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**Price Transmission Subject to Security-based Trade Barriers in the Context of the
Israeli-Palestinian Conflict**

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Abstract: Israel's imposition of military security measures in the Palestinian territories as a consequence of the long-lasting violent conflict yields depressing economic effects to all parties involved. One crucial implication is the limited ability to carry out trade which brings about welfare losses. This paper assesses the consequences of the Israeli-Palestinian conflict on price dynamics of agricultural trade between Israel and the West Bank by analyzing daily wholesale prices subject to movement restrictions. An exogenous regime switching cointegration model is estimated using a novel extension of the Johansen estimation method. We find Hebron and Tel Aviv wholesale markets to be integrated for the main trading products. Deviations from price equilibrium are quickly adjusted for. The model suggests that the movement restrictions temporarily cut off both markets from each other. Welfare implications of the closures depend on the direction of trade, harming both Palestinian and Israeli consumers.

Keywords: Agricultural trade, cointegration, exogenous regime-switching, Israel, Middle East, Palestinian territories, price transmission, violent conflict

JEL: C32, D74, Q11, Q13, F15

1. Introduction

A separation wall being built by the state of Israel divides Israeli residents and the Palestinians living in the West Bank. This physical barrier separates two economies which are at very different stages of development. Nominal GDP per capita in 2010 in Israel was estimated at \$28,000, while for the Palestinian territories (including Gaza) it was estimated at a stagnant level of around \$4,000 between 1999 and 2008 (World Bank 2008a).

The agricultural sector is one of the main economic activities in the Palestinian territories. In 2010, agriculture accounted for 9.4% and 5.3% of the GDP in Gaza and the West Bank, respectively. The total number of workers in this sector reached 81,000 in 2010, which accounted for 8% and 13% of the total labor force of these regions. In Israel, only 2% of the GDP was attributed to agriculture and 1.5% of the total labor force was employed in the agricultural sector (ICBS 2011, PCBS 2011).

The agro-climatic conditions in the Palestinian territories and Israel are relatively similar, but the characteristics of the two agricultural sectors are very different. First, there are differences in the supply of production factors. Palestinian agricultural labor is available and relatively inexpensive, while Israeli agriculture is capital intensive and suffers from a shortage of unskilled labor. Secondly, Israeli agriculture benefits from high-end research and development carried out by government institutes and universities. Third, Israel enjoys a good reputation in export markets for high quality and phyto-sanitary standards. Conversely, export of agriculture products from the Palestinian territories to overseas markets are limited and conducted mainly through Israeli export companies. In fact, Israel and Jordan are the main importing countries of Palestinian agricultural products. Under these circumstances, substantial welfare gains from specialization and trade for Israel and the Palestinians can be expected (Berends, 2008).

Nevertheless, the realization of the economic potential of trade is subject to various military security measures put in place by Israel. The relatively more extreme measures have been taken ever since the first intifada (i.e. the uprising of the Palestinian people) which erupted in 1987 in the Israeli-occupied territories (see, e.g., Tessler, 2009, for more information on this political conflict). A number of such measures are imposed on the movement of people and goods within the Palestinian territories and between them and Israel in order to deal with security challenges. The goal of this paper is to explore the linkage between agricultural markets in Israel and the West Bank during the implementation of one type of such measures. In particular, we study the implications of complete closures of the commercial terminals which connect the two markets with each other. The focus of this paper is the price dynamics of agricultural commodities of

bilateral trade and the economic implications, that is, the wellbeing of market participants both in Israel and the West Bank during the post second intifada era.¹

2. Agricultural markets and bilateral trade

There are four main wholesale markets for fruits and vegetables in Israel located in Haifa, Tel Aviv, Rehovot and Jerusalem. They jointly account for about 50% of the fruit and vegetables marketed domestically. The residual amount is supplied by smaller wholesale markets consisting of only a few traders. Other marketing channels include logistic centers established by the two largest Israeli supermarket chains Shupersal and Mega. These centers purchase agricultural products directly from growers. Finally, a small amount is delivered directly from growers to retailers.

Within the West Bank, the largest wholesale market is located in Hebron. The capitals of the other West Bank governorates (Jenin, Tulkarem, Qalqelia, Nablus, Ramallah, East Jerusalem, Jericho and Bethlehem) each host a major Palestinian fruit and vegetable wholesale market.

The Israeli Defense Forces (IDF) use various measures for controlling the movement of people and goods for security purposes within the Palestinian territories and between them and Israel. Those include checkpoints, roadblocks, gates and other fixed or temporary obstacles which have differing impacts on the day to day economic activities in general and trade in particular (see, e.g., World Bank, 2007a; World Bank, 2008b; World Bank 2010a). These various types of barriers differ in their duration, implementation frequency, costs of erection and maintenance, their scope, the amount of uncertainty created to the local population and their effectiveness in controlling movement.

Besides their role in improving security, these security measures yield a number of economic side-effects and can thus be seen as analogue to the outcome of certain economic policies. Concerning trade, they can cause a number of conflict specific transaction costs. These conflict specific costs can considerably augment the set of transaction costs encountered in normal circumstances.² They can cause additional expenditures which raise the usually incurring transaction costs. For example, freight, insurance, financing, contracting, quality standards or unit duties may be subject to increases. Furthermore, they may indirectly influence transaction costs by changing costs for formal and informal barriers to trade, opportunity or search costs. In the context of the Israeli-Palestinian conflict, there are three main economic side-effects of directly increasing transport costs, hence indirectly leading to higher fixed costs per unit of distance and increasing the uncertainty for the movement of people and goods (World

¹ The second intifada (aka *Al-Aqsa Intifada*) is a period of intensified Israeli-Palestinian violence which erupted shortly after the failure of the peace summit in Camp David in the summer of 2000 and lasted until late 2004; for more information, see, e.g., Ben-Ari et al. (2010).

² For a detailed discussion on the components of transaction costs in normal, that is, non-conflict circumstances see, e.g., Barrett (2001).

Bank, 2008b). Consequently, trade costs are markedly raised. The World Bank (2010a, pp. 51) estimates the costs for exporting and importing a container from/to the Palestinian territories to be higher than for most neighboring economies (and almost three times higher than for Asian “good practice economies” such as Malaysia). The implementation of security measures is not stable over time because the intensity of measures tends to follow the evolving security situation or may be implemented for the prevention of potential security threats. Thus, the conflict specific transaction costs are likely to vary considerably over time and not be symmetric, as mentioned above. In general, then, conflicts increase costs and discourage and reduce trade.

Agricultural trade between Israel and the West Bank takes place across the commercial terminals in the separation barrier (see Figure 6 in the Appendix). It is administered and controlled by the Israeli Civil Administration (ICA). Regulations and the conditions of trade tend to be asymmetric. Agricultural products originating from the West Bank are to be unloaded from the Palestinian truck, checked and loaded to an Israeli truck waiting at the other side of the barrier (aka *back-to-back system*, see World Bank, 2008b). Food originating from Israel is often shipped to its destination in the West Bank using trucks with Israeli plates so that transaction costs caused by the various security policies, such as the waiting times at terminals, are considerably reduced. Furthermore, quantities imported to Israel are recorded by an ICA representative working with the Israeli Ministry of Agriculture for data collection and samples are used by Israeli officials for monitoring health regulations.

Due to the complex and comprehensive structure of the security measures, the impact of each of these on the ability to perform (agricultural) trade is very difficult to determine. Therefore, this analysis only considers comprehensive closures of the barrier terminals. B’Tselem (2011) defines this type of measure as follows: ‘During a comprehensive closure, 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.’ This means that the West Bank barrier is completely closed during these periods and no movements of people or goods between the West Bank and Israel can occur, in other words, bilateral trade is put on hold.

3. Data and descriptive statistics

In this study we focus on fruit and vegetable crops.³ More specifically, we focus on the linkages of the price behavior of two heavily traded products: cucumbers and apples. Israel is a net importer of cucumbers from the West Bank. In 2010 the imported amount of cucumbers for household consumption and processing was 18,778 and 12,859 tons, respectively. This amount jointly accounted for 50% of all agricultural products transferred from the West Bank to Israel in that year (Figure 1). The main horticulture

³ Israeli law bans the transfer of animals and animal products from the Palestinian territories to Israel due to sanitary restrictions.

products shipped from Israel to the West Bank are fruits because their production is capital insensitive compared to most vegetables. The total amount of fruits imported during 2010 was 15,885 tons, of which banana was the most important product with 9,083 tons traded. Second to that was apple with 3,794 tons. Since the banana prices obtained suffered from problems of data reliability, apple prices are chosen for the analysis.

The period under investigation is post *Al-Aqsa Intifada* (a period of intensified Israeli-Palestinian violence) which is characterized by a decrease in security measures and movement restrictions. During this period bilateral trade took place almost continuously so that it represents a relatively steady period of bilateral agricultural trade. The developments of the trade volumes of cucumbers and apples are depicted in Figure 2.

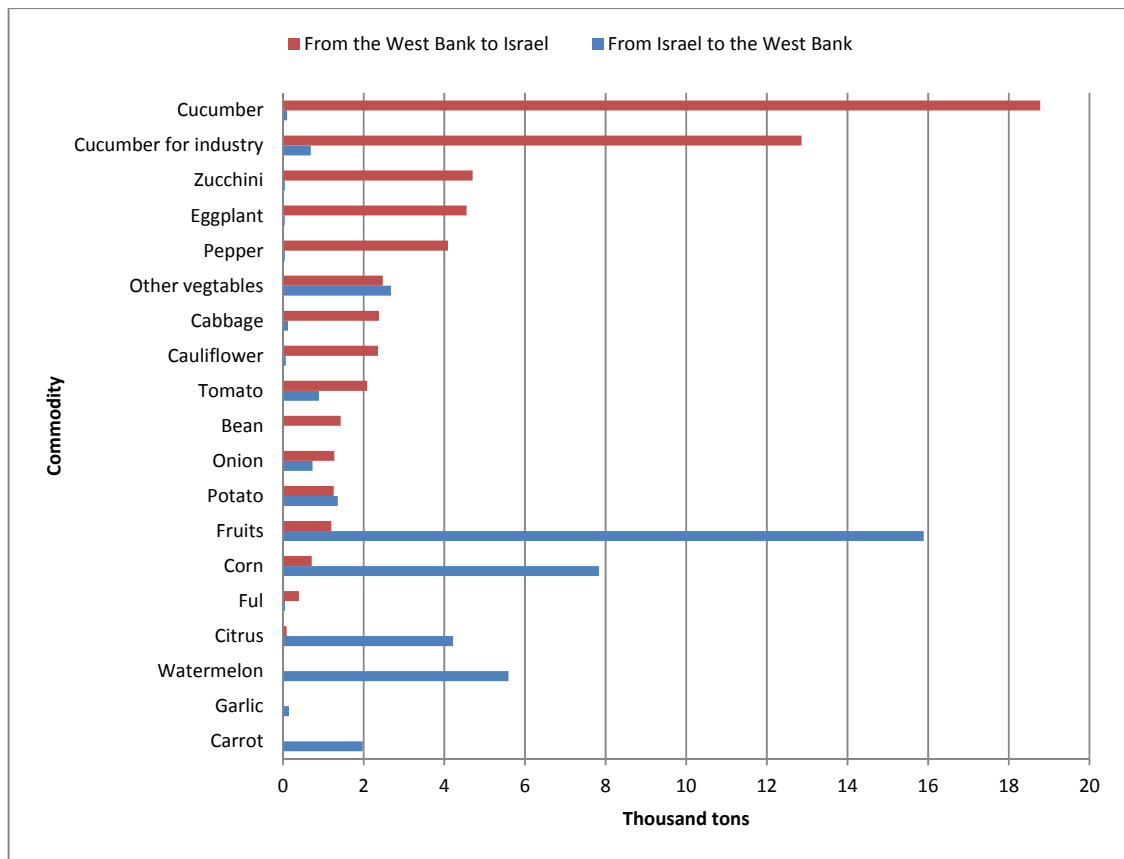


Figure 1: Fruit and vegetable trade between Israel and the West Bank 2010 (Source: ICA, 2010)

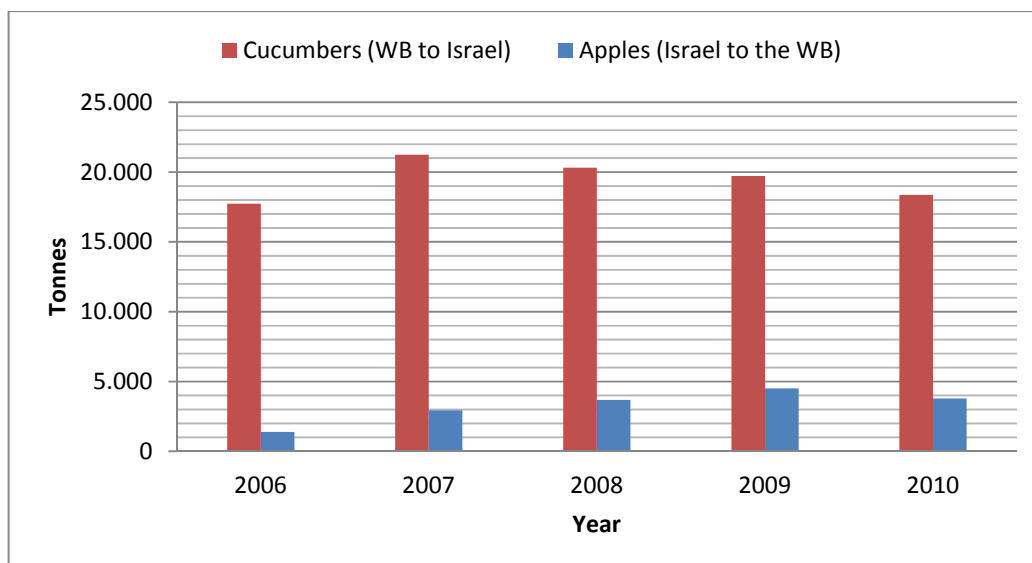


Figure 2: Trade between Israel and the West Bank (Source: IMARD, 2011a)

We obtained daily price data for cucumbers and apples collected in the two largest wholesale markets. We use prices of the Tel Aviv wholesale market which are reported by the Israeli Ministry of Agriculture on a daily basis. The recorded price is the mode of each daily sample of a number of wholesale traders. Data of the Hebron wholesale market is collected by its administration and includes a comprehensive list of products.

The data for analysis of price dynamics in the context of the conflict is subject to market operation patterns on both sides of the separation barrier. Unfortunately, the days of market operation in Israel and the West Bank do not fully match. Trade at Israeli wholesale markets takes place mainly during weekdays, which are Sunday to Thursday. Limited trade occurs on Friday mornings as well, but on Saturdays the markets are entirely closed. In the West Bank markets operate regularly from Saturdays to Thursday and trade does not take place on Fridays. Friday prices are not at all sampled by the Israeli Ministry of Agriculture and the Hebron data contains a large number of Fridays without reported data as well.⁴ On other days, price observations are missing partly due to national holidays in Israel or the West Bank (which usually differ from each other with respect to their timing), as markets are closed on those days, or are either missing at random due to other reasons. These missing values are imputed utilizing routines of the R package (R Development Core Team, 2010) Amelia II (Honaker et al., 2007) as proposed by in King et al. (2001). We adapt these and perform 1000 imputations of which the mode is estimated (Parzen, 1962; Poncet, 2010) as the final imputed value.

Daily data on complete closures is made available by B'Tselem, an Israeli organization for human rights. The maximum period of available data in all three datasets ranges from

⁴ Since the markets only operate partially and only minor quantities are traded during the weekend, we follow the standard approach adapted in the financial economic literature and omit Fridays and Saturdays from the analysis in order to avoid modeling problems due to regularly missing values.

May 2007 until December 2008 (Figure 3). During this period, 45 days of complete closure in the West Bank were observed, some of which happened during Israeli holidays, namely Jewish high holidays and the Israeli Independence Day, accounting for 11 of the closure days.

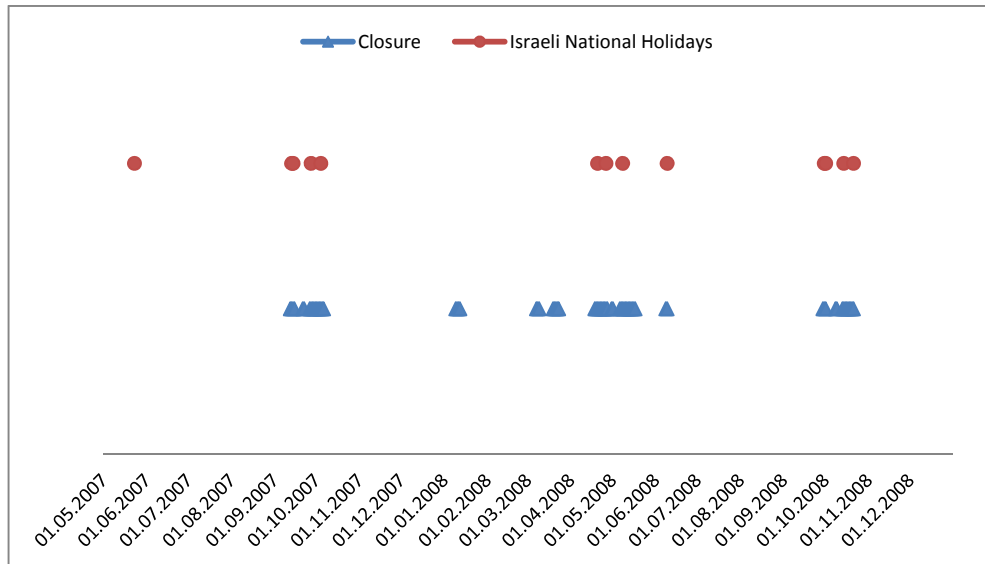


Figure 3: Closures and Israeli high holidays (Source: B'Tselem, 2011, and authors.)

While only one variety of cucumber is traded in the region, the apple data includes a number of varieties traded and sampled in the course of a year. Since many varieties are traded and not all of them are recorded every day, we calculate the average daily prices of apples in each market. This appears reasonable for several reasons. First, we suppose that consumers' marginal rates of substitution between different varieties of apple are large. Second, the narrow geographical scope of the region makes it sensible to assume that the same varieties are traded in Tel Aviv, Hebron and other markets in the region at the same time. Therefore, relating the daily average prices of apples in these markets to each other is appropriate. Lastly, when examining the dataset we observed that, although price differences between some varieties of apples seem consistent, the magnitude of the difference is negligible.

Distributional properties of the prices are presented in Tables 1 and 2 (NIS/kg when applicable) which also show that the data with the imputed missing values closely resemble the original data with gaps. The average prices of cucumbers are 2.28 and 2.97 NIS/kg in Hebron and Tel Aviv, respectively. On average, the Tel Aviv price is higher by 0.64 NIS/kg. The coefficients of variation in both markets are almost identical although prices in Tel Aviv reach 9 NIS/kg while the maximum cucumber price at the Hebron wholesale market is 7.81 NIS/kg. Figure 4 suggests that the volatility of Tel Aviv is more pronounced. While the Tel Aviv prices experienced two phases of markedly increased

prices (October/ November 2007 and the first quarter of 2008), Hebron prices only rose strongly in the first quarter of 2008.

Table 1: Descriptive statistics of cucumber prices

Market	Hebron		Tel Aviv	
	Observed	inc. imputed values	Observed	inc. imputed values
Number of obs.	427	437	406	437
Mean	2.28	2.31	2.97	2.99
Median	1.95	1.96	2.50	2.50
Stand. dev.	1.28	1.29	1.68	1.65
Min	0.68	0.68	0.70	0.70
Max	7.81	7.81	9.00	9.00
Coeff. of var.	0.56	0.56	0.57	0.55

Source: Authors' calculations.

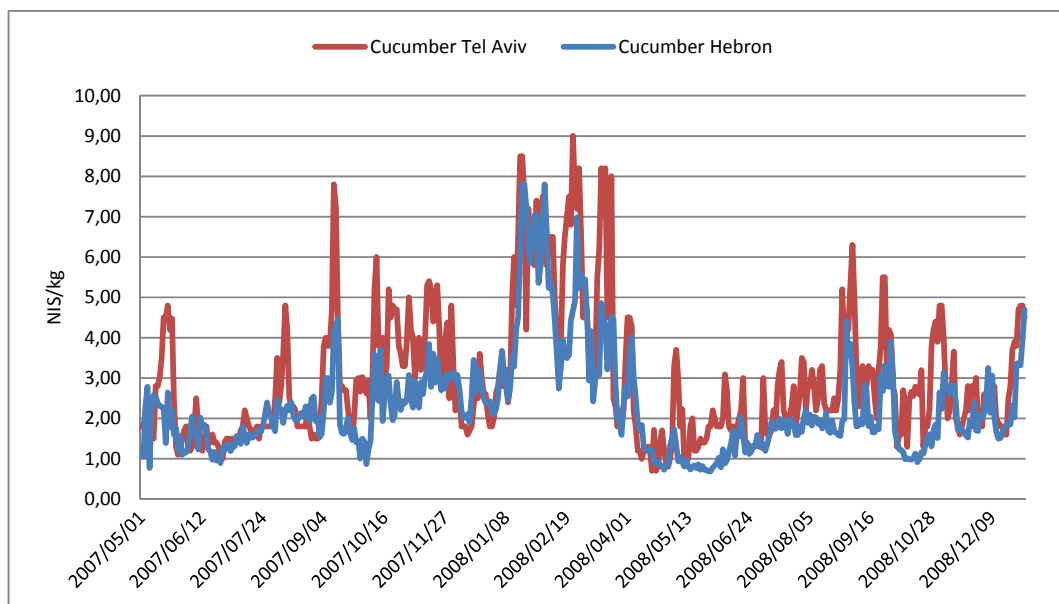


Figure 4: Cucumber prices (Source: IMARD, 2011b, and HWM, 2011)

The difference in apple prices between both markets is much more substantial with a mean difference of 3.36 NIS/kg. This corresponds to a 114% average gap in the prices between the West Bank and Israel (Figures 4 and 5). Hebron prices are much more volatile than Tel Aviv prices as illustrated by the coefficients of variation of 0.24 NIS/kg in Hebron and 0.09 NIS/kg in Tel Aviv. The daily price difference between both markets has a coefficient of variation of 0.22 NIS/kg. Unlike cucumbers, the apple price series do not show phases of extraordinary increases in late 2007 and the first half of 2008. The Hebron prices show a moderate increase in April/ May 2008 followed by a moderate decrease in June/ July.

Table 2: Descriptive statistics of apple prices

Market	Hebron		Tel Aviv	
	Observed	inc. imputed values	Observed	inc. imputed values
Number of obs.	374	437	402	437
Mean	2.95	2.97	6.33	6.34
Median	2.87	2.91	6.29	6.32
Stand. dev.	0.74	0.72	0.57	0.56
Min	1.00	1.00	4.61	4.61
Max	5.12	5.12	7.76	7.76
Coeff. of var.	0.25	0.24	0.09	0.09

Source: Authors' calculations.

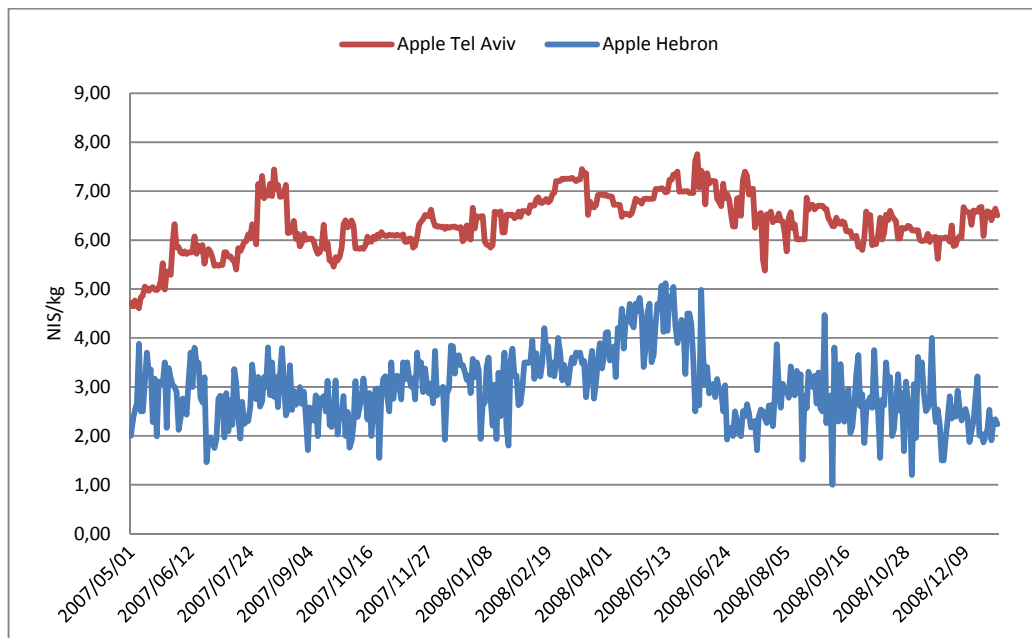


Figure 5: Apple prices (Source: IMARD, 2011b, and HWM, 2011)

4. The Econometric Model

We understand market integration as a dichotomous long run measure. In general, markets are considered to be integrated if they ‘share both the same traded commodity and the same long run information’ (Gonzalez-Rivera and Helfand, 2001, p. 576), that is, if $v-1$ long-run price equilibria among v locations and trade flows between the considered locations exist. We regard market integration as a necessary condition for price transmission. Price transmission, in contrast, is a gradual measure having both a long run and a short run dimension providing evidence about the long run price equilibrium, i.e.,

the average price relationship⁵, and the intensity of short-run price movements triggered by the equilibrium-restoring force to correct (neutralize) price shocks which brought the system out of equilibrium.

We assess price interdependencies using the cointegration framework. In particular, we use a vector error correction model (VECM) for examining the spatio-temporal dynamics of and between them. The VECM is formulated as:

$$\Delta p_t = \alpha \beta' p_{t-1} + \sum_{i=1}^k \Gamma_i \Delta p_{t-i} + \varepsilon_t = \alpha e q e_{t-1} + \sum_{i=1}^k \Gamma_i \Delta p_{t-i} + \varepsilon_t = \Pi p_{t-1} + \sum_{i=1}^k \Gamma_i \Delta p_{t-i} + \varepsilon_t. \quad (1)$$

The vector $p_t = \{p_t^1, \dots, p_t^v\}'$ is a vector of the price series of v locations while Δ denotes the first difference operator, i.e., $\Delta p_t = p_t - p_{t-1}$. The parameters α and β quantify the partial impact of the past price levels on the current price changes. The $(v \times r)$ cointegration matrix β provides an estimate of the long run price equilibria (the measure for long run price transmission) so that $\beta' p_{t-1} = e q e_{t-1}$ contains the deviations from the r equilibrium relationships (*equilibrium errors*)⁶. Hence, the $(v \times r)$ *loading matrix* α can be interpreted as measuring the partial impact of the past equilibrium errors on the current price movement Δp_t (the measure for short run price transmission). The $(v \times v)$ matrices Γ_i contain the partial impact of past on current price movements (*short-run parameters*). Finally, ε_t denotes Gaussian white noise errors and k denotes the lag length, that is, the number of the regarded periods of past price changes.

The trade between the West Bank and Israel is characterized by phases which are or are not subject to closures of the commercial terminals. Such periods of fundamentally differing economic conditions point to the potential existence of more than one dynamic price relationship. They put doubt on the assumption of unique constant model parameters and suggest a regime-dependent modeling approach. Ihle (2010) provides an extensive treatment of alternative modelling approaches which relax the assumption of parameter constancy and model the evolution of model parameters over time by stochastic processes. Among other approaches, Ihle and Amikuzuno (2010) suggest a novel estimation method for multivariate exogenous regime-switching VECMs. This class of models is characterized by regime-dependent parameters which are allowed to switch between constant parameter values in each regime. The regimes and thus the timings of the switchings are exogenously determined based on the context of the market considered. This model is very flexible. It represents an extension of the bivariate asymmetric VECM as suggested by von Cramon-Taubadel (1998) into three dimensions by allowing to simultaneously consider more than two price series, more than one

⁵ If the long run price transmission parameters can be restricted to unity, the long run price transmission is said to be perfect or complete.

⁶ These can alternatively be interpreted as the common factors which drive the system prices considered.

cointegration relationship and more than two regime-classifying categories, of which each may consist of more than two regimes.

The given context strongly suggests two fundamentally differing market regimes: the regime of complete closures in the West Bank (abbreviated as c for “*complete closures*”) disrupting the trade inside the West Bank and with Israel and, secondly, the periods without this security measure imposed (noc - “*no closure*”). Hence, we use this exogenous regime-switching framework for modelling the disequilibrium response of cucumber and apple prices subject to the two trading regimes. We estimate the following model with the extension of Johansen’s estimation method (Johansen, 1988, 1991) as suggested by Ihle and Amikuzuno (2010). This approach has the advantage that it uses a modified version of Johansen’s reduced rank regression which was shown by Gonzalo (1994) to possess superior statistical properties in comparison to most competing estimation approaches. The model for each of the bivariate vectors of cucumber and apple prices can be formulated as:

$$\Delta p_t = \begin{pmatrix} \alpha^{noc} & \alpha^c \end{pmatrix} \begin{pmatrix} eqe_{t-1}^{noc} \\ eqe_{t-1}^c \end{pmatrix} + \sum_{i=1}^k \Gamma_i \Delta p_{t-i} + \varepsilon_t = \alpha^{noc} eqe_{t-1}^{noc} + \alpha^c eqe_{t-1}^c + \sum_{i=1}^k \Gamma_i \Delta p_{t-i} + \varepsilon_t. \quad (2)$$

The regime-dependent equilibrium errors eqe_t^{noc} and eqe_t^c are obtained from the data on the closure incidences as $eqe_t^c = \beta' p_t I_t^c$ and $eqe_t^{noc} = \beta' p_t (1 - I_t^c)$ where I_t^c is an indicator variable which takes unity if there is a closure implemented in period t and zero otherwise.

5. Estimation Results

5.1 Time Series Properties

We first assess the time series properties of the prices by testing for unit roots and cointegration. Tables 3 and 4 contain the results of the unit root tests for the levels and the first differences of the series, respectively. We employ a number of tests in order to obtain comprehensive evidence on the existence of unit roots in the data. The first two tests have the null hypothesis of a unit root while the third one assesses the hypothesis of stationarity. The Augmented Dickey-Fuller (ADF, Dickey and Fuller, 1979) test clearly indicates for all series, apart from apples in Tel Aviv, that they possess a unit root at the 5 percent level of significance. The MZ_{α}^{GLS} statistic developed by Ng and Perron (2001) suggests unit roots for all series except for cucumbers in Tel Aviv, although the test statistic exceeds the critical values just slightly. However, the test yields non-consistent results for the apples series in first differences⁷.

⁷ We report this test statistic here only. Also the results of the other statistics suggested in Ng and Perron (2001) are not entirely conclusive and contradict each other for some cases.

Table 3: Results of the unit root tests of the price levels

Product	Location	ADF		MZ_{α}^{GLS}		KPSS	
		lags ^a	statistic ^b	k^c	statistic ^d	lags	statistic ^e
Apple	Hebron	7	-2.331	7	-3.414	11	0.471*
	Tel Aviv	2	-3.874*	12	-0.761	11	1.155*
Cucumber	Hebron	8	-2.550	10	-6.391	11	0.345
	Tel Aviv	9	-2.857	9	-9.296*	11	0.270

Source: Authors' calculations.

Notes:

* Significant at the 5 percent level.

^a Lag length selection according to the Akaike Information Criterion (AIC) and the Hannan-Quinn Model Selection Criterion.

^b The critical value at the 5 percent significance level is -2.86.

^c Selection according to the Modified Akaike Information Criterion (MAIC).

^d The critical value at the 5 percent significance level is -8.100.

^e The critical value at the 5 percent significance level is 0.463.

The KPSS test (Kwiatkowski et al., 1992) does not yield consistent results. Although the test statistics for the first differenced series strongly indicate stationarity, the statistics for the level data is not significant for the cucumber series (i.e. not indicating nonstationarity). However, for the Tel Aviv apples series, it strongly points to nonstationarity while the ADF test suggests the opposite. Hence, the unit root tests yield ambiguous results for the four prices. Hence, we adopt the recommendation of Juselius (2008, p. 19) who states: ‘There are many arguments in favor of considering a unit root (a stochastic trend) as a convenient econometric approximation rather than a deep structural parameter’ and regard all series as unit root series⁸ due to the partly contradicting evidence.

⁸ This strategy is also plausible based on the consideration that there are many different unit root tests because none of them is free from (statistical) problems when applied to agricultural time series which are usually subject to a set of complex (–ly interacting) determinants. This fact becomes obvious by the differing test results in Tables 3 and 4.

Table 4: Results of the unit root tests of the first differenced prices

Product	Location	ADF		MZ_{α}^{GLS}		KPSS	
		lags ^a	statistic ^b	k^c	statistic ^d	lags	statistic ^e
Apple	Hebron	6	-12.601*	16	-0.182	11	0.057
	Tel Aviv	1	-19.121*	16	-1.283	11	0.118
Cucumber	Hebron	7	-9.889*	1	-209.746*	11	0.054
	Tel Aviv	8	-10.852*	0	-211.074*	11	0.029

Source: Authors' calculations.

Notes:

* Significant at the 5 percent level.

^a Lag length selection according to the Hannan-Quinn Model Selection Criterion.

^b The critical value at the 5 percent significance level is -1.94.

^c Selection according to the Modified Akaike Information Criterion (MAIC).

^d The critical value at the 5 percent significance level is -8.100.

^e The critical value at the 5 percent significance level is 0.463.

Subsequently, we carry out two cointegration tests in order to test whether each of the market pairs shares a cointegration relationship interpreted as the existence of a long run price equilibrium, that is, market integration (Table 5). The Saikkonen-Lütkepohl test (Saikkonen and Lütkepohl, 2000a, 2000b) has the advantage that it is, opposite to the Johansen trace test (Johansen, 1991), robust against several parameter instability issues. The results of the two tests on cointegration are more consistent than the unit root tests above. Both tests clearly reject a cointegration rank of zero for three of the four cases at the 5 percent level. Only for apples is the Johansen trace test statistic just slightly below the critical value. But since the Saikkonen-Lütkepohl test is unambiguous in its decision, we conclude for both price pairs that they are cointegrated, that is, that the prices of apples and cucumbers in Hebron and Tel Aviv share a stable long run equilibrium, respectively. Furthermore, since they also are connected by trade flows, we conclude that the two cucumber and apple markets are integrated.

Table 5: Results of the cointegration tests

Product	Market pair	Johansen trace ^a		Saikkonen-Lütkepohl ^b	
		lags ^c	statistics	lags ^c	statistics
Apple	Hebron – Tel Aviv	8	20.03/ 5.32	4	21.67/ 0.47
Cucumber	Hebron – Tel Aviv	9	32.29/ 5.71	9	19.60/ 2.31

Source: Authors' calculations.

Notes:

^a The critical values at the 5 percent significance level for a cointegration rank of zero and one are 20.16 and 9.14, respectively.

^b The critical values at the 5 percent significance level for a cointegration rank of zero and one are 12.26 and 4.13, respectively.

^c Lag length selection according to the AIC.

5.2 Model Building

We first estimate a linear VECM for each commodity in order to impose some over-identifying restrictions in order to test whether the model adequately describes the data. We estimate the model for untransformed price series which implies additive transaction costs, as costs for performing trade are postulated to be independent from the price levels which is a reasonable assumption in the given context. Model selection criteria yield differing recommendations regarding the optimal lag length k of model (1) (Table 6). Although all lag length choices yield models with more or less problems in the diagnostic residuals tests, we opt for the largest suggested values of k since it removes autocorrelation from the residuals. Hence, we employ a model of seven lags for apples and a model of ten lags for cucumbers.

Table 6: Optimal lag length choices of model selection criteria

Product	AIC	Hannan-Quinn Criterion	Schwarz Criterion
Apple	7	3	1
Cucumber	10	1	0

Source: Authors' calculations.

Tables 7 and 8 display the results of these linear models. Table 7 illustrates that the long run price equilibrium may be restricted to the simple price difference. Hence, the parameter β^0 quantifies the average price differential between the prices of either commodity in the Hebron and Tel Aviv wholesale markets. Hence, the estimated average margin between the apple and cucumber prices at the Hebron and Tel Aviv wholesale markets amounts to 30 percent and 117 percent of the Hebron price, respectively.

Table 7: Estimates of the cointegration relationships

	Product	β^0	β^H	β^{TA}	p-value of Wald test
Unrestricted	Apple	7.579	1	-1.639	-
	Cucumber	-12.052	1	-0.905	-
Restricted	Apple	3.475	1	-1	0.089
	Cucumber	0.677	1	-1	0.206

Source: Authors' calculations.

Notes: β^0 , β^H and β^{TA} are the constant and the coefficients of the Hebron and the Tel Aviv prices, respectively.

Table 8 indicates that both prices significantly respond to deviations from this average margin. The adjustment reactions are significant at the 5 percent level. For apples, a commodity which is mainly shipped from Israel to the West Bank, it is the Hebron price which responds more sensitively to price disequilibria. For cucumbers, which is the main

product shipped from the West Bank to Israel, Tel Aviv prices are found to react more pronounced to price shocks. Moreover, the error correction rates are extraordinarily strong in magnitude ranging to almost one quarter of the equilibrium error. Such high rates seem very plausible given the context of probably the two largest wholesale markets in the region which are also located near to each other⁹.

Table 8: Estimates of the adjustment speeds

	Product	α^H	α^{TA}
Unrestricted	Apple	-0.031 (-0.927)	0.054 (3.751)
	Cucumber	-0.084 (-1.834)	0.280 (3.744)
Restricted	Apple	-0.117 (-2.277)	0.045 (2.033)
	Cucumber	-0.126 (-2.602)	0.230 (2.885)

Source: Authors' calculations.

Notes: t-values in parentheses.

5.3 Estimates of the Regime-Switching Model

Subsequently, we devote our interest to the question of to what extent the movement restrictions imposed due to security reasons exerted a significant impact on these fast short run adjustments of prices. For assessing this aim, we estimate the regime-dependent model (2). Since we did not obtain evidence against imposing the over-identifying restrictions mentioned in Table 7, we also estimate the regime-dependent model with these restrictions. Table 9 shows the regime-dependent estimates of the adjustment speeds α .

Both commodities regarded show the same pattern. In the regime of imposed complete closures, we find no significant error correction. This result implies that prices are temporarily not cointegrated in this regime. Hence, the closures are found to have had the maximum impact on price dynamics because they completely cut off the Hebron and the Tel Aviv wholesale markets from each other. By restricting the information set on the periods without closures, it is only the Tel Aviv prices which show significance responses to disequilibria. Hebron prices, although numerically to the same magnitude, are not significant at the 5 percent level.

Table 9: Estimates of the regime-dependent loading parameters of the restricted model

Regime	Product	α^H	α^{TA}
No closure	Apple	0.068 (1.165)	0.062 (2.620)
	Cucumber	0.335 (1.332)	0.266 (3.405)
Closure	Apple	0.007 (0.053)	-0.096 (-1.720)
	Cucumber	0.040 (0.267)	-0.061 (-1.289)

Source: Authors' calculations. Note: t-values in parentheses.

⁹ Disregarding any extensions due to movement restrictions, the direct driving distance is approximately 110 km.

6. Discussion

In politically unstable environments subject to violent conflict, the economic circumstances of food production and trade are often shaped by determinants other than agricultural or economic policies and are, hence, mostly of non-economic nature. These encompass actions of interest groups which aim to influence the public decision making process in non-peaceful ways, e.g., by terrorist attacks, kidnapping or harsh security measures implemented in order to control the conflict. Consequently, not only the welfare of market participants but also existential issues of food security and livelihoods are indirectly affected.

This analysis focuses on the economic implications of security policies in armed conflicts. In particular, it deals with the impacts of the measures put forward by Israel on the ability of both sides involved in the Israeli-Palestinian conflict to benefit from bilateral trade. It thus also provides indications on the intermediate consequences and the welfare implications of conflict for market participants (producers, traders and consumers). To our knowledge, this study is the first analysis which uses a quantitative approach to do so. It contributes to the literature by focusing on the economic side effects of security-based policy decisions on agriculture and trade.

The agricultural sector and agricultural goods are important for both the Israeli and the Palestinian economies. In Israel, agricultural key input factors are subsidized by the government (water, land, labor) and trade is regulated by high tariffs in order to provide incentives for domestic agricultural production (Finkelshtain, Kachel and Rubin, 2011). In the Palestinian territories, agricultural production and trade is of fundamental economic importance both for the livelihoods and the food security of a large part of the population and it is one area of intensive economic exchange.

We study price interdependencies of cucumber and apple prices between the wholesale markets of Hebron and Tel Aviv because both commodities belong to the most important traded goods between the West Bank and Israel. We also regard a time series of comprehensive closures enforced by the Israeli Defense Forces on the West Bank. We examine daily average prices of both commodities between May 2007 and December 2008 using a multivariate exogenous switching vector error correction model. For the model estimation we use a recently suggested adaptation of Johansen's cointegration estimation approach. The regimes are defined by the incidences of the comprehensive closures. These movement restrictions represent an immediate consequence of the political conflict and are exogenous to the existing economic exchange of both economies.

While prices of cucumbers in Israel are slightly higher than in the West Bank, differences in apple prices are momentous. One reason for the significant gap may be attributed to quality differences between markets. Another reason might be linked to a non-competitive behavior. Israeli marketers may perform price discrimination by exporting apples to the West Bank, thereby cutting off local supply and in turn driving up prices in

Israel. Interestingly, we show that the question of whether markets are competitive or not does not prevent finding strong price dynamics linking these markets.

We employ three unit root tests which approach the issue of unit root testing from various perspectives. We find mixed evidence of the order of integration of the time series. However, since the series are characterized by short periods of extreme price spikes, we suspect that the unit root test might have difficulties with this property of the price series in question. We find the price series to be cointegrated. Hence, the regarded wholesale markets are found to be integrated for both commodities because they share the same long run price information (cointegration) and also the same commodity (existing trade flows).

The welfare impacts of the closures depend on the direction of trade. For cucumbers, Palestinian traders and producers will be faced with an increased local supply which is likely to drive down prices and thus create pressure for these groups¹⁰. The magnitude of the price response will depend on the responsiveness of the prices to the increased supply, the duration of the comprehensive closure, the storage facilities of the traders (for which costs incur) and their ability to withdraw supply from the market on short notice by other measures. If the retail sector served by the Hebron wholesale market is competitive¹¹, these price decreases transmit to (the urban and net-food buying) consumers of Hebron who would hence benefit from the closures. Israeli traders, on the other hand, will face delivery failure. The price effects on the Tel Aviv wholesale market will depend on their storage capacities and their ability to anticipate the closures and to obtain produce from alternative sources such as Jordan or Egypt. Figure 4 suggests that cucumber prices are somewhat more responsive in the Tel Aviv market than in the Hebron market due to their increased volatility. However, Israeli consumers will be worse off due to the price increases.

Effects on apple prices go the opposite way since they are mainly transported to the Palestinian territories from Israel. However, price effects on the Tel Aviv market, and the potential effect on market participants of the domestic Israeli markets in general caused due to the temporarily increased supply because of the comprehensive closures, are expected to be lower than for apple prices in Hebron and for the case of cucumber prices. A major reason could be that (refrigerated) storing facilities are likely to be easily available to Israeli traders. In contrast to the case above, Palestinian traders are not able to obtain the commodity from alternative sources since a comprehensive closure means that all foreign borders of the West Bank are closed. Figure 5 supports this presumption since the markedly increased responsiveness of Hebron apple prices is reflected by their considerable higher volatility. Hence, Palestinian consumers seem to be the most affected

¹⁰ This would be the case if no intra-West-Bank movement restrictions occurred simultaneously which would inhibit West Bank trade from the growing areas in the North and the Jordan valley.

¹¹ This is very likely to be the case since Palestinian fruit and vegetable marketing is characterized by a high number of small shops.

group of market participants in this case due to markedly increased volatility of prices and strong short-term price increases.

In general, the effects of the closures depend on the direction of trade. Consumers in both the West Bank and in Israel will be the most affected groups of market participants. Hence, these security measures not only harm Palestinian consumers but also fall back upon a part of the Israeli population. Production effects are negligible since this type of security measures is only imposed for a short period of up to a couple of days. However, price volatility, which means price uncertainty for the consumers, is likely to increase. Moreover, the volatility seems to increase more strongly in the market in which the commodity is delivered to across the separation barrier which is confirmed by the estimation results: In the absence of closures it is the destination markets which react more sensitively to price disequilibria.

The results of the regime-switching model suggest that the prices in the two wholesale markets during the occurrence of comprehensive closures are temporarily not linked, i.e., they temporarily cut off the prices of the two wholesale markets from each other. Hence, this security measure is found to have the maximum possible impact on prices and food trade which is plausible since the closures significantly reduce or even completely cease trade for a period of one up to a few days. The welfare implications are complex (World Bank, 2010b, pp. 16) since the closures are likely to create temporary situations of commodity glut or shortage depending on the wholesale market and the direction of trade.

This analysis can be extended into several directions. First, it would be desirable to consider more commodities and more than two wholesale markets of the Israeli-Palestinian trade network which could be challenging due to data availability and data completeness. In the given context, data completeness plays a major role in determining not only the extent of the research concerning the time frame, markets and products covered but also the reliability of the research since results become increasingly vague with a growing number of imputed data points. Some fruits and vegetable commodities basically exist only in one variety. However, commodities characterized by high quality and/ or variety differences may pose the question of adequate price aggregation.

Regarding further research, it might prove insightful to increase the information set considered, for example, by regarding the role and the impact of internal movement restrictions, i.e., closures inside the West Bank, rather than the comprehensive closures since they also affect consumer welfare within the West Bank. Naturally, movement restrictions within the West Bank impact trade between the West Bank and Israel as well. In this context, a higher number of observations of comprehensive closures might also be of interest and, in particular, an extension of the period studied to include the time briefly after the outbreak of the Al-Aqsa intifada might yield more robust estimation results and, hence, more robust evidence on the price effects of the comprehensive closures.

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Appendix

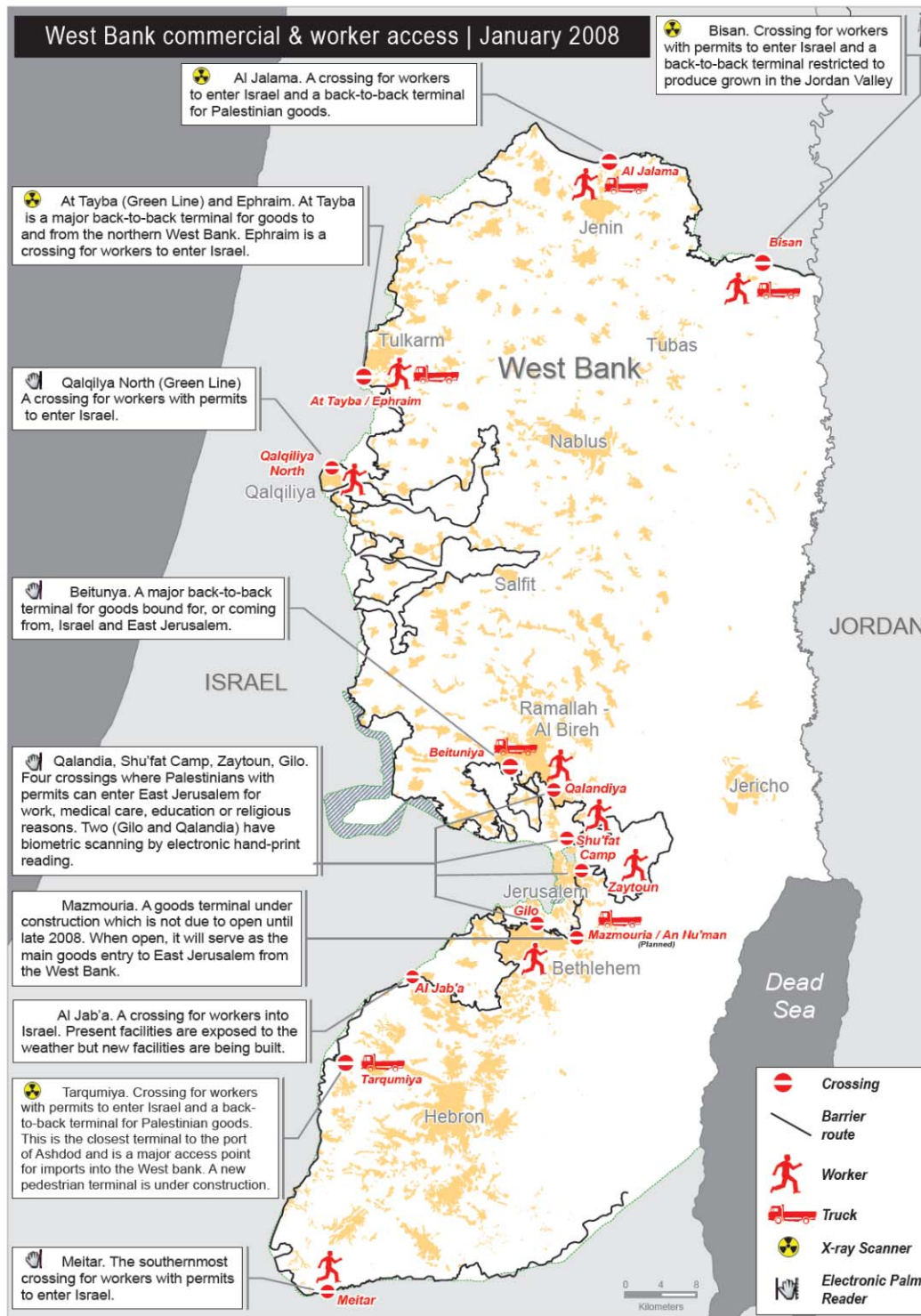


Figure 6: Commercial terminals in the separation barrier (Source: OCHAoPt, 2008)