased the abnormal returns of the "Angolan" portfolio. This effect is sizeable and statistically significant, and is not likely to arise from unmeasured shocks to the diamond industry occurring at the same time, as the

[18] If we limit our attention to the periods from which the daily returns used in our event studies are drawn (estimation windows), instead of the full sample, the corresponding statistics are basically unchanged: 20 and 39 percent for "Angolan" and control companies, respectively. To obtain these incidence statistics we averaged individual company data, applying equal weights in the case of "Angolan" companies, and the same weights of the control portfolio for the other companies. Equivalently, these statistics correspond to an average number of days between trades of 1.3 and 1.6, respectively.

[19] In the case of tests based on trade-to-trade returns, a longer estimation window of 63 days was employed, as computation of trade-to-trade returns implies loss of observations. A Technical Appendix posted on the web provides details on the two methods.

"counterfactual" constituted by our control portfolio shows no significant reaction. In related research using a *continuous* indicator of tension we show that moderate levels of conflict can be beneficial to private firms, while extremely low or high levels of tension reduce their abnormal returns (see Guidolin and La Ferrara, 2004).

We interpret our results in the light of the benefits that some incumbent firms may derive from a conflict environment in resource dependent economies such as Angola. The occupation of parts of the territory by the rebels and the instability created by civil war may constitute a barrier to entry, reduce the government's bargaining power, and facilitate non-transparent licensing schemes. A cynical reader of our results may consider the popular street saying during the 1992 presidential elections in Angola – "The MPLA steals, UNITA kills" – and say that our findings cast doubt on whether private investors perceived killing to be worse than stealing. We understand that our findings are based on a small sample of firms and that they may be specific to the African context, though not solely to Angola. In this sense, they should not be viewed as in opposition to previous studies that found conflict to negatively affect firm value in industrialized countries. This paper does suggest, however, that in the debate on whether or how growth of the mining industry in Africa can bring widespread benefits to its population, one should acknowledge a simple fact: to the extent that some incumbent firms may benefit from civil war, this may affect their incentives to exert political and economic pressure to prevent or stop ongoing conflicts.

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Figures

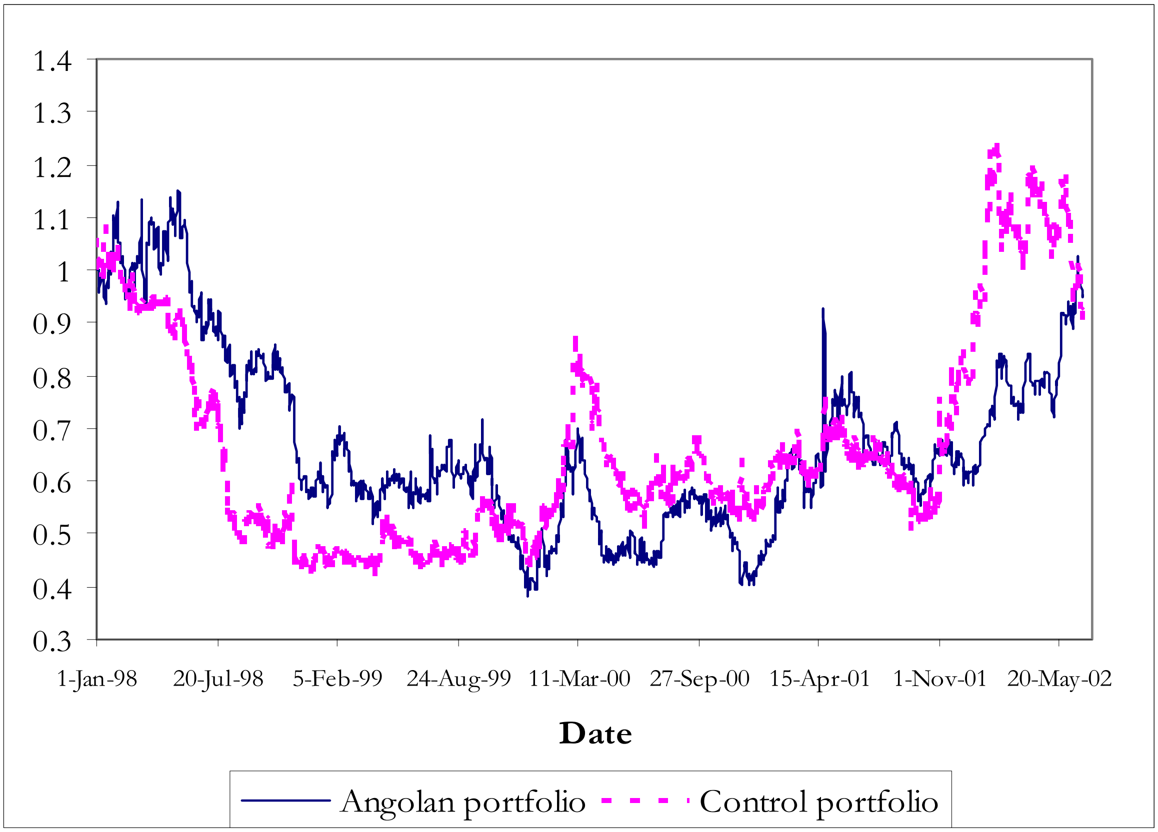
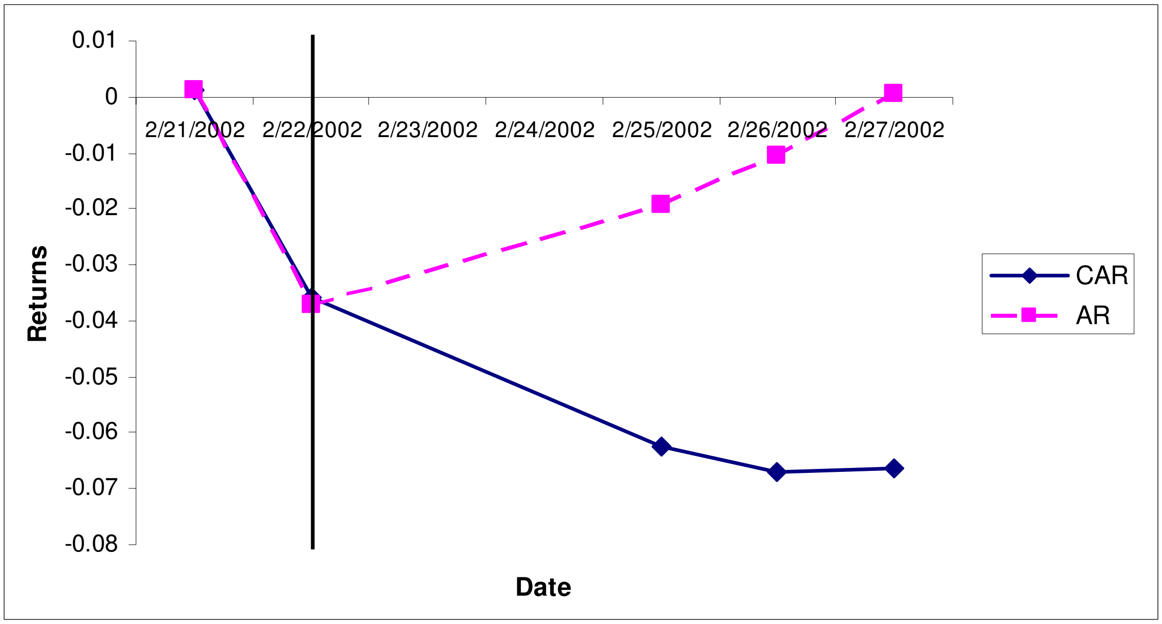
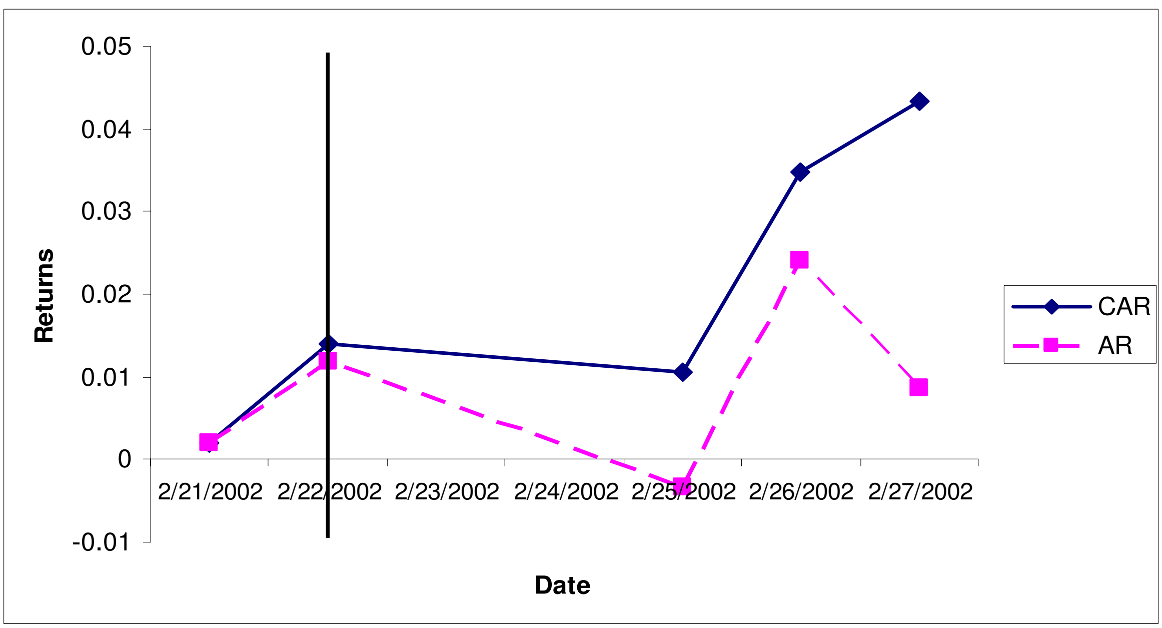


Figure 1: Angolan and Control Portfolio



(a) Angolan portfolio



(b) Control portfolio

Figure 2: Savimbi's death

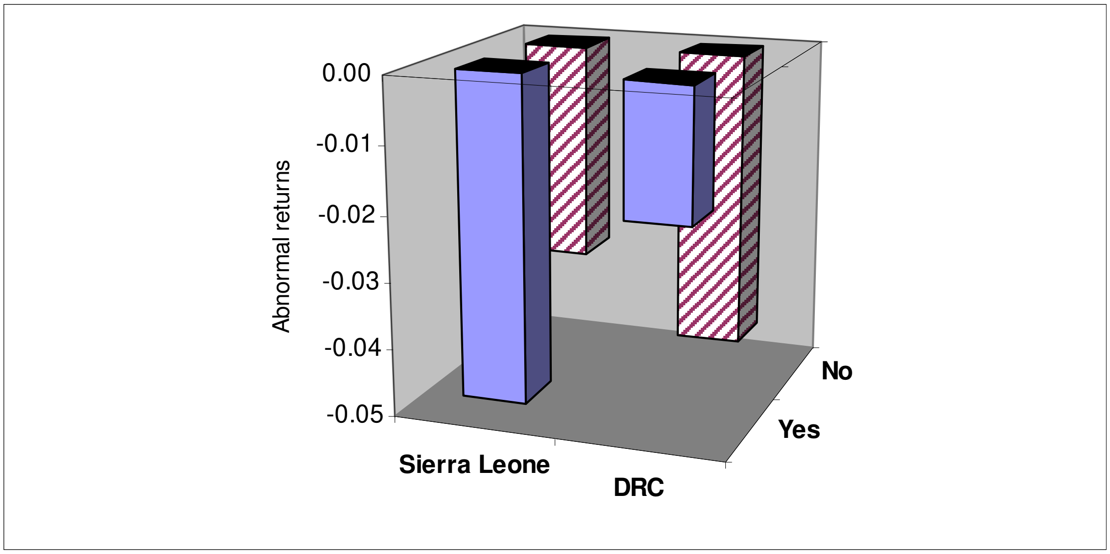
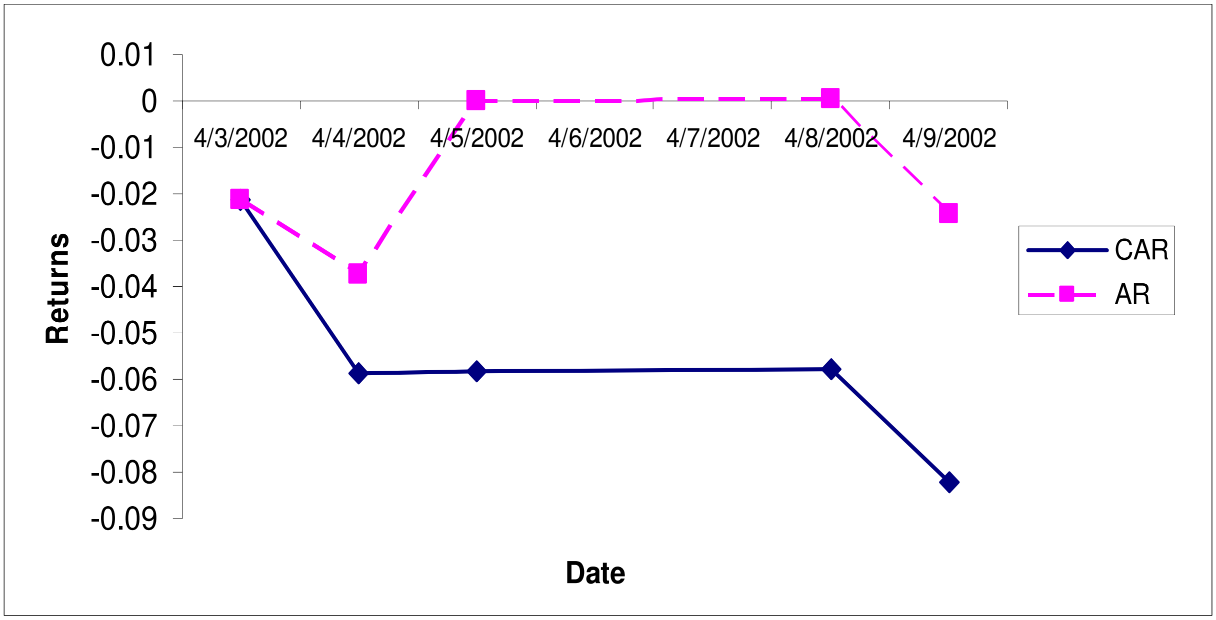
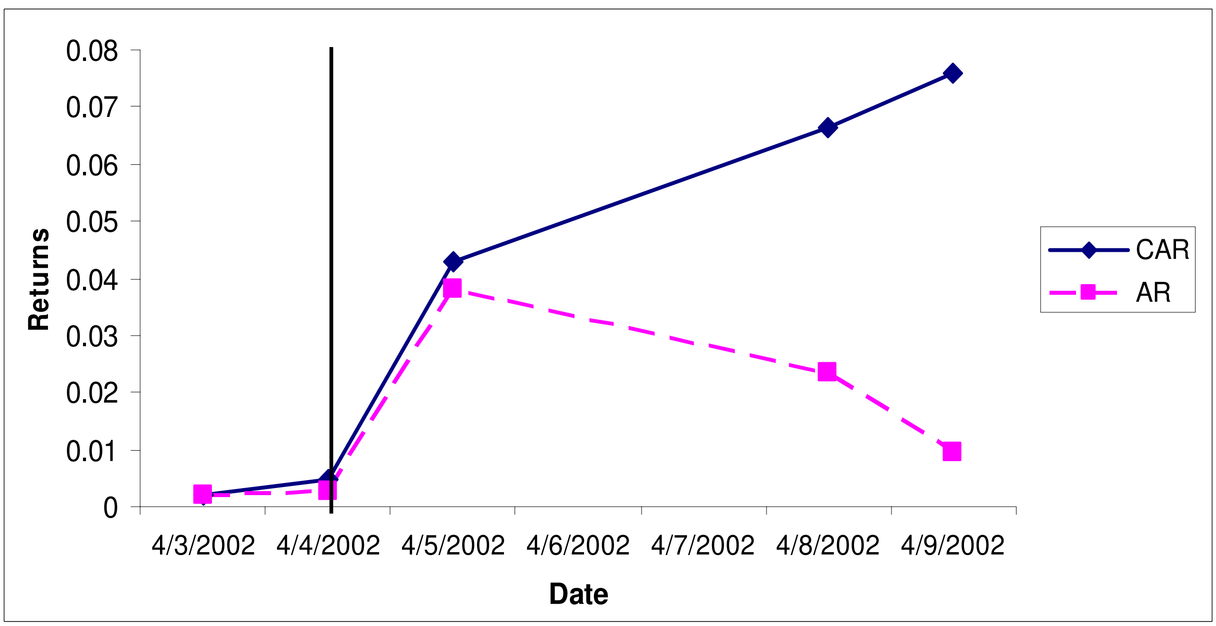


Figure 3: Involvement in conflict zones



(a) Angolan portfolio



(b) Control portfolio

Figure 4: Cease fire

Table 1: Testing the impact of Savimbi's death

	ANGOLAN portfolio						CONTROL portfolio						Difference*	
Event window	***Rank statistic***	*p-value Two-tailed*	*p-value One-tailed*	***Sign statistic***	*p-value Two-tailed*	*p-value One-tailed*	***Rank statistic***	*p-value Two-tailed*	*p-value One-tailed*	***Sign statistic***	*p-value Two-tailed*	*p-value One-tailed*	***Rank statistic***	*p-value One-tailed*
Abnormal returns														
(-0,+1)	-3.065	0.002	0.001	-1.414	0.157	0.079	1.300	0.194	0.097	2.000	0.046	0.023	-1.715	0.043
(-3,+3)	-2.430	0.015	0.008	-6.584	0.000	0.000	0.444	0.657	0.329	3.000	0.003	0.001	-3.050	0.001
Raw returns														
(-0,+1)	-2.020	0.043	0.022	-2.554	0.011	0.005	0.390	0.696	0.348	3.000	0.003	0.001	-1.754	0.040
(-3,+3)	-2.711	0.007	0.003	-2.000	0.046	0.023	0.024	0.981	0.490	1.000	0.317	0.159	-3.142	0.001

* Test of the null that the "Control" mean minus the "Angolan" mean is zero, against the alternative that it is positive.

Table 2: Abnormal returns and different types of events

	ANGOLAN β_A	CONTROL β_C	Test β_A-β_C = 0 (p-value)
End of conflict	-.03**	.004	0.001
	(.009)	(.003)	
Government victories	.014	.042**	0.1
	(.012)	(.012)	
UNITA attacks civilians	.019	-.0001	0.28
	(.017)	(.004)	
UNITA attacks mines	-.028	.013**	0.03
	(.017)	(.005)	
UNITA attacks garimpeiros	-.014	.009	0.15
	(.014)	(.005)	
Industry regulation	-.01**	-.013	0.82
	(.004)	(.010)	
Company fixed effects	Yes	Yes	

Notes:

Table reports estimated OLS coefficients. Standard errors in parenthesis are corrected for heteroskedasticity and clustering of the residuals at the company level. N = 55,155.

* denotes significance at the 5 percent level, ** at the 1 percent level.

Last column reports p-value of the test for the difference of the coefficients against two-sided alternative.

Technical Appendix to
Diamonds Are Forever, Wars Are Not.
Is Conflict Bad for Private Firms?

September 2006

The purpose of this Appendix is to provide some technical details which complement the analysis presented in the September 2006 version of our paper.

1. **Hypothesis Testing in Event Studies**

1.1. *Baseline Setup*

Suppose to have time series data $\{r_{it}\}_{t=1}^{T}$ on daily stock returns for n companies, $i = 1, ..., n$. Call τ the length of the fixed estimation window. Denote as $t_0 - k$ the first day of the chosen event window, where t_0 is the event date. We estimate some model for stock returns on the sample that goes from $t_0 - k - \tau$ to $t_0 - k - 1$. We use the estimated parameters (say, $\widehat{\alpha}_i, \widehat{\beta}_i$ and $\widehat{\theta}_i$) to obtain the series of fitted abnormal returns and its variance over the estimation window and calculate residuals, i.e.:

$$\begin{aligned} e_{it} &= r_{it} - \widehat{\alpha}_i - \widehat{\beta}_i r_t^M - \widehat{\theta}_i S_{it} \\ \hat{\sigma}_i^2 &= \frac{1}{\tau - 1} \sum_{t=t_0-k-\tau}^{t_0-k-1} e_{it}^2 \quad i = 1, ..., n. \end{aligned} \tag{1}$$

We then project abnormal returns in the event window and generate the $i-$th cumulative abnormal return as

$$CAR_i = \sum_{j=t_0-k}^{t_0+k} e_{ij}^*$$

$$e_{ij}^* \equiv r_{ij} - \widehat{\alpha}_i - \widehat{\beta}_i r_j^M - \widehat{\theta}_i S_{ij} \qquad j = t_0 - k, t_0 - k + 1, ..., t_0 + k,$$

where $i = 1, ..., n$ refers to the individual companies. After performing this analysis for each company in isolation, we aggregate the cumulative returns for the various companies by constructing the average cumulative abnormal return:

$$\overline{CAR} = \frac{1}{n} \sum_{i=1}^{n} CAR_i. \tag{2}$$

In vector notation, $\mathbf{e}_i^*$ and $\mathbf{CAR}$ are $(k+1)\times 1$ and $n \times 1$ vectors of company-specific abnormal returns and cumulative abnormal returns, respectively.

1.2. *Parametric Gaussian Tests*

In the earlier version of the paper, i.e. Guidolin and La Ferrara (2004), we followed the traditional event study literature and used the parametric Gaussian tests presented in Campbell et al. (1997) to test hypotheses concerning average effects across portfolios. Underlying the validity of that approach is the assumption that returns are drawn from an independently, identically distributed multivariate normal distribution. A thorough reading of the more recent financial econometrics literature has made us aware of the following issues.

1. Asset returns are massively heteroskedastic, especially at relatively high frequencies such as with daily data. This violates the i.i.d. assumption.

2. Asset returns are non-normal, even when account is taken of the presence of heteroskedasticity.

3. Even if the original return data were truly multivariate Gaussian i.i.d., the clustering of events (i.e. more than one asset is affected by an event at the same time) is likely to generate cross-correlation and heteroskedastic effects in panel data sets, i.e. when more than one asset is under investigation. As discussed by Bernard (1987) and Campbell and Wasley (1993), clustering causes issues that are formally different from non-normalities: clustering violates the i.i.d assumption that support classical tests. The effects of clustering are important only when $k \geq 1$, i.e. the event study spans an event window that exceeds the day.

4. The analysis is often performed with limited cross-sections and short estimation windows, which prevents a researcher from invoking asymptotic results concerning the limiting distribution of the test statistics. Brown and Warner (1985), Corrado (1989), Corrado and Zivney (1992) report disappointing results on the small sample properties of Gaussian based parametric tests when τ and n are both small. In particular t-tests appear to severely overreject the null of no effect as a result of leptokurtic and right-skewed small-sample distributions of the test statistic in experiments with $n = 5$ and 10, and with $\tau = 39$ observations. Campbell and Wasley (1993) work with infrequently traded NASDAQ stocks and find that even with $n = 25$ and $\tau = 250$, the distribution of the equally weighted abnormal returns substantially deviates from normality.

Given that the above problems would undermine the validity of our earlier tests, we decided to implement nonparametric tests in the new version of the paper.

1.3. *Nonparametric Tests*

Corrado (1989) proposes a useful nonparametric test derived as an adaptation of Wilcoxon two-sample rank test that applies to general multivariate distributions for abnormal returns, including asymmetric, fat-tailed and multimodal ones, i.e. the typical non-Gaussian cases encountered in high frequency financial data. Furthermore, Brown and Warner (1985) and Corrado and Zivney (1992) show that nonparametric rank tests are much less influenced by event-induced heteroskedasticity (i.e. variance changes) than their parametric counterparts. Chandra et al. (1995) show that rank tests perform on average the best across all tests, i.e. they are approximately independent of the underlying and unknown model for the true change in the mean of abnormal returns. Finally, rank tests take care not only of departures from normality (since they do not rely on it), but also of clustering problems as (see below for details) the approach is based on the transformation of a panel of abnormal returns into a time series of identically, independently distributed ranks.

In the following we describe the two nonparametric tests we implement in the latest version of our paper.

1.3.1. **Rank Tests**

The nature of rank tests is easily illustrated with reference to the case $k = 0$, i.e. when the event window consists uniquely of the day on which the event occurs. Let κ_{ij} denote the rank of the abnormal return e^*_{ij} over the estimation window $j = t_0 - \tau$, ..., t_0: the highest abnormal return gets rank $\kappa_{ij} = \tau + 1$, the second rank equal to τ, etc., i.e. $e^*_{ij} \geq e^*_{il'} \iff \kappa_{ij} \geq \kappa_{il'}$ and $\tau + 1 \geq \kappa_{i\tau} \geq 1$. In case of ties, each member of the group of tied observations gets a rank equal to the simple average of the ranks they would have if they were not tied. By construction, the average rank is equal to $(\tau + 1)/2$. κ_{i0} is the rank of the event day abnormal return. Under the null hypothesis of no effect of the event on the value of the target security, we do not expect the rank of the abnormal return associated to the event day to depart significantly from the average rank of $\tau/2 + 1/2$, i.e. in some sense the event day should be no different than what one would expect ex-ante. In practice, the test statistic simply formalizes this intuition by transforming the distribution of abnormal returns into a homoskedastic, uniform distribution across ranks and calculating the t-ratio of the difference between κ_{i0} and the ranks' mean, across companies:

$$\frac{\sum_{i=1}^{n}\left(\kappa_{i0} - \frac{\tau+1}{2}\right)}{\sqrt{\frac{1}{\tau}\sum_{j=t_0-\tau}^{t_0-1}\left[\sum_{i=1}^{n}\left(\kappa_{ij} - \frac{\tau+1}{2}\right)\right]^2}} \overset{a}{\sim} N(0,1). \tag{3}$$

Corrado (1989) shows that even for n between 5 and 10 this test statistic has an approximate Gaussian distribution while classical, parametric tests are significantly leptokurtic and display positive skewness. For $n = 10$ the power properties (i.e. probability of rejection of the null of no effect, when there is a positive abnormal return at time t_0) are far superior to standard tests. Campbell and Wasley (1993) report simulation experiments in which rank tests have close to 100% power in medium-sized samples even with $n = 10$ only.

Extensions to event studies involving many event days are straightforward (see Campbell and Wasley (1993)):

$$\frac{\sum_{i=1}^{n}\left[\frac{1}{k+1}\sum_{j=t_0-k}^{t_0+k}\left(\kappa_{ij} - \frac{\tau+1}{2}\right)\right]}{\sqrt{\frac{1}{\tau}\sum_{\tau=t_0-k-\tau}^{t_0-k-1}\left[\sum_{i=1}^{n}\left(\kappa_{ij} - \frac{\tau+1}{2}\right)\right]^2}} \overset{a}{\sim} N(0,1),$$

i.e. the event-day rank may be simply replaced by the average rank over the event window. Campbell and Wasley (1993) report that for $k = 4$ and 10, $n = 10$, and $\tau = 250$ the rank statistics has correct size and its power always exceeds 50%, while classical parametric and portfolio-based tests frequently display wrong sizes (they over-reject the null) and very poor power. These conclusions are robust to simulations performed with perfect clustering, i.e. assuming that all assets are subject to events on the same time period t_0.

Maynes and Rumsey (1993) propose a modification of this test – essentially based on standardized returns which adjust for the effects of thin trading, in particular to take into account the heteroskedasticity produced by missing returns – that Bartholdy et al. (2005) have shown to produce good results in terms of size and power in the presence of extreme thin trading.

1.3.2. **Sign Tests**

Corrado and Zivney (1992) expand the class of nonparametric tests of cumulative abnormal asset performance to sign tests, preserving complete robustness to departures from normality as well as symmetric distributions. These tests generally respond to the same need as rank tests: make inferences free of parametric, distributional assumptions. Define the variable $G_{i\tau}$ as:

$$G_{ij} = sign\left[e_{ij}^* - median(e_i^*)\right] = \begin{cases} +1 & \text{if } e_{ij}^* > median(e_i^*) \\ 0 & \text{if } e_{ij}^* = median(e_i^*) \\ -1 & \text{if } e_{ij}^* < median(e_i^*) \end{cases}.$$

This transformation is crucial as it turns a raw distribution of abnormal returns that can be asymmetric (i.e. with non-zero median) into one such that $\Pr(G_{i\tau} = +1) = \Pr(G_{i\tau} = -1)$, i.e. the distribution is perfectly symmetric around a zero median. Importantly, the resulting distribution is homoskedastic. The intuition for the test statistic to follow is otherwise straightforward: if the event fails to have an impact on asset values, then G_{i0} should not be statistically different from its zero mean. The sign test statistic is thus:[1]

$$\frac{\sum_{i=1}^{n} G_{i0}}{\sqrt{\frac{1}{\tau}\sum_{j=t_0-k-\tau}^{t_0-k-1}\left[\sum_{i=1}^{n} G_{ij}\right]^2}} \overset{a}{\sim} N(0,1). \tag{4}$$

1.3.3. **Wilcoxon Signed Rank Test for Differences in Means**

Given m matched pairs of abnormal returns $\{e_{ij}, e_{lj}\}_{j=1}^{m}$ for two stocks or portfolios (indexed as i and l) drawn from a bivariate population with means $E[e_i]$ and $E[e_l]$ and unknown variance-covariance matrix, then a test of the hypothesis that $E[e_i] = E[e_l]$ against the alternative that $E[e_i] < E[e_l]$ may be based on a statistic U_{il}^+ which computes the sum of the ranks of the positive differences $z_{il,j} \equiv e_{ij} - e_{lj}$:

$$U_{il}^+ \equiv \sum_{j=1}^{m} \hat{\kappa}_{ij} \qquad \hat{\kappa}_{ij} \equiv \begin{cases} \tilde{\kappa}_{ij} \text{ if } z_{il,j} > 0 \\ 0 \text{ otherwise} \end{cases},$$

[1] Note that when the event window is expanded by an even number of observations, it is possible that the value of the statistic (4) remains constant. Calling $G_i^p \equiv \sum_{i=1}^{n} G_{ij}$ the portfolio G statistic, it is clear that $\frac{1}{\tau}\sum_{\tau=t_0-k-\tau}^{t_0-k-1}(G_i^p)^2 = 1$ when τ is an even number so that $G_i^p = 0$ is guaranteed not to be possible (the median interpolates two actual values for the abnormal returns). Therefore the statistic simplifies to $\sum_{\tau=t_0-k}^{t_0+k} G_i^p \sim N(0,1)$. Now, if the event window increases by an even number, and half of the new values for G_i^p equal +1 and the other half −1, so that they perfectly cancel out, the sign test statistic remains unchanged.

where $\tilde{\kappa}_{ij}$ is the rank for the difference series $\{z_{il,j}\}_{j=1}^{m}$ and $\hat{\kappa}_{ij}$ takes only the ranks that correspond to the abnormal returns of i exceeding those from l. The moment generating function of U^{+} can be easily characterized in recursive fashion and it implies that $E[U_{il}^{+}] = \frac{1}{4}k(k+1)$, while $Var[U_{il}^{+}] = \frac{1}{24}k(k+1)(2k+1)$. As k becomes large, the distribution of the standardized U_{il}^{+} statistic,

$$\frac{U_{il}^{+} - E[U_{il}^{+}]}{\sqrt{Var[U_{il}^{+}]}},$$

converges to a $N(0,1)$. In the paper, we compute an estimate of $Var[U_{il}^{+}]$ by using information from the estimation window of length τ, in line with the way in which non-parametric test statistics are generally computed in event studies application, i.e. $\widehat{Var}[U_{il}^{+}] = \frac{1}{\tau}\sum_{j=t_0-k-\tau}^{t_0-k-1}(U_{il,j}^{+} - \bar{U}_{il,j}^{+})^2$. Extensions to the case in which abnormal returns concern portfolios of stocks are straightforward.

1.4. *Thin Trading Issues*

Since Heinkel and Kraus (1988) researchers in finance have been aware that event studies performed on thinly traded stocks may present a number of difficulties. Chiefly, it is common for standard data sets to treat days in which no trading occurs on a stock in a very simple way: by repeating the last realized transaction price from the preceding day(s). This means that thinly traded stocks will be characterized by frequent occurrences of zero (raw) returns, instances in which the realized price seems not to have changed, while in fact no trading has occurred. On the other hand, when trading occurs, recorded returns tend to be relatively large, in absolute value. This practice of computing returns is referred to as "based on lumped returns", in the sense that realized returns are simply entirely attributed to the day in which trading actually takes place. The presence of numerous zeros in the return series leads to underestimating the variance of returns and may bias test statistics used to judge of abnormal performance.

In the paper, we experiment with two additional methods of return computation that have been popular in the literature, see e.g., Maynes and Rumsey (1993). The first method – "uniform returns" – computes (lumped) returns between trades and then allocates the average daily return to each day within the multi-period interval between two subsequent trades. For instance, the sequence of daily returns $-1\%, 0\%, 0\%, +3\%$ is transformed into the sequence $-1\%, +1\%, +1\%, +1\%$. Since this technique still leads to some degree of smoothing of returns, the danger of underestimating the variance of returns and of biasing the test statistics is still present. In fact, Maynes and Rumsey (1993) report that uniform returns techniques fail to dominate standard lumping methods.

On the contrary, Maynes and Rumsey (1993) report encouraging results for another method of return calculation, the so-called "trade-to-trade returns". These positive findings (in terms of size and power of the tests) have been recently confirmed by Bartholdy et al. (2005), especially when non-parametric test statistics are employed. The method proceeds in two steps. First, the series of returns $\{r_{it}\}_{t=1}^{T}$ is (i) modified to erase all zero raw returns, generating a sub-sequence $\{\tilde{r}_{it}\}_{t=1}^{T_0}$ (T_0 is the total number of returns which are not zero), (ii) matched with a series $\{m_{i\tau}\}_{\tau=1}^{T_0}$ which equals one plus the number of zero raw return which precede a trading day. For instance, the sequence of daily returns $-1\%, 0\%, 0\%, +3\%$

is shrunk into the sequence $-1\%, +3\%$, to which the sequence $0, 3$ is matched since the $+3\%$ follows a period with two zero raw returns. Second, the market model is estimated through the least squares regression

$$\frac{1}{\sqrt{m_{i\tau}}} r_{i\tau} = \sqrt{m_{i\tau}} \alpha_i + \frac{1}{\sqrt{m_{i\tau}}} \beta_i r_\tau^M + \theta_i S_{i\tau} \quad \tau = 1, ..., T_0.$$

At this point the abnormal returns are given by

$$e_{i\tau} = \frac{1}{\sqrt{m_{i\tau}}} r_{i\tau} - \sqrt{m_{i\tau}} \hat{\alpha}_i - \frac{1}{\sqrt{m_{i\tau}}} \hat{\beta}_i r_\tau^M - \theta_i S_{i\tau},$$

where the factor $\sqrt{m_{i\tau}}$ removes the heteroskedasticity introduced by the method.

2. Construction of the Control Portfolio

To build the control portfolio, we proceed as follows. We start with the Angolan portfolio, whose excess returns are modeled by the process $E_t = n^{-1} \sum_{i=1}^{n} e_{i,t}$, n being the number of "Angolan" companies, and we are interested in building a control portfolio constituted by diamond mining companies that do not hold concessions in Angola. The objective is to find a vector of weights $\mathbf{w} \equiv \{w_1, ..., w_J\}$ to be assigned to stocks in the control portfolio, where J is the number of companies not operating in Angola for which data are available. The excess returns of this "Non-Angolan" portfolio"are thus:

$$E_t^C = \sum_{j=1}^{J} w_j e_{j,t}^C,$$

where the superscript C stands for "Control."

In order for the control portfolio to constitute a meaningful benchmark, we chose $\mathbf{w}$ so that in the pre-event period the control portfolio matches as closely as possible three natural properties of the Angolan portfolio: (i) the mean of abnormal returns; (ii) the variance of abnormal returns; and (iii) a market model beta employing returns on the world market portfolio as a regressor. Specifically, we select $\mathbf{w}$ to minimize the Euclidean distance between the vector $\mathbf{v}$ collecting the three features of our Angolan portfolio and a vector $V^C\mathbf{w}$ collecting the same features for the control portfolio, where V^C is a $3 \times J$ matrix that collects the same features for each of the J non-Angolan companies:

$$\min_{\mathbf{w}} (\mathbf{v} - V^C \mathbf{w})' Q (\mathbf{v} - V^C \mathbf{w})$$
$$s.t. \ \mathbf{w}'\mathbf{1}_J = 1 \quad \mathbf{w} \geq \mathbf{0}.$$

The constraints in the above problem require that weights are nonnegative and sum up to one; Q is a weighting matrix that adjusts for the different scale of the quantitative features under consideration.

In particular, let $\mathbf{v}$ be defined as:

$$\begin{aligned}
\mathbf{v} &\equiv [\hat{\mu}_E \; \hat{\sigma}^2_E \; \hat{\beta}_E]' \\
\hat{\mu}_E &= \tau^{-1}\sum_{t=1}^{\tau} E_t \\
\hat{\sigma}^2_E &= \tau^{-1}\sum_{t=1}^{\tau}(E_t - \hat{\mu}_E)^2 \\
\hat{\beta}^W_E &= \frac{\tau^{-1}\sum_{t=1}^{\tau}(E_t - \hat{\mu}_E)(R^W_t - \tau^{-1}\sum_{t=1}^{\tau} R^W_t)}{\tau^{-1}\sum_{t=1}^{\tau}(R^W_t - \tau^{-1}\sum_{t=1}^{\tau} R^W_t)^2}.
\end{aligned}$$

Clearly, $\hat{\mu}_E$ and $\hat{\sigma}^2_E$ are simply sample estimators of the mean and the variance of abnormal returns, while $\hat{\beta}_E$ represents the sample estimator of a market model beta employing returns on the world market portfolio as a regressor, $E_t = \alpha + \hat{\beta}^W_E R^W_t + \eta_t$, with η_t standard white noise disturbance. Since it is clear that means, variances and betas are measured in different units, a natural candidate weighting matrix in this case is:

$$Q_1 \equiv \begin{bmatrix} \sqrt{\tau}/\hat{\sigma}_E & 0 & 0 \\ 0 & \tau/\hat{\sigma}_E & 0 \\ 0 & 0 & \sqrt{\tau}\hat{\sigma}_W/\hat{\sigma}_E \end{bmatrix}.$$

This is the inverse of the (asymptotic) standard deviations of the MLE estimators of the mean, the variance, and the market model beta, respectively. We refer to these weights as "Variance weights".

An alternative choice, similar to Abadie and Gardeazabal (2003), consists of setting Q_2 to the diagonal matrix that allows the control portfolio to best reproduce any of the quantitative features under consideration. In particular, we shall care of using a target portfolio that matches as accurately as possible the *monthly* mean abnormal returns characterizing the target, Angolan portfolio, i.e.

$$\hat{\mathbf{m}}_E \equiv \left[E_1,\ 1/2\sum_{t=1}^{2} E_t,\ 1/3\sum_{t=1}^{3} E_t,\ \dots\ ,\ 1/\tau\sum_{t=1}^{\tau} E_t\right]'.$$

Q_2 is the diagonal, positive definite (i.e. with positive diagonal elements only) matrix that solves:

$$\min_{Q_2}(\mathbf{m}_E - M\mathbf{w}(Q_2))'(\mathbf{m}_E - M\mathbf{w}(Q_2))$$

where

$$M = \begin{bmatrix} e^C_{1,1} & e^C_{2,1} & \cdots & e^C_{J,1} \\ e^C_{1,2} & e^C_{2,2} & \cdots & e^C_{J,2} \\ e^C_{1,3} & e^C_{2,3} & \cdots & e^C_{J,3} \\ \vdots & \vdots & \ddots & \vdots \\ e^C_{1,\tau} & e^C_{2,\tau} & \cdots & e^C_{J,\tau} \end{bmatrix},$$

i.e. a matrix that collects in each of its columns the vector of daily abnormal returns for each of the J control stocks. The notation makes it explicit that $\mathbf{w}$ effectively depends on Q_2 through the optimization problem. The sense of this choice of the weighting matrix Q_2 is that we would like the control portfolio to give mean abnormal returns of the same magnitude as the target portfolio. We denote the resulting weights as "A-G weights".

The pre-event sample period we used for the weighting was from January 1, 1998 to Jan. 31, 2002. In Guidolin and La Ferrara (2004) we showed that results were very similar with the two sets of weights. Appendix Table A1 reports the estimated weights we employ in the current version of the paper, which are the "A-G weights".

[Insert Appendix Table A1]

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Appendix Table A1: Composition of Control Portfolio

Company	*Weight*
AKD	0.010694
ALCASTON MINING	0.029895
BHP BILLITON	0.022666
CONQUEST MINING	0.008826
CROWN DIAMONDS	0.005888
GONDWANA RESOURCES	0.021115
GRAVITY CAPITAL	0.006645
KIMBERLEY DIAMOND	0.017457
MOUNT BURGESS MINING	0.009056
OROPA	0.005141
PLENTY RIVER CORP.	0.003275
REEFTON MINING	0.003750
RESOURCE MINING	0.016354
RIMFIRE PACIFIC MINING	0.526298
TAWANA RESOURCES	0.004851
AFMINEX	0.005653
CLUFF RES. PAC	0.008743
GOLDSEARCH	0.007797
STRIKER RESOURCES	0.005126
ASTRO MINING	0.005616
FORTUNE MINERALS	0.007794
GUYANOR RES.SA (TSE)	0.007113
PLATINOVA A/S	0.004979
SOUTHWESTERN RES.	0.013450
ABER DIAMOND	0.008358
DIAMOND FIELDS INTL.	0.033868
ETRUSCAN RESOURCES	0.008588
REX DIAMOND MNG.	0.004758
BAND ORE RES.NEW	0.006644
BRAZILIAN DIAMONDS	0.008247
CALDERA RES.	0.007287
COMAPLEX MINERALS	0.054323
GOLDEN STAR RESOURCES	0.013539
MOUNTAIN PROV.DIAS.	0.012391
PURE GOLD MRLS.	0.034170
SUDBURY CONTACT MNS.	0.005056
TAHERA	0.005403
RNC Gold	0.006080
AFRICAN GEM RES.	0.008067
GOOD HOPE DIAMONDS	0.009157
THABEX EXPLORATION	0.012262
ZENITH CONCESSIONS	0.003620