The impact of violent political conflict on commodity prices: The Israeli food market

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Abstract:

The impact of violent conflict on the state of the economy has been studied extensively since the two recent decades. In most studies the state of the economy is operationalized by stock market indices of the respective countries. In this paper we suggest investigating the impact of violent conflict on the lives of civilians by looking also at food prices. We gathered a unique dataset of daily frequency for this purpose which offers a number of variables quantifying relevant events which occurred between 1997 and 2011 in the Israeli-Palestinian conflict. We model domestic Israeli prices of several fresh fruits and vegetables using a GARCH framework and control for the state of the economy, exchange rate effects, international prices, seasonal variation and Muslim holidays. Intensity of the conflict is measured by the incidences of movement restrictions which are implemented due to security reasons and temporarily cut off the otherwise dynamic agricultural trade between Israel and the Palestinian Territories, and daily casualty numbers for both sides of the conflict. Our analysis yields plausible results for the comprehensive impact of the controls as well as of the conflict variables. We find that comprehensive closures imposed on the Palestinian Territories do not show much impact on food price dynamics in Israel. Conversely, while days with many Israeli casualties raise both the mean and the volatility of several prices, the opposite effect is observed in the case of high numbers of fatalities on the Palestinian side.

Keywords: Casualties, Closures, Food prices, GARCH, Intifada, Israeli-Palestinian conflict, Middle East

JEL: F15, F51, Q11

Introduction

In this study we aim at analyzing the impact of the ongoing Israeli-Palestinian violent political conflict on the Israeli food market. Food consumption is an important economic segment for wellbeing in general and particularly in this framework, as the agricultural activities of Israel and the Palestinian territories are well integrated (Ihle & Rubin, 2012). This micro-level analysis of economic effects of violent conflict is of great importance for additional reasons. First, the Israeli-Palestinian conflict is a long lasting political struggle with cycles of violence and fluctuating intensity levels. Therefore, the high number of incidents and the long duration of the conflict can be used for empirical tests of renewed theories in political science, economics and related fields with implications for conflict resolution and peace research. Second, this violent conflict takes place domestically and not in foreign land. It has been shown that wars in the homeland have higher economic consequences than foreign wars (Caplan, 2002; Collier, 1999). The conflict on hand is not a civil war, as the involved parties are of different political entities. Yet, the geographical proximity and the high volume of bilateral trade between them in goods and input factors yield a complex structure of this conflict regarding high interaction between the two parties on the disputed land and the economic implications to civilians. Third, Israel is the party of the conflict with the most powerful military capabilities. Impacts on wellbeing of the Palestinian side are therefore relatively more apparent and more severe, as reported by series of publications by the World Bank (2007; 2008a; 2008b; 2010a; 2010b; 2011) and the United Nations (2009). Unlike these studies, we attempt to measure the impact of the violent conflict on civilians belonging to the supposedly stronger side of the dispute and examine if and to what extent they are affected.

The impact of violent incidents in the framework of wars or terror acts on the state of the economy has been studied broadly during the last two decades (e.g. Schneider and Troeger 2006; Guidolin and La Ferrara 2010; Eldor and Melnick 2004; Chen and Siems, 2004; Hon et al., 2004 and Drakos 2004; Zussman, Zussman and Nielsen 2008 and others). In most of the studies scholars adopted the approach that financial markets mirror best the state of the economy. This assumes that participants in stock markets have rational expectations with regard to assets in trade, which in turn implies that observed (equilibrium) prices represent the true state of the economy. This operationalization proved to be useful for capturing the short term and

long term impacts of events like natural disasters, financial crashes and terrorism on the economy (e.g. Chesney, Reshetar and Karaman 2011).

Nevertheless, we contemplate two limitations of this operationalization. First, adopting this approach implies that traders' expectations represent accurately the expectations of all capital holders in the economy under investigation. This, however, is not always the case. Because not all people in the economy are invested in the stock market - and even within the group of those who invest - the concentration level of stock holdings is substantially high, it is to the scholar to verify in each case whether the stock market reflects the true state of the economy or whether it is limited only to the perceptions of active traders and the magnitudes of selected firms.[1] Second, and more relevant to our study, we aim to examine how the violent conflict affects the livelihoods of most of the civilian population. Often, most of a country's population is not active at stock markets and is therefore not immediately affected by fluctuations in financial markets. It is not clear to what extent stock indices give a comprehensive picture of the state of the economy, how these effects impact the real economy and to what extent they affect civilians whose livelihoods are subject to violent political conflict. However, all parts of a population – from the poorest to the wealthiest class - have to make expenses for food. Therefore, we adopt this micro-level perspective in order to obtain evidence on the welfare effects of conflicts on fundamental economic activities.

Specifically, we focus on food prices as they affect all segments of the population. Fresh agricultural produce appears to be a suitable choice for quantifying the impact of the violent conflict on civilians. Frequent fluctuations in food prices may play a vital role for food security. Shocks in agricultural prices are often caused by severe weather conditions, abrupt changes in input prices, declines of the stocks to use ratio or macroeconomic crises (e.g. Masters and Shively, 2008 and OECD, 2008). We consider in this study shocks to domestic food prices which result from violent political dispute. Moreover, we investigate to what extent this kind of market shocks has an impact in shaping the Israeli agricultural market. The Israeli-Palestinian conflict appears to be an important case study for examining this issue due to the lack

[1] For instance, in the richest countries, the 10 largest companies hold between 94% (Greece) and 20% (United States) of their respected overall stock markets value. The European rich countries are in the range of ~42% (Britain) and ~93% (Denmark) on this scale (The Economist, 2010).

of attention of economic research devoted to it despite its long history, extent and international significance. We assess in this work the effects of a violent escalation of the conflict which is the outbreak of the second Intifada (uprising of the Palestinian people) on price dynamics of selected food products in the domestic Israeli market. Only very few economic articles are published on this topic, e.g., Boer and Missaglia (2006), Fielding (2003) or Salem (2003).

The Israeli agricultural sector is characterized by intensive international trade. The most important trading partner is the EU which is the destination of 70% of Israel's exports (mainly fruits and vegetables) and the origin of around 40% of total Israeli imports (mainly grains; Israeli Central Bureau of Statistics, 2008). These statistics however are based on the presumption that Israeli-Palestinian trade is not considered as international trade although agricultural trade with the Palestinian territories is significant for fruits and vegetables. The Israeli agricultural sector is specialized on the production of high-value fruits such as bananas and apples which are exported in large quantities to the Palestinian territories. Labor intensive vegetables such as cucumbers are traded the other way. Therefore, the agricultural sectors of the Palestinian territories and of Israel are tightly intertwined despite the political conflict. Hence, manifold exchange of agricultural produce and input factors between Israel and the Palestinian territories developed from which both sides have been benefitting due to the mutual comparative advantages.

This large potential cannot always be exhausted due to occasional outbreaks of violence resulting from the lasting political conflict between Israel and the Palestinians (see, e.g., Tessler, 2009, for more details on its history). The most recent decisive event was the Second Intifada which started in September 2000 and lasted until 2005. In order to curb security threats and to control the security situation, the Israeli Defense Forces (IDF) implemented a number of security policies. Among these, comprehensive closures of the West Bank barrier were applied on a daily basis which led to temporary stops of the movement of people and goods between the West Bank and Israel (B'Tselem, 2013a). During the closure incidences, Palestinian and Israeli producers are not able to exchange the complementary food commodities they produce. The application of this type of security measure hence yielded substantial temporary supply and demand shocks for both agricultural and food sectors. These shocks can be seen as side effects of security policies taken due to the conflict. The

economic implications of the resulting strong pressure are potentially large for both sides due to the mutual importance of these sectors.

We assess whether and to what extent the movement restrictions implemented during the second Intifada changed the price dynamics of selected food products in the Israeli agricultural sector. Furthermore, we wish to examine whether this escalation of the conflict changed price dynamics enduringly also after its end by comparing the periods before and after the Second Intifada. This research focus is of high relevance because it assesses massive interferences into the economic activities of regional agricultural and food markets which are not induced by immediate economic policy but rather collateral consequences of security policies due to violent political conflict. Hence, it focuses on determinants which threaten the food security of civilians whose livelihoods are subject to such dispute.

In this study we employ univariate volatility models in order to model wholesale prices of fresh agriculture commodities in Israel while accounting for macroeconomic indices, international prices, movement restrictions which cut off the otherwise dynamic agricultural trade between Israel and the Palestinian Territories, and casualties continuously caused by the conflict for both sides. The analysis obtains empirical evidence on the dynamics of agricultural prices concerning their levels and volatilities and the change of these dynamics before, during and after the escalation of the conflict during the Second Intifada.

The paper proceeds as follow. In the next sections we outline the literature on economic effects of violent conflicts. This is followed by a detailed discussion of the Israeli agricultural markets and trade and the potential effects of the Israeli-Palestinian conflict on food markets and price dynamics. Afterwards, we discuss the data and present the econometric model and its results. In the last section, we summarize our findings and discuss the implications of this study for better understanding of the impact of violent conflict on civilians.

State of the art: Violent conflict and the state of the economy

The study of the impact of violent conflicts on the economy has been advanced widely in the last two decades. The recent rapid increase in this body of literature may be attributed to two central reasons. One likely reason is the unfortunate sharp increase in the frequency in which violent conflict occurred in recent years in the

world. These tragic events gave rise to numerous case studies on the economic effects of terror, see for example studies on September 11 (Chen and Siems, 2004; Hon et al., 2004 and Drakos 2004), Madrid and London bomb attacks in March 2004 and July 2005, respectively (Kollias, Papadamou and Stagiannis 2011) and the numerous terror incidents in the Israeli-Palestinian conflict (Eldor and Melnick, 2004; Zussman, Zussman and Nielsen 2008) and others. The second reason for the widespread attention given to this subject may be that high frequency data has become increasingly available from stock markets. This financial data makes up a practical approach to test renowned theories regarding violent conflict.

The analysis of this data is valuable for several reasons. First, stock market data is documented in a transparent and standardized manner hence it is readily available for time series regression analysis. Second, it is very rare that stock exchanges do not operate, even during times of conflicts. Therefore they constitute invaluable sources of real-time information which reflect immediate reactions to news of the moment or deteriorations of the political situation until extreme events as unexpected terror attacks or active warfare. Third, it is customary to assume that investors trading in these markets have rational expectations regarding their assets in trade. Hence, their decision making is likely to aggregately reflect the current state of the economy and its near or medium term future. Consequently, we witness considerable quantitative studies on the relationship between violent conflicts and the state of the economy which are based on the convenient platform of data generated from one financial market or in some cases comparative studies which are based on data compiled from several stock markets.

While it is understood that violent conflicts have devastating outcomes, it has been shown over the years that asset pricing may be affected positively, negatively or not at all by wars and incidents of terror. Most commonly, studies report a negative impact of violent conflicts on stock exchange. This is because generally stake holders tend to perceive violent conflict as potential risk to political stability, future economic conditions, investments and firms' performances. For example, Schneider and Troeger (2006) examine the reactions of international markets to three war regions and conclude that the stock market response is most often negative. Based on six different financial markets, Arin, Ciferri and Spagnolo (2008) find that terror has a significant negative impact on both stock market returns and volatility. In a case

study, Abadie and Gardeazabal (2003) show that the conflict in the Basque Country had negative effects on stocks of firms which make significant part of their business in that area. Lastly, in the framework of the ongoing Israeli-Palestine conflict, it has shown that the Tel-Aviv stock exchange (TASE) declines in periods of intensified violence (Eldor, and Melnick, 2004; Zussman, Zussman and Nielsen 2008). Conversely, under some circumstances, going to war or the use of military power to a lesser extent can be seen as the beginning of a better period which will start after a temporal escalation of the conflict. In such cases, the stock market may respond positively as it mirrors expectations for improving economic conditions (Schneider and Troeger, 2006, Guidolin and La Ferrara 2010). For example, the expectations regarding Saddam Hussein's fall before and during the Iraq wars have been shown to be positively correlated with stock prices in the United States (Amihud and Wohl, 2004; Leigh, Wolfers and Zitzewitz, 2003). In the same manner, a study that looked at assassinations of Palestinian leaders by Israel in the midst of the Second Intifada found that the TASE declined after the assassinations of senior political leaders but increased after assassinations of senior military leaders. Implying that trades perceive the first type of assassination as negative for economic activity and the second type as positive (Zussman and Zussman, 2006).

The works cited above treat stock market indices as a perfect representation of the state of the economy. But stock markets do not necessarily mirror this comprehensive information and represent all societal groups somehow involved in the economy properly. For example, focusing on the diamond sector in Angola Guidolinand and La Ferrara (2007) show that the outcome from civil war may be perceived quite differently from one firm to another. In the case of Angola, a poor country suffering from civil war, the end of the fights had negative impact on returns for the diamond sector. This means that some firms may actually benefit from the ongoing civil war and, hence, have an incentive to put political and economic pressure to postpone conflict resolution. Considering the relative weight of the diamond sector in such a poor country as Angola, this might be a serious matter. Another example for possible misrepresentation of the general public perception is given by DiPietro, Anoruo and Sawhney (2008) who study the relationship between stock market performances and military expenditure in the United States and the United Kingdom. They find a strong positive relation which similarly to the previous example, presents

a situation in which some parties enjoy higher returns during times of conflict. Moreover, they find that when military expenditure increases the stock market on average goes up, making all traders better off. This implies that in places where the stock market is concentrated in the hands of the relatively higher classes there is a risk that military spending will be suboptimal.

In addition, as acknowledged by Schneider and Troeger (2006), the stock market as a whole does not provide sufficient insight on the various effects that conflict may have on different sectors. Only a few studies looked at sector-specific impacts in the framework of firms in the stock markets. The ones investigating terror attacks reported strong negative effects on the gold, insurance, travel and airline industries, the banking sector found to be quite resistant and other sectors had mixed results. The impacts of terror attacks was short and the market rebounded in a short period (Kollias, Papadamou and Stagiannis 2011; Chesney, Reshetar and Karaman 2011).

While it has been shown in the literature that stock market data can be useful for the purpose of examining the perceptions of investors and stake holders in certain sectors of the economy, it does not reflect the potential immediate day to day effect on civilians and especially poorer strata of the society which are exposed to the economic implications of violent conflict. In order to look at the direct economic impact on all groups of civilians one should be able to keep track with expenditure data. To the best of our knowledge, there is no study that matches the violence conflict indices with high frequency data other than stock markets to estimate this impact.

Characteristics of the Israeli Fruit and Vegetable Market

The Israeli market for fresh agricultural products is characterized by far-reaching changes with regard to consumption habits as well as the structure of agricultural production and marketing. Central factors influencing structural changes in supply chains for agricultural products in Israel are the change in the retail market structure and the liberalization of agricultural exports.

Consumption patterns

Traditionally, fresh vegetables and fruits are an important part of the Israeli diet and of Israeli agriculture. They account for 13% of the total consumption

expenditure of households for food. The quantity of vegetables and fruits consumed in Israel is relatively high compared to the US and most countries in Europe but changes in lifestyle and diets have a negative influence on their intake also in Israel.

Fruits and vegetables account for about 45% of the total value of agricultural production in Israel. In 2012, Israel produced about 2.2 million ton of vegetables (including potatoes and melons) and 1.7 million ton of fruits. 55% of this amount is supplied to the domestic market, 21% to the processing industry and intermediate uses and 23% is exported. Imports of fresh fruits and vegetables are small. Vegetables are imported mainly from the West Bank and Jordan while fruits are mostly supplied by the US and EU countries in the framework of tariff rate quotas with reduced custom duties.

Fruits and vegetable production increased in the last decade but most of the increase was due to rise in vegetable exports. Agricultural exports were gradually opened to competition in the nineties, leading to the establishment of many new export companies. Quantities supplied to the domestic market hardly changed while the population increased substantially, pointing to a decline in the consumption of fresh fruit and vegetables.

Marketing Channels for Fruit and Vegetables

Israeli fruits and vegetable growers sell their products to wholesalers, retailers, processing companies or exporters. The structure of the downstream sector differs for different agricultural commodities. Some varieties of fruits and vegetables are grown almost exclusively for domestic fresh consumption (e.g. salad, watermelons, bananas), while others are supplied in substantial quantities to export markets, in addition to domestic consumption (e.g. sweet peppers, potatoes, avocados). In the citrus sector, processing companies provide an important outlet for fruits not satisfying quality requirements for marketing as fresh fruits. The main vegetables grown for processing are tomatoes and corn.

Farmers supply fruits, vegetables and potatoes for export to packing houses where the produce is sorted and packed. Also the majority of fruits and potatoes for the domestic market is supplied to packing houses. Some vegetables for the domestic market are packed close to the field by farmers themselves. Packing houses are

usually owned by large growers, grower cooperatives or private partnership of growers.

There are approximately 200 fruits and vegetable wholesalers in Israel, about half of them in one of the four main wholesale markets (Tel Aviv, Haifa, Rehovot, Jerusalem). In addition to the four main wholesale markets there are a few more small wholesale markets with just a handful of wholesalers each. The remaining wholesalers are located outside of wholesale markets. Additionally, there are about 20 wholesalers specialized in the marketing of bananas and 130 large farmers or farmers cooperatives with wholesale licenses marketing their production and the produce of additional farmers. The two main supermarket chains in Israel established their own logistics centers for fruits and vegetables and buy directly from producers; other retailers buy fruits and vegetables from wholesalers or sometimes directly from farmers.

There is no reliable up-to-date information on the share of different operators at wholesale level in the marketing of fresh fruits and vegetables to the domestic market. Zenobar et al. (2000) estimated that nearly 50% of fruits and vegetables are delivered directly to retailers – including all produce delivered from farmers directly to retail outlets, either by farmers or farmers organizations, or by wholesalers but without entering the wholesale market or logistics centers. According to Zenobar's estimates, about 30% of fruit and vegetables marketed domestically are delivered through wholesale markets, about 15% to logistic centers of retail chains, and about 7% to logistic centers of wholesalers situated outside of wholesale markets. It is likely that the share of produce supplied to the logistics centers of retail chains increased in the last decade, parallel to an increase of the share of fruit and vegetables bought by consumers in retail chain stores. Generally, there is an increase in the importance of wholesalers located outside the wholesale markets.

The organization of the agricultural export sector in Israel has changed considerably during the last two decades. Motivated by government policies to decrease public intervention in the economy and to privatize state monopolies, parastatal export monopolies were abolished and export licenses were granted to a number of firms. Currently, there are more than 100 companies exporting horticultural products. Despite the entry of many new export companies, for most

products a handful of companies are responsible for the major shares of horticultural exports.

Structure of the retail sector

Similar to other industrialized countries, the share of retail chains in the marketing of food is increasing, parallel to a decline in the importance of traditional outlets like fruits and vegetable stores and open markets. Nevertheless, the market share of retail chains in Israel is still lower than in Northern European countries, especially for fresh fruits and vegetables. In 2010, consumers spent 46% of their expenditure for fresh fruit and vegetables in supermarket chains, compared to 26% in specialized shops (fruit and vegetable shops), 20% in open markets and 6% in neighborhood grocery shops. Also for fresh fruit and vegetables, the importance of supermarket chains is increasing**.**

Potential micro-economic effects of violent conflict on food markets

The political conflict has comprehensive effects for the economies of both involved parties (Fielding, 2004). In the following, we focus on the effects on Israeli fresh fruits and vegetable markets. The conflict and its varying intensity yield a number of consequences for price dynamics in Israeli food markets. These effects depend on the specific characteristics of the commodity, its production, demand and trade structure since not only demand and supply inside Israel are affected, but also trade with the Palestinian Territories and, less so, Israel's trade with the rest of the world. Most noticeably, the effects can be expected to depend strongest on the extent to which the acts of the conflict are carried out on Israeli territory.

Periods of increased resort to violence and intense fighting obviously also worsen the security situation inside Israel. Most importantly, the uncertainty in form of the risk of a damage of the physical integrity and health of each person in Israel increases with the intensity of the conflict, e.g., through suicide bombing or rocket attacks. Even though Israeli security authorities aim at preventing damage from Israeli civilians, this cannot be guaranteed with certainty. The unknown location, timing, form and size of potential future terror attacks lead to the perception of an omnipresent danger for personal lives and an increased awareness and avoidance of

potentially unsafe public locations by the civil population. Although comprehensive security screenings at the entrances of public buildings and other enclosed areas of public interest will be enforced then, the danger of an attack on the people waiting for the security check cannot be precluded. Hence, citizens have to bear an additional cost of personal security while moving in public space which sharply rises with the intensity of the conflict.

Such security risks and their minimization by the individual also translate into consumers' behavior during violent periods in general and particularly in regard to food purchasing. Since the benefits of food consumption remain unaltered by the conflict, but costs of food purchasing increase due to the risk premium to be borne by the consumers, demand is likely to be depressed during intensified phases of the conflict. Consumers will think twice when and where to go shopping and will tend to decrease their shopping frequency in order to curb the risk of becoming victim of an attack. These effects will be of course only of limited scope since food is an essential aspect of consumption. The more luxurious a commodity is the stronger can they expected to be.

Besides changes in the demand for food, e.g., by avoiding eating in public places, restaurants etc., and in the frequency of shopping, also changes in the shopping destinations and in the composition of the food basket may occur. Consumers will tend to avoid open markets and prefer enclosed shopping facilities, such as supermarkets, which are relatively separated from the public space and offer security screening at the entrances. Since the pricing behavior of supermarket chains differs from the pricing of small retail sellers in open markets, this might also lead to at least temporarily altered price dynamics.

Last, the duration of the violent conflict phases and the evolution of the intensity of the use of force by the involved parties can only be determined with certainty in retrospect. This implies, that during such phases the civilians (as well as the security authorities) subject to the conflict suffer from immense uncertainty about the course of the conflict-related events in the near and medium term future. A worsening or an improvement of the current situation during the immediate future would raise or alleviate their risk costs of shopping, respectively. Depending on which scenario consumers expect for the next days and weeks to come, they will adapt the

composition of their food basket accordingly. If the expectations of a large part of consumers coincide, food markets will be affected by such collective action. For example, if many consumers expect a violent escalation of the conflict during the following weeks, they will resort to more storable food due to their uncertainty about the extent and the duration of the anticipated deterioration. Consequently, demand for storable food commodities or tinned food will temporarily shift outwards and prices of such good will increase while demand for perishable fresh fruits and vegetables collapses.

Such temporary changes of the substitution characteristics between staple food commodities also affect the supply side. Conflict-induced events might temporarily change consumer numbers of various retail channels. As, mentioned above, supermarkets and other enclosed shops are likely to be preferred during periods of increased use of force due to their comparatively more easily controllable and consequently safer shopping environment. Small retail traders in open markets might therefore suffer considerable losses during such periods. If supermarket owners are aware of this effect, they might try to profit from it and charge additional price markups for the food commodities in particularly high demand in order to increase their margins. This would harm consumers in second respect since fruits and vegetables, according to the perception of many consumers, tend to be consistently more expensive in Israeli supermarkets than in open markets. However, these increased margins for selected goods might be deliberately budgeted by supermarket owners in order to offset losses incurred due to lower consumption frequencies and lower demand for perishable food. This supply response might therefore also at least temporarily affect food price dynamics.

Besides the welfare effects for the retail sector, especially the domestic transport sector, producers of fruits and vegetables will suffer from violent escalations of the conflict. The transport sector might be challenged by damages to the infrastructure. Primary producers of such food commodities which are prone to demand collapses during escalations will suffer the most and may lose entire harvests and may thus be threatened by bankruptcy while producers of commodities which are storable or can be canned or otherwise preserved will even benefit from the conflict. In the case of sustained fighting over months or years, the conflict may induce or fuel structural change among producers from the demand-shock susceptible towards

relatively more storable commodities and may, thus, potentially permanently alter price dynamics of various food commodities.

Third, Israeli trade in food commodities may be affected by the conflict. As mentioned above, impairments of the domestic infrastructure will impede local transport. But more importantly, security measures implemented by the IDF in order to control the flows of goods and people will hinder trade with the Palestinian territories. Depending on the commodity and its dominant direction of trade flow, Israeli consumers or Israeli producers will suffer additionally. For cucumbers and tomatoes which are predominantly shipped from the West Bank and the Gaza strip, respectively, to Israel, movement restrictions or bans will constitute major shocks to the Israeli market and alter price dynamics for the respective commodities for longer or shorter time horizons.[2] Depending on the sizes of such short-termed drop outs and on whether the Israeli retail sector and the food processing industry will be able to compensate them, Israeli consumers may temporarily face markedly raised fruits and vegetables prices. Additionally to the decreased demand by Palestinian consumers, transport to major Palestinian cities is usually largely restricted if not completely banned during periods of conflict escalations. From the perspective of Israeli producers, the demand for fresh food commodities which are in significant amounts shipped to the Palestinian territories, such as apples or bananas, and for which Israeli production constitutes by far the main source of demand is thus heavily impaired since hundreds of thousands Palestinian consumers are temporarily cut off from Israeli supplies. Israeli producers will therefore, depending on the gravity and the duration of the situation, incur considerable losses, whereby perishable commodities are likely to be more strongly affected than storable ones. Israeli consumers, in contrast, will benefit from the resulting temporary glut and downward pressured prices on the domestic market. International food trade of Israel is likely to be the least affected sector.

As long as the country's harbor facilities are not damaged by the conflict, effects should be minimal. However, Israeli producers and retailers might resort to international markets in order to cushion the above described effects in the domestic food market due the unrealized trade with the Palestinian territories. While price

[2] For example, since 2008, there have not been any fruits or vegetable exports from the Gaza strip to the Israeli market.

increases might be successfully addressed by increased imports, exporting the quantities which were scheduled for the Palestinian territories is more challenging because Israel has only very limited trade relationships with its neighbors and quality standards for exports to the EU and the USA are higher. Hence, price-increasing shocks to the domestic Israeli food market due to the conflict are more likely to be alleviated by foreign trade than price-depressing events so that, in tendency, Israeli consumers seem to be favored in this respect over domestic producers.

Data

We use a comprehensive dataset of 3662 daily observations of a range of variables. Observations start on January 1 1997 and range until December 29 2011. We study the dynamics of the price of four fresh fruits and five fresh vegetable products which are apples, bananas, grapes, sugar melons and cucumbers, lettuce, potato, tomato and sweet peppers. These nine commodities have been selected based on their importance in the diet of the average Israeli as published in the 2010 Household Expenditure Survey of Israel (CBS, 2012) and data availability. Descriptive statistics of the variables are shown in Table 1.

The Israeli wholesale price series have been obtained from the Israeli Ministry of Agriculture and Rural Development.[3] In order to isolate the effects of the conflict we control for the general state of the economy, proxied by the TA-100 stock index of the 100 largest companies in terms of market capitalization of the Tel Aviv Stock exchange, because it might affect food consumption. We also account for the exchange rate (XR) of the New Israeli Shekel (NIS) to the Euro, also obtained from the Bank of Israel, since the EU is the major partner of Israeli foreign trade in fruits and vegetables. Furthermore we control for the European price of each good proxied by the monthly commodity specific import indices of Germany as the largest Member State of the union (DeStatis, 2013).[4] For the analysis, all of these series are transformed by $100(\log(p_t) - \log(p_{t-1}))$ into returns. We imputed the few missing

[3] The Israeli Ministry of Agriculture and Rural Development regularly publishes wholesale prices on its website at http://www.moag.gov.il/agri/services/maagarey_meyda/

[4] Since these data are incomplete for sweet peppers and sugar melons, we use the index of the monthly average price at German wholesale markets obtain from Agrarmarkt Informations-Gesellschaft mbH (AMI).

values in the time series of the variables by using a structural time series model based on the state-space approach of Harvey (1989).

Since the integration of the economies of Israel and the Palestinian Territories is very close, we also account for important Muslim holidays which are celebrated by the Arab Muslims which account for about 17% of the Israeli population and the majority of Palestinians. These holidays, which therefore potentially influence aggregate food demand, are the Feast of Sacrifice (Eid al-Adha), the Feast of Breaking the Fast at the end of Ramadan (Eid al-Fitr) and the Islamic New Year. They occur in 0.9 percent of all observations (Table 1). We distinguish the Ramadan period from these holidays since it lasts much longer (8.4 percent of the observations) than any other holiday and nutrition habits differ considerably both from the remaining holidays and from the rest of the year. Although the assessment of the effects of Israeli weekends and holidays for food markets might yield interesting insights, this cannot be done because wholesale markets are closed during the Israeli weekend on Fridays and Saturdays and the important national and religious Jewish holidays[5] so that no trade occurs and no prices exist. We, therefore, exclude these days from the analysis by omitting the respective days from the price time series.

Moreover, we consider dummies for the four seasons of the year[6] and for the occurrence of the Second Intifada as the major eruption of extended violence due to the political conflict[7]. 29.1 percent of the observations fall into this period while almost 46 percent fall into the time after the Intifada. This set of dummy variables enables us to account for general effects which potentially fundamentally differed between the years before, during and after.[8]

[5] This holds for Passover, the Israeli Independence Day, Shavuot, the Jewish New Year, Yom Kippur, Sukkot and Shemini Atzeret.
[6] Spring ranges from beginning of March to end of May, summer from June to August, etc.
[7] The dummy *During Intifada* takes unity between September 28 2000 and February 8 2005, which are mostly regarded as the beginning and the end of the Second Intifada. The two other dummies are structured accordingly.
[8] The operation "Cast Lead" of the Israeli Army against rocket fire from Gaza which took place between December 27 2008 and January 18 2009 was a major eruption of violence, but is not separately considered here due to its short duration.

Table 1: Descriptive Statistics

Variable	Min	Max	Mean	Median	Stand. dev.	Coeff. of variation
Apple price	-12.86	15.44	0.001	-0.0004	1.53	2423.90
Banana price	-42.35	38.29	0.001	0	2.39	3634.02
Grapes price	-47.00	111.32	0.007	-0.024	5.69	798.15
Sugar melon price	-34.85	62.40	-0.007	-0.002	5.32	-802.50
Cucumber price	-59.51	60.04	0.014	0.057	10.03	709.64
Lettuce price	-16.90	20.27	0.004	0	2.69	745.92
Potato price	-24.34	24.21	0.002	0	1.57	670.18
Tomato price	-40.40	19.17	-0.005	-0.123	4.44	-914.01
Sweet pepper price	-16.79	18.34	0.002	-0.051	2.73	1203.69
TA100	-4.51	4.25	0.018	0.013	0.59	32.60
XR	-6.47	3.60	0.002	0	0.32	147.47
Muslim holidays	0	1	0.009	0	0.09	10.65
Ramadan	0	1	0.084	0	0.28	3.31
Spring	0	1	0.239	0	0.43	1.78
Summer	0	1	0.268	0	0.44	1.65
Autumn	0	1	0.230	0	0.42	1.83
Winter	0	1	0.263	0	0.44	1.67
Before Intifada	0	1	0.252	0	0.43	1.72
During intifada	0	1	0.291	0	0.45	1.56
After Intifada	0	1	0.457	0	0.50	1.09
Closure	0	1	0.168	0	0.37	2.22
Closure day	0	160	5.281	0	18.20	3.45
Deadly day Is	0	1	0.003	0	0.06	17.44
Deadly day Pal	0	1	0.032	0	0.18	5.51
Days after deadly day Is	0	2676	853.6	670	777.6	0.91
Days after deadly day Pal	0	1366	261.4	80	352.7	1.35
# Is casualties last 3 days	0	26	0.3553	0	1.95	5.48
# Is casualties last 30 days	0	84	4.00	0	8.57	2.14
# Pal casualt. last 3 days	0	404	3.75	1	16.32	4.35
# Pal casualt. last 30 days	0	1409	39.00	13	98.91	2.54

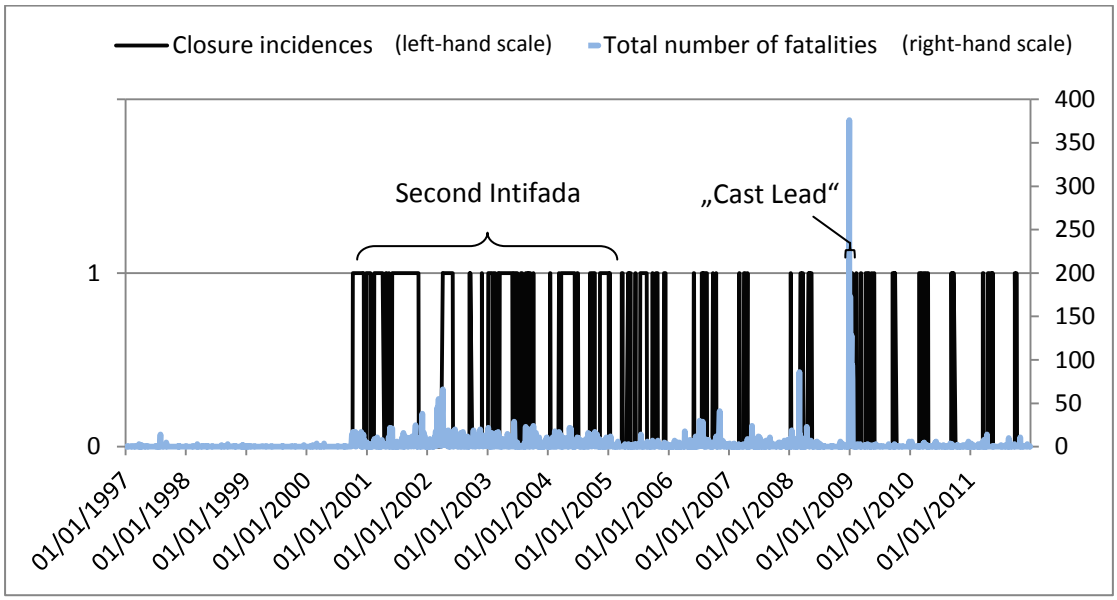
Note: The nine fruits and vegetables prices shown are the Israeli national wholesale prices. The statistics of the corresponding nine European commodity prices are not show here, but can be obtained from the authors upon request.

Measuring the extent of conflict

We consider ten variables with which we aim at measuring the various aspects of the intensity of the political conflict. In contrast to Schneider and Troeger (2006) or Zussman et al. (2008) which use macro-variables such as election outcomes, political agreements between Israeli and Palestinians and other major political events in the Middle East such as the start of the Gulf War, we follow a pronounced micro-perspective. As elaborated above, food markets are more likely to be impacted by "facts on the ground", that is, by the consequences of the conflict for the speed, possibilities and conditions of the movement of people and commodities or for the uncertainty and the tangible threats to life and physical integrity due to (unpredictable) periods of intensified fighting. We use two basic datasets which have been published on the website of B'Tselem, an Israeli human rights NGO, based on which we construct a number of further variables which quantify various aspects of the conflict.

The first data set are the so-called *comprehensive closures* of the West Bank enforced by the Israeli army due to security threats during which "all permits previously issued to residents of the Occupied Territories for purposes of work, trade, or medical treatment are invalid. Residents are also not allowed to travel between the West Bank and Gaza." (B'Tselem, 2013a). In almost 17% of the observations these closures were implemented which starkly inhibit commodity trade to and from the West Bank and the movement of people between Israel and the West Bank. The more perishable a commodity is - which is particularly important for fresh fruits and vegetables - the more potential damage they may induce. Figure 1 shows that this security measure was first introduced with the outbreak of the Second Intifada at the end of 2000 and was particularly implemented during the Intifada on a frequent and long-lasting basis. The variable "closure day" is derived from this variable in order to measure the effects of the duration of closures. The longest continuous closure period which lasted for 160 days (Table 1) happened during the second half of 2001 and ended on November 8.

Figure 1: Comprehensive closures and fatalities in the Israeli-Palestinian conflict



Source: B'Tselem (2013a, 2013b).

While these two variables rather measure the existence and the duration of movement obstacles, the second group measures the intensity of fighting due to the conflict and of the resulting uncertainty for the health and the lives of the civil population. The number of Israeli and Palestinian casualties (B'Tselem, 2013b) is a well-suited measure for this end (Figure 1 shows the total number of fatalities). Table 2 summarizes some aspects of the Israeli and Palestinian casualties who lost their lives between the beginning of 1997 and the end of 2011. The uncertainty and the fear created by the eruption of violence resulting in fatalities are likely to have lasting impacts diminishing over time on behavior of the civil populations.

Therefore, we construct four variables counting the number of Israeli and Palestinian victims during the last 3 and 30 days in order to quantify the short-run and the long-run impacts of the intensity of violence, respectively. Furthermore, we explicitly regard days with exceptionally high numbers of casualties. We define these days as having more casualties than the 90% quantile of all days with casualties (Table 2). Therefore, the variables *deadly day Is/ deadly day Pal* take unity for all days of more than 13.3/7 Israeli/Palestinian casualties which was in 17 and 173 days (0.3 and 3.2 percent of all observations), respectively, the case. Lastly, we regard the two variables *days after deadly day Is* and *days after deadly day Pal* in order to assess the average temporal development of the food price dynamics between such days of

exceptionally heavy use of violence by any of the parties which affect at the median every 80 days Palestinians and every 670 days Israelis (Table 1).

Table 2: Casualty numbers in the Israeli-Palestinian conflict 1997-2011

	Total casualties	Israeli casualties	Palestinian casualties
Sum	7845	736	7109
No of days with casualties	1834	168	1758
Mean casualties/day	4.28	4.38	4.04
Median casualties/day	2	2	2
90% quantile casualties/day	8	13.3	7
Max	358	30	357
Date of maximum	2008/12/27	2002/03/27	2008/12/27

Source: B'Tselem (2013b).

Methods

We apply the General Autoregressive Conditional Heteroscedasticity (GARCH) model developed by Bollerslev (1986) because it offers a flexible framework in order to comprehensively assess the role of exogenous factors on the dynamics of food prices. All of the explanatory variables mentioned above are exogenous to the development of food prices. Since Israel is a small country its foreign trade in fruits and vegetables will not influence European prices, neither play national food prices a significant role for national stock indices or exchange rates as the entire agricultural sector accounts for about 2% of Israel's GDP. The variables quantifying the development of the conflict are also completely independent from these prices.

The GARCH model generalizes the Autoregressive Conditional Heteroscedasticy (ARCH) model developed by Engle (1982) by also regarding lags of the conditional variance in the variance equation. The GARCH (*p*,*q*) model (1) of returns r_t has a characteristic nonlinear variance equation (2):

$$r_t = E(r_t|\mathrm{F}_{t-1}) + \varepsilon_t = \mu_t + \varepsilon_t \text{ where } \varepsilon_t = z_t\sigma_t \text{ and } z_t \sim i.i.d.D(0,1) \quad (1)$$

$$\sigma_t^2 = Var(r_t|\mathrm{F}_{t-1}) = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 . \quad (2)$$

The variance function σ^2 is therefore a weighted average of a constant ω, previous squared shocks/ innovations ε_{t-i}^2 (the moving average component of the conditional variance) and previous forecasts σ_{t-j}^2 (the autoregressive component).

These models allow therefore for a time-varying conditional variance while their unconditional variance is constant.

The second part of the model, the mean equation μ_t, is usually specified in the form of a linear autoregressive moving average ARMA (*v*,*w*) model:

$$\mu_t = \phi_0 + \sum_{k=1}^{v} \phi_k \, r_{t-k} + \sum_{l=1}^{w} \theta_l \, \varepsilon_{t-l}^2. \quad (3)$$

which is a weighted average of past returns and past shocks. This basic model for statistically describing autoregressive heteroscedasticity has been extended into many directions by modifying the nonlinear variance equation, see Teräsvirta (2006) or Bollerslev (2008) for overviews. Brümmer et al. (2013) provide an overview of how these volatility models have recently been used in agricultural and development economics for the analysis of international food prices during the aftermath of the 2007/2008 food price crisis.

We follow the literature and use the standard GARCH (1,1) model for describing the conditional variance which has one moving average and one autoregressive lag:

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \, . \quad (4)$$

This equation has to satisfy the nonnegativity constraints $\alpha_1 \geq 0$ and $\beta_1 \geq 0$ in order to ensure a well-behaved model. Moreover, the stationarity condition $\alpha_1 + \beta_1 < 1$ has to hold in order to guarantee that it is covariance stationary.

For the mean equation, we use an ARMA (1,0) model for the means of the prices:

$$\mu_t = \phi^0 + \phi_1 r_{t-1}. \quad (5)$$

We augment both equations by a number of the above mentioned exogenous variables in order to assess their impact on price dynamics. This simply yields models in which the constant terms become time-varying:

$$\phi_t^0 = \phi^0 + \sum_{a=1}^{n_1} \phi_a^0 x_{a,t} \text{ and } \omega_t = \omega + \sum_{b=1}^{n_2} \omega_b x_{b,t} \, . \quad (6)$$

Estimation Results

For estimation we use the Simulated Annealing Algorithm proposed by Goffe et al. (1994). Table 3 presents the part of the results which are of interest in this context, namely the effects of the above presented exogenous variables. For the sake of readability, it only contains the direction of the effects and whether the mean and/ or the conditional variance of the price series are affected at the 5 percent (10 percent) level of significance.

The general picture is that both the controls and the conflict variables matter a lot both for prices as well as for the stock index and also the exchange rate NIS/€. The significant relationships as well as the directions of the impacts are plausible in general.[9] The European prices, as well as the general state of the economy and the exchange rate seem to play a major role for the formation of domestic Israeli fruits and vegetable prices (Table 3). Also Muslim holidays and the Ramadan appear to be important. For example, during the considered Muslim holidays the mean and volatility of apple prices increased markedly because these fruits play a traditionally prominent role for the special diet on these occasions and are, therefore, much more demanded for a short period.

Furthermore, also the seasonal dummies also indicate plausible results. For example, grapes prices have indeed markedly higher prices during the winter season in comparison to the rest of the year since there is no local supply and small quantities are imported from South Africa. Prices of banana which are exclusively supplied from domestic production indeed fall in autumn since harvest quantities rise considerably during this season. Domestic production quantities of sweet peppers as well as lettuce are markedly reduced during summer. Moreover, stock indices tend to be depressed in summer in many Western economies as they also apparently are in Israel.

[9] Table 5 in the Appendix indicates stability problems for the apple and the grapes models. All other models satisfy the necessary condition.

Table 3: Effects of the explanatory variables on the returns of fruits & vegetable prices, the TA100 stock index and the exchange rate NIS/€

Category	Variable	Apple	Banana	Grapes	Melon	Cucum-ber	Lettuce	Pepper	Potato	Tomato	TA100	XR
Controls	EU price	-/-	M-/-	M-/V-	M-/V-	M-/V-	-/(V+)	-/V-	-/-	-/V-	na	na
	TA100	-/-	M+/-	M-/V-	M+/V+	M-/-	-/-	-/-	-/-	-/V-	na	M-/V-
	XR	-/-	(M+)/-	M-/V+	M+/-	-/-	(M+)/-	-/-	M-/V+	M-/V-	M+/-	na
	Muslim holidays	M+/V+	-/-	-/-	M-/V-	-/-	-/-	-/V-	-/-	-/-	-/-	-/-
	Ramadan	-/-	-/V-	-/-	M-/-	-/V-	(M+)/-	-/-	-/-	-/-	M+/V+	-/-
Seasonal dummies	Summer	-	-	-	-	-	(M+)	M+	-	-	M-	-
	Autumn	-	M-	-	-	-	-	-	-	-	-	-
	Winter	-	-	M+	-	-	-	-	-	-	-	-
Phases	During Intifada	-/-	-/-	-/-	-/-	-/-	-/V-	-/V-	-/-	-/-	-/V-	-/-
	After Intifada	-/-	-/-	-/-	-/-	-/V+	-/V-	-/-	-/-	-/-	-/V-	-/(V-)
Conflict variables	Closure	-/-	-/-	-/-	-/-	(M-)/-	-/-	-/-	-/-	-/-	M+/-	-/V+
	Closure day	-/-	-/-	-/-	-/-	-/V-	-/-	-/-	-/-	-/-	-/V-	-/V-
	Deadly day Is	-/-	-/-	-/V+	-/-	-/-	-/-	-/V+	M+/-	-/-	M-/-	-/-
	Deadly day Pal	-/-	-/-	-/V-	-/-	-/-	-/-	-/-	-/-	-/V-	M-/-	-/-
	Days after deadly day Is	-/-	-/-	-/-	-/V-	-/-	-/V-	-/-	-/-	-/-	-/V+	-/V+
	Days after deadly day Pal	-/-	-/-	-/-	-/-	-/V-	-/V+	-/-	-/-	-/-	-/V-	-/V-
	# Is casualties last 3 days	-/-	-/V+	-/V-	-/-	M+/V-	-/-	-/-	M-/-	-/-	(M-)/-	-/V+
	# Is casualties last 30 days	-/-	-/(V+)	-/-	-/-	M+/V+	-/-	-/-	-/V+	-/-	-/V+	-/V+
	# Pal casualt. last 3 days	-/-	M+/V+	M+/-	-/V-	-/V+	-/-	-/-	-/-	-/-	-/V+	-/V+
	# Pal casualt. last 30 days	-/-	-/-	-/-	-/V-	M-/V-	-/V+	-/-	-/-	-/-	-/V-	-/V-
Number of sig. variables		1	6 (8)	8	8	9 (10)	5 (9)	5	4	4	14 (15)	9 (10)

Note: "-/-" means that there is neither an impact on the mean/ the conditional variance of the price at the 10 percent significance level. "+" or "-" denote a positive/ negative impact on the Mean M or the Variance V. ( ) indicate significance at the 10 percent level while impacts at a higher level of significance are marked without parentheses. The three seasonal dummies have only been included into the mean equation.

The last row of Table 3 suggests that the stock index and the exchange rate react most sensitively both to the control variables as well as in particular to eruptions of violence due to the political conflict. Also cucumber, grapes and sugar melons prices show distinct susceptibility to intensifications of the conflict while the other crops appear to be largely robust. In particular apple prices seem to be mainly untouched by any macroeconomic or conflict-related events.

The last row of Table 4 suggests that the conditional volatility is in total considerably more often significantly affected by the exogenous variables than the means of the price series. The control variables affect in particular the mean of the prices while the conflict variables, except for the variables deadly days as well as casualties during the last three days which measure the short run impacts of the conflict and mainly depress and raise mean prices, respectively, predominantly affect the volatility. In total, negative effects on both aspects of price dynamics prevail while this differs strongly for single variables some of which have exclusively positive or negative effects, respectively.

The closures themselves seem only to exert a slight impact on price dynamics in Israel. While they only affect mean cucumber prices in Israel at 10 percent level of significance, with each day the comprehensive closures are implemented, the conditional volatility is increasingly depressed which may be due to decreased quantities entering Israel during such periods. Extremely violent days of the conflict with exceptional numbers of casualties both depress the mean of the Tel Aviv stock index. While large casualties on the Israeli side raise both the mean and the volatility of several prices, the opposite effect is observed if Palestinians suffer such a humanitarian shock - effects which are especially remarkable given the low number of observations for both variables far below five percent of all observations (Table 1). While Israeli consumers may in such a situation switch to potatoes (which temporally raises their price) because it is a storable vegetable due to the uncertainty shock experienced, grapes and peppers as more perishable food do plausibly mirror this suddenly elevated uncertainty.

Table 4: Number of significant effects per variable

Variable	Number of significant					
	effects on mean			effects on variance		
	positive	negative	total	positive	negative	total
EU price	0	4	**4**	(1)	5	**5 (6)**
TA100	2	3	**5**	1	3	**4**
XR	2 (4)	3	**5 (7)**	2	1	**3**
Muslim holidays	1	1	**2**	1	2	**3**
Ramadan	1 (2)	1	**2 (3)**	1	2	**3**
Summer	1 (2)	1	**2 (3)**	na	na	**na**
Autumn	0	1	**1**	na	na	**na**
Winter	1	0	**1**	na	na	**na**
During Intifada	0	0	**0**	0	3	**3**
After Intifada	0	0	**0**	1	2 (3)	**3 (4)**
Closure	1	(1)	**1 (2)**	1	0	**1**
Closure day	0	0	**0**	0	3	**3**
Deadly day Is	1	1	**2**	2	0	**2**
Deadly day Pal	0	1	**1**	0	2	**2**
Days after deadly day Is	0	0	**0**	2	2	**4**
Days after deadly day Pal	0	0	**0**	1	3	**4**
# Is casualties last 3 days	1	1 (2)	**2 (3)**	2	2	**4**
# Is casualties last 30 days	1	0	**1**	4 (5)	0	**4 (5)**
# Pal casualt. last 3 days	2	0	**2**	4	1	**5**
# Pal casualt. last 30 days	0	1	**1**	1	4	**5**
Sum	14 (18)	18 (20)	**32 (38)**	23 (25)	35 (36)	**58 (61)**

The four variables quantifying the numbers of casualties and, thus, the intensity of the conflict in the short and the medium run only affect some of the price dynamics of the nine commodities. Except for the medium run conflict effects for Palestinians (*# Pal casualt. last 30 days*) which has mostly a volatility-reducing effect both the means and the conditional volatilities are significantly pushed up.

Summary

The economic costs of violent conflicts for countries are usually measured by the way they reflect on the value of their respected domestic stock markets. This operationalization has many apparent advantages for capturing the state of the

economy in quantitative studies. At the same time, it does not allow one to go beyond asset pricing and evaluate the immediate impact on civilian population via market prices.

To receive a broader perspective, we combine the accepted approach in which the stock market is used to evaluate the state of the economy with a high frequently dataset of daily food prices to enable the assessment of the relation between conflict and costs of basic food commodities.

We analyze a unique micro-level dataset which describes the daily development of one of the most complex current violent conflict in the world—the Israeli-Palestinian conflict by using a GARCH framework. We cover a time horizon of 15 years which spans around the Second Intifada. Similar to previous studies, we find a strong impact of the intensity of the conflict on stock market performances. When we use the stock market as a control for the state of the economy we show that food prices are affected as well. They are affected by expected factors as world prices, seasons, and holidays but also by incidents due the conflict.

We are able to distinguish between escalations on both sides of the conflict by separately regarding Israeli and Palestinian casualties which results in comprehensive effects for prices of fresh fruits and vegetables. Moreover, we are able to evaluate the effects of security policies implemented in response to the escalations by the Israeli Army which is found only to have minor effects on food markets. We cannot find a consistent general effect which distinguishes the Intifada and the post-Intifada periods from the five years before this massive eruption of violence.

Although we cannot pin down price changes in terms of weighting adjustments in consumer behavior in times of insecurity, supply response to disrupted trade and other forces that effect food prices, the dynamics and the implications for expenditure and welfare, as estimated in this study are apparent and significant for the Israeli consumer. To the best of our knowledge, this is a first attempt to evaluate the effect of the conflict on civilians on the supposedly stronger side of a conflict. Further micro level analysis is required for better understanding of the many ways that violent conflict impacts the civilian population involved.

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Annex

Table 5: Estimated GARCH coefficients (except exogenous variables)

Model part	Variable	Apple	Banana	Grapes	Melon	Cucum-ber	Lettuce	Pepper	Potato	Tomato	TA100	XR
Mean equation (5)	ϕ^0	0.008 (1.000)	0.040 (0.998)	-0.141 (0.698)	-0.590 (0.924)	-0.411 (0.588)	0.050 (0.820)	-0.045 (0.789)	-0.010 (0.997)	-0.126 (0.990)	0.071 (0.017)	0.001 (0.935)
	ϕ_1	-0.250 (0.352)	-0.185 (0.652)	-0.187 (0.151)	-0.167 (0.095)	0.021 (<0.001)	-0.209 (<0.001)	-0.130 (0.772)	-0.220 (<0.001)	-0.045 (0.592)	0.019 (0.278)	0.019 (0.073)
Volatility equation (4)	ω	0.139 (1.000)	1.132 (0.996)	2.357 (0.127)	1.936 (<0.001)	11.553 (<0.001)	3.508 (<0.001)	0.836 (<0.001)	0.201 (0.666)	3.169 (1.000)	0.019 (<0.001)	0.002 (<0.001)
	α_1	0.290 (0.706)	0.136 (<0.001)	3.534 (<0.001)	0.180 (0.968)	0.074 (<0.001)	0.267 (<0.001)	0.100 (0.118)	0.106 (<0.001)	0.126 (<0.001)	0.090 (<0.001)	0.037 (<0.001)
	β_1	0.801 (0.706)	0.733 (<0.001)	0.599 (<0.001)	0.792 (<0.001)	0.814 (<0.001)	0.623 (<0.001)	0.801 (<0.001)	0.823 (<0.001)	0.722 (<0.001)	0.863 (<0.001)	0.955 (<0.001)
	$\alpha_1 + \beta_1$	1.090	0.869	4.133	0.972	0.888	0.890	0.901	0.929	0.848	0.953	0.992

Note: P-values in parentheses.