Manuscript

The Economic Effects of Terrorism: Counterfactual Analysis of the Case of Israel

Dotan Persitz

Tel Aviv University[†]

Abstract

The paper evaluates the effect of Palestinian terror on the Israeli economy by using counterfactual methodology and quarterly data for the macroeconomic aggregates of OECD countries and Israel from 1980 to 2003. Had there been no terror in Israel since 1994, the country's per-capita GDP in 2003:3 would have been 8.6% higher than it was. Predictions based on low future levels of terror and the absence of a peace process produced good out-of-sample fit for 2003:4-2005:3. Palestinian terror increased the shares of consumption and government expenditures and decreased the shares of investment and trade balance in GDP. Weak evidence of a structural change at the aggregate level was observed.

[†] The Eitan Berglas School of Economics, Tel Aviv University, Tel Aviv, Israel, 69978. Phone: +972-3-6405816. E-mail: persitzd@post.tau.ac.il.

Introduction

There is no doubt among economists that wars, terrorism, and political instability have a significant negative effect on the economies in which they take place. Recent economic literature investigates both the consequences of political violence and the mechanisms that transform this violence into economic damage. Unfortunately, Israel has long been experiencing a high and volatile level of terrorism, making it a viable "natural experiment" for this literature. The objective of this study is to quantitatively estimate several aspects of the macroeconomic consequences of Palestinian terror against Israel since the mid-1990s. Three questions stand at the heart of this paper. First, how badly has terror affected Israel's per-capita GDP since the country suffered its first suicide attack?[1] Second, how did this lengthy period of terror change the open-economy National Accounts composition of GDP? Third, did this terror-intensive period induce a structural change in the Israeli economy?

Some of these questions were partially answered at the theoretical level by Eckstein and Tsiddon (2004a). They used the "Blanchard-Yaari Model" of finitely lived individuals in an infinitely lived economy and incorporate terror into the model by lowering life expectancy, which individuals translate into a reduction in the value of the

I would like to thank Daniel Tsiddon for his excellent and highly appreciated guidance. While working on this paper, I benefited greatly from the wisdom of Zvi Eckstein, Yona Rubinstein, Offer Lieberman, Gabi Gayer, Yaniv Yedid Levi, and Ran Eilat. I thank an anonymous proposal referee, the participants in the TAU Macroeconomics Workshop, and the members of the Forums that were convened by the Economics of National Security Program at the Samuel Neeman Institute for their many important comments. I also thank the Economics of National Security Program at the Samuel Neeman Institute for Advanced Studies in Science and Technology for its scholarship grant.

[1] The first suicide bombing in Israel took place in Afula on April 6, 1994, exactly forty days after a murderous attack by a Jewish settler, Baruch Goldstein, which took the lives of twenty-nine religious Muslims at the Cave of the Patriarchs.

future relative to the present.[2] This framework predicts that terror will cause investment to decrease immediately and income and consumption to decline in the long run. In the second stage, confronting a constant and exogenous level of terror, the optimizing government uses taxes to manufacture security in order to reduce the terror level. The prediction is a long-term equilibrium that features lower output, lower capital, and an indecisive direction of change in long-term consumption, relative to the original state.[3]

Empirically, Eckstein and Tsiddon (2004a) find that Palestinian terror has had a significant negative effect on Israel's GDP, investment, and exports. Had the terror ended in 2003:3, they predict, per-capita GDP would have increased by 2.5% annually and would have recouped within two years half of the decrease that had occurred since the beginning of the "second Intifada."[4] If it continued at its average level for a year (two years), then in 2005:3 the annual growth rate relative to 2003:3 would have been zero (–2%).[5]

The literature finds inconclusive evidence about the effect of terror attacks on private consumption. On the one hand, Fielding (2003a) argues that Israel's low private savings rate since the 1980 is mainly the result of political instability. A total absence of terror

[2] The literature proposes many mechanisms through which terror affects an economy. Most are subsets of the following: an increase in government defense expenditure (e.g., Eckstein and Tsiddon (2004a)), property damage, lower marginal productivity of capital (e.g., Arias and Ardila (2003)), an increase in the depreciation rate (e.g., Imai and Weinstein (2000)), an increase in production and transaction costs (e.g., Frey et al. (2004)), shorter subjective life expectancy, higher uncertainty and risk levels, fear of death (e.g., Eckstein and Tsiddon (2004a,b), Becker and Rubinstein (2004) and Naor (2006)) and "worst-case scenario" behavior (e.g., Viscusi and Zeckhauser (2003)).

[3] For an alternative model demonstrating the effects of an increase in government spending due to terror, see Arias and Ardila (2003). An increase in government defense expenditure lowers the tax base (e.g., Frey et Al. (2004)) and crowds out investment, savings, consumption, and exports (e.g., Heo (1999), Collier (1999)). However, the government's reaction might also have favorable economic effects (e.g., Knight et al. (1996), Stroup and Heckelman (2001)). For an exhaustive discussion of this ambiguity, see Sandler and Hartley (1995).

[4] The Palestinian uprising that started at the end of September 2000.

[5] See Abadie and Gardeazabal (2003) and Riascos and Vargas (2004) for the effects of terror on per-capita GDP in the Basque country and Colombia, respectively. See Imai and Weinstein (2000) and Collier (1999) for estimates of the effects of a widespread civil war on GDP growth rates.

inside the Green Line,[6] he says, would dampen consumption by 7.4% and increase GDP through savings by 4%. On the other hand, Eckstein and Tsiddon (2004a) predict that if terror continued at its average rate in 2002:4–2003:3 for two more years, by 2005:3 real nondurable consumption would be 2% lower and investment would be 20% lower than in 2003:3. Hess (2004) uses international pre-Intifada data to estimate a 0.94% increase in the growth rate of Israel's per-capita consumption if the environment were conflict-free.

Terror attacks are known to cause a decrease in aggregate private investment. For example, Fielding (2003b) uses Israeli quarterly data from 1988–1999 to find that zero fatalities to both sides of the conflict raises steady-state investment in nontraded capital goods by 27.9% and in traded capital goods by 14.6%. Frey et al. (2004) demonstrate the same negative effect for open-economy aggregates; they find, using international terror data, that even low levels of terrorism tend to reduce a country's capital inflow.[7]

These empirical results should be treated with caution, however, since violent acts come in many different shapes and types that may affect an economy in significantly different ways. International terror, for example, has many characteristics that national terror lacks (e.g., large numbers of casualties and low-intensity, infrequent military involvement). Another example might be the differences among the Colombian, the Basque, and the Israeli cases regarding the targets of the aggressors. Colombian terrorists wish to damage infrastructure; Basque terrorists target government officials, entrepreneurs, and business people, and Palestinian terrorists attempt to harm Israeli citizens arbitrarily. Moreover, the effect of the Palestinian terror on the Israeli economy is

[6] The 1949 Armistice lines established between Israel and its opponents (Syria, Jordan, and Egypt) at the end of the 1948 Arab-Israeli War.

[7] See Enders and Sandler (1996) and Abadie and Gardeazabal (2005) on the effect of terror on FDI and Nitsch and Schumacher (2004) and Heo (1999) on the effects of terrorist attacks and defense expenditure on bilateral volume of trade.

substantially different before and during the "second Intifada." Therefore, it is not obvious that one can generalize the effects of terror on the economy by using the existing empirical literature.

To estimate the effect of terror on the Israeli economy since 1994, one has to distinguish not just between this effect and that of the "dotcom bubble" that burst at around the time the Palestinian uprising began, but also between the effect of terror and that of long-term international processes such as globalization. Thus, to answer the foregoing questions, a counterfactual methodology that controls for worldwide events is employed. First, a counterfactual rule is constructed on the basis of quarterly time series of various macroeconomic aggregates of some OECD countries from 1980:1 to 1994:2. This rule is established in order to achieve the best possible artificial resemblance to pre-terror Israel. Second, a counterfactual for the later period is built from OECD countries' macroeconomic series during that period, using the rule that was found earlier. Then, the impact of terror is analyzed by examining the differences between the economic behavior of real Israel and that of the "pseudo-Israel" that existed after the eruption of lethal Palestinian terror.

Counterfactual methodologies are rather common in the literature on the consequences of terror. To calculate the potential economic gains of peace, Hess (2004) follows Lucas' approach and considers two consumption paths, one on which there is some positive probability of entering into an adverse or beneficial state and a "synthetic" path on which these probabilities are zero. Eldor and Melnick (2004) use the similarity between the S&P500 index and the TA-100 index before the "second Intifada" to devise a "clean" TA-100 index for the "Intifada" period using the S&P500 series and then to

compare it with the actual TA-100 index. Abadie and Gardeazabal (2003) try to distinguish between the effect of ETA terror and the economic behavior of Spain by constructing a "synthetic" Basque region using a linear combination of other Spanish regions. The coefficients of the linear combination are calculated using pre-Basque-terror data. Then they analyze the differences between the evolution of the "synthetic" region and the actual series.

This counterfactual method produces a straightforward interpretation of the results, using explicit assumptions about the relations among the macroeconomic aggregates and allowing restrictions on the coefficients. An alternative method might be a multi-equation time-series regression that finds correlations between Israel and each OECD country across all aggregates. In this case, however, the regression has an unnatural interpretation; it demands heavy assumptions about the variance-covariance matrix and does not easily permit coefficient restrictions.

The counterfactual methodology presented in this paper presumes the existence of macroeconomic similarity between Israel and the OECD countries. Specifically, Israel and the average OECD country are affected by global macroeconomic events at the same time and order of magnitude. Israel's response to global macroeconomic events is assumed to be the same before and during the terror period (excluding changes occasioned by the terror itself). Many economic parameters, such as per-capita macroeconomic aggregates and their shares in GDP, the structure of the capital markets, and the population characteristics, support this assumption. The implications of fundamental differences between Israel and the average OECD country in sectoral structure are discussed in detail in the structural-change analysis that appears in the

"Results" section.

Nevertheless, Israel has unique characteristics that should be taken into consideration. Importantly, unique characteristics that predate the terror period cannot bias the results since the counterfactual rule will take them into account and pseudo-Israel will imitate real Israel correctly. Unique characteristics that appeared after 1994, however, are not imitated by pseudo-Israel and may bias the results. For example, none of the OECD members experienced the mass immigration that Israel absorbed from the former Soviet Union in the 1990s. Since half of the immigrants reached Israel in 1989–1994, the counterfactual rule can only partly simulate the real Israel under circumstances of extreme immigration. However, as shown below, the immigration waves had no adverse effect on the gap between pseudo-Israel and real Israel. Another example is high-tech industry, which is believed to be more important to the Israeli economy than to most OECD members. Yet, no bias is expected to arise from this characteristic for two reasons: there is no evidence that high-tech industry is really so dominant macroeconomically[8] in Israel and both Korea and Finland, which appear in the counterfactual database, also have very large high-tech industries (for example, these countries have higher shares of "information and communications technologies" exports in merchandise exports than Israel has).

Briefly, the results confirm that had Israel been free of terror in the last decade, the country's per-capita GDP in 2003:3 would have been 8.6% higher than it was. Moreover, an "average Intifada" quarter of terror, with Israel on its potential path, decreases Israeli per-capita GDP immediately by 1.4%. Predictions show that two years of intense terror

[8] In 2000, a remarkable year for high-tech industry, start-up companies accounted for 3%-4% of GDP of the business sector and were responsible for 20% of its growth. In 2004, the high-tech sector was roughly 8%–10% of the Israeli GDP.

and no peace process would decrease real per-capita GDP by another 1.1%. Absent terror from 2003:3 onward, the Israeli economy would be able to recoup, within two years, about two-thirds of its loss relative to the third quarter of 2000, the last Intifada-free quarter. These predictions are slightly more optimistic than those of Eckstein and Tsiddon (2004a) which might suggest a successful control over international economic shocks. Comparison to actual per-capita GDP in Israel during 2003:4-2005:3 demonstrates good out-of-sample fit of the "no terror and no peace process" scenario prediction.

Analysis of the composition of the National Accounts shows that two quarters after an average "Intifada quarter" of terror, the share of investment and the trade balance in the "GDP pie" contracts by 0.3% and 0.6%, respectively. Concurrently, the share of government spending increases by 0.2%. An important result, due to contrasting economic effects mentioned in the literature (see above), is the 0.7% increase in the share of consumption. Thus, the ambiguity in the literature may be explained by a negative income effect and a positive "substitution effect." The increase in the portion of consumption in the GDP may be attributed to stronger time preferences or to households' interpretation of the Palestinian uprising as a transitory shock.

The investment response to terror although seemingly small, is characterized by a "long memory" that has a significant cumulative effect on the economy. Government expenditure seems to be extremely sensitive, especially to the intensity of the peace process, probably due to Israel's immediate need to increase the security of its citizens and, for this reason, to increase its spending. The trade balance is sensitive both to the terror level and to the intensity of the peace process, due to the low cost of portfolio

substitution by foreign countries and the high costs and risks of international trade.

The evidence for structural change in the Israeli economy due to Palestinian terror is very weak. Although the tourism, transport, and insurance industries are known to be sensitive to terror (at least in the short run), no major changes are observed at the aggregate level. Though the results for the agriculture industry show differently, agriculture accounts for a small fraction of Israel's GDP. Therefore, the evidence does not suffice to allow us to identify a terror-induced structural change in the Israeli economy. Other processes, especially the movement from classical industries to modern industries and mass immigration from the former USSR, seem to be the main determinants of the current structure of the Israeli economy.

The second section of the paper documents the econometric method and the data in detail. The third section presents the results; the last section concludes.

The Econometric Methodology and the Data

The methodology, an extension of Abadie and Gardeazabal (2003), strives to investigate the effect of the Palestinian terror on Israel's macroeconomic aggregates since the third quarter of 1994 while controlling for international economic processes. First, a counterfactual rule for Israel is formed on the bases of series describing Israel and a subset of OECD countries before the Palestinian terror erupted. Second, a pseudo-Israel for the later period is built from the counterfactual rule that was found in the first stage and the series of OECD countries during the time when Israel experienced high levels of terror. Then, series of differences between pseudo-Israel and real Israel are calculated and the relations between these series and series describing the Palestinian terror and the

status of the peace process are analyzed.

To construct the framework, let X be panel data consisting of T matrices of dimension $K \times N$, $X = \{X_1, X_2, \ldots, X_T\}$. Each $X_{t \in \{1,2,\ldots,T\}}$ denotes a cross section of K variables of N countries (the OECD countries, not including Israel) at period t. Let the scalar $T_{sp} \in \{1,2,\ldots,T\}$ denote the starting point of the suicide terror (the third quarter of 1994). $X^C = \{X_1, X_2, \ldots, X_{T_{sp}-1}\}$ and $X^E = \{X_{T_{sp}}, X_{T_{sp}+1}, \ldots, X_T\}$ represent the division of the time series into pre-terror OECD data and within-terror OECD data, respectively.

Let Y be series of T vectors of length K, $Y = \{Y_1, Y_2, \ldots, Y_T\}$. $Y_{t \in \{1,2,\ldots,T\}}$ denotes a column vector of K parameters as measured in Israel at period t. $Y^C = \{Y_1, Y_2, \ldots, Y_{T_{sp}-1}\}$ and $Y^E = \{Y_{T_{sp}}, Y_{T_{sp}+1}, \ldots, Y_T\}$ represent the division of the time series of Israel into pre-terror Israel data and within-terror Israel data, respectively.

Define weights vector $W = (w_1, w_2, \ldots, w_N)$ in which $0 \le w_i \le 1$ and $\sum_{i=1}^{N} w_i = 1$[9], w_i represents the weight of the i^{th} country in a linear combination of the countries.[10]

Before moving to the construction method, consider the case in which the j^{th} element in the vectors of Y^C is higher or lower than all the elements in row j of the matrices of X^C in the same period, for all periods. In this case, there is no W that satisfies the aforementioned conditions and elicits a series that resembles Israel's in any reasonable way. This problem is avoided by a simple linear transformation of Israel's pre-terror data

[9] As Abadie and Gardeazabal (2003) note, these restrictions prevent extrapolation from the support of the variables and perfect fit. Moreover, under these restrictions the coefficients can have a macroeconomic similarity interpretation.

[10] For simplicity, I limit the number of parameters in the description of the technique to one per country. The general case, which assigns one parameter to each country and variable, will be used throughout the paper. Note that the description of the method is identical except that in the general case W is a $K \times N$ matrix in which every row sums to one.

that assigns for each variable j - a multiplier A_j. The multiplier is chosen so that the first transformed observation of Israel will equal the mean of the first observation in the OECD countries. Formally, $\left(Y_t^{CT}\right)_j \equiv A_j\left(Y_t\right)_j \ \forall t \ 1 \le t \le T_{sp-1}$ where $A_j = \frac{\frac{1}{N}\sum_{n=1}^{N}\left(\left(X_1\right)_{j,n}\right)}{\left(Y_1\right)_j}$.

Although the problem appears only in some of the variables, this transformation is performed on all of them (see table A.1 in the Appendix).

For given vector $W \in B = \left\{\left(w_1, w_2, ..., w_N\right) | \ \forall i \in \{1, \ldots, N\} 0 \le w_i \le 1 \text{ and } \sum_{i=1}^{N} w_i = 1\right\}$, define a possible pseudo-Israel path as $\hat{\mathrm{Y}}^{\mathrm{CT}} = \left\{\hat{\mathrm{Y}}_1^{\mathrm{CT}}, \hat{\mathrm{Y}}_2^{\mathrm{CT}}, \ldots, \hat{\mathrm{Y}}_{\mathrm{T_{sp}-1}}^{\mathrm{CT}}\right\}$ where $\hat{Y}_t^{CT} = X_t W'$.

Define the series of vectors $\hat{\mathrm{U}}^{\mathrm{CT}} = \left\{\hat{\mathrm{U}}_1^{\mathrm{CT}}, \hat{\mathrm{U}}_2^{\mathrm{CT}}, \ldots, \hat{\mathrm{U}}_{\mathrm{T_{sp}-1}}^{\mathrm{CT}}\right\}$ where $\hat{\mathrm{U}}_{\mathrm{t}}^{\mathrm{CT}} = \begin{pmatrix} \hat{\mathrm{U}}_{1,\mathrm{t}}^{\mathrm{CT}} \\ \hat{\mathrm{U}}_{2,\mathrm{t}}^{\mathrm{CT}} \\ \vdots \\ \hat{\mathrm{U}}_{\mathrm{K,t}}^{\mathrm{CT}} \end{pmatrix}$ and $\hat{U}_{k,t}^{CT} = \left(\frac{Y_{k,t}^{CT} - \hat{Y}_{k,t}^{CT}}{Y_{k,t}^{CT}}\right)^2$ as the differences between the transformed Israel path and the possible pseudo-Israel path in squared percentages. Let $D(W) = \sum_{t=1}^{t=T_{sp}-1} \hat{U}_t^{CT}$ be a $\mathrm{K} \times 1$ vector in which the k^{th} element is the sum of differences in squared percentages calculated for the k^{th} variable. Let F be the algebraic average of the elements of D. $W^* = \arg \underset{W \in B}{Min} F(D(W))$ is the *counterfactual rule* that constructs the pseudo-Israel that

"best resembles" the transformed Israel in the terms of $\hat{U}_{k,t}^{CT}$, D and F.[11]

Now a counterfactual can be built using the rule and the within-terror macroeconomic series of the OECD countries. Define $\hat{\mathrm{Y}}^{\mathrm{ET}} = \left\{\hat{\mathrm{Y}}_{\mathrm{T_{sp}}}^{\mathrm{ET}}, \hat{\mathrm{Y}}_{\mathrm{T_{sp}+1}}^{\mathrm{ET}}, \ldots, \hat{\mathrm{Y}}_{\mathrm{T}}^{\mathrm{ET}}\right\}$ where $\hat{\mathrm{Y}}_{\mathrm{t}}^{\mathrm{ET}} = \mathrm{X_t W}^{*'}$. Since the rule found earlier refers to the transformed Israel data, $\hat{\mathrm{Y}}^{\mathrm{ET}}$ resembles the transformed data for the real Israel. To compare the pseudo-Israel path with the real-Israel path, a retransformation is needed. Denote $\hat{Y}^{E} = \left\{\hat{Y}_{T_{sp}}, \hat{Y}_{T_{sp}+1}, \ldots, \hat{Y}_{T}\right\}$ where $\left(\hat{Y}_{t}\right)_{j} = A_{j}^{-1}\left(\hat{Y}_{t}^{ET}\right)_{j} \forall t\, T_{sp} \le t \le T$. $\hat{\mathrm{Y}}^{\mathrm{E}}$ is the simulation of Israel's path from 1994:3 onward.

Denote the difference between the counterfactual path and the actual path by $Diff = \left\{Y_{T_{sp}} - \hat{Y}_{T_{sp}}, Y_{T_{sp}+1} - \hat{Y}_{T_{sp}+1}, \ldots, Y_{T} - \hat{Y}_{T}\right\}$, a $\mathrm{K} \times \left(\mathrm{T} - \mathrm{T_{sp}} + 1\right)$ matrix. The object of the paper is to analyze the relationship between *Diff* and the characteristics of the Palestinian terror.

Let P be a series of $\mathrm{T} - \mathrm{T_{sp}} + 1$ vectors of length L, characterizing the Palestinian terror, where L is the number of characteristics. Denote the terror index by $\mathrm{PI_t} = \mathrm{G}\left(\mathrm{P_t}\right)$ where G is the logarithm of one plus the average of the elements of P.

---

[11] The choice of $\hat{U}_{k,t}^{CT}$,D and F determines the similarity interpretation of this technique. The choice of $\hat{U}_{k,t}^{CT}$ normalizes the difference and gives underestimation and overestimation the same weight. The choice of D as the sum of deviations assumes the same weight for each time period in the construction data. This choice captures the requirement of a long-term fit of pseudo-Israel to the transformed Israel. The need for F arises since the space of all possible D's has only partial order (lattice). One possible alternative choice of F could have been to have the "grade" be the value of the k^{th} element of D. This choice causes the similarity to be narrowly interpreted (e.g., "GDP-similar pseudo-Israel" if the k^{th} element is the GDP deviations). Abadie and Gardeazabal (2003) use a different scheme: they define a diagonal matrix V to represent the relative importance of the variables and compute the "best" weights for each V using cross-section pre-terror data. Then they use the pre-terror GDP time series to choose the V that "best" simulates these time series given the weights calculated beforehand. This scheme does not allow the macroeconomic aggregates to be given equal importance and may not use the pre-terror data optimally.

The resulting framework permits Granger causality tests, simple regressions, impulse response simulations, and predictions. Its main advantage is that its conclusions about the analysis of the adverse effect of terror on the Israeli economy are free of international economic considerations. The independence of the results and international economy considerations relies, as stated above, on the assumption that Israel reacts in the same manner (timing and magnitude) to international shocks as the average OECD member. Note that the choice of a relatively large group of countries (both in the database and, especially, in the chosen pseudo-Israel) reduces significantly the "noise" in the counterfactual that may originate in internal processes that are unique to a specific country such as specific government policy. Obviously, this framework assumes that the OECD members' economies are independent of Palestinian terror. Though some Palestinian terror organizations appear on the European Union list of terror organizations, the European countries' security concerns revolve around international terror and internal terror in Western Europe (mainly Spain and France). The same may be said about Australia, New Zealand, and Korea (the non-European countries in the database).[12] Another assumption is the exogeneity of the Palestinian terror to the Israeli economy. This assumption is common in the literature[13] and will be checked for. This framework, however, cannot separate one Israeli internal process from another. Specifically, Palestinian terror and the peace process are highly correlated and definitely have an important aggregate effect on the Israeli economy. We attempt to distinguish between

[12] For an exhaustive discussion about counterterror policy in Europe from a Mid-Eastern point of view, see Chapter 4 of Eilam (2005).

[13] See the results in Alesina et al. (1996), Enders et al. (1992), Enders and Sandler (1996), Fielding (2003b), Krueger and Maleckova (2002), and Berrebi (2004). For opposite results, see Londergan and Poole (1989), Abadie and Gardeazabal (2003) and possible implications of Krueger and Laitin (2003). See also the objections raised by Nitsch and Schumacher (2004), Paxson (2002) and Saleh (2004) and the discussion in Krueger and Maleckova (2002).

them by using a dummy variable that controls for the success of the peace process during the terror period.

This study uses quarterly time series of seasonally adjusted macroeconomic data. The following variables are used[14] (the abbreviations used in the Results section appear in parentheses):

1. Natural logarithm of real per-capita GDP in thousands of 1995 USD (LNGDPPC).
2. Private final consumption expenditure as a percentage of GDP (C/GDP).
3. Government final consumption expenditure as a percentage of GDP (G/GDP).
4. Gross fixed capital formation as a percentage of GDP (I/GDP).
5. Exports of goods and services as a percentage of GDP (EX/GDP).
6. Imports of goods and services as a percentage of GDP (IM/GDP).
7. Population density (DEN).
8. The Agriculture, hunting, forestry, and fishing sectors as a percentage of GDP (AG/GDP).
9. The mining, manufacturing, electricity, and gas sectors as a percentage of GDP (MM/GDP).
10. The construction sector as a percentage of GDP (CN/GDP).
11. The services sector as a percentage of GDP (SR/GDP).

[14] These variables are known in growth economics to be main growth determinants. Abadie and Gardeazabal (2003) used a very similar set of variables and added human-capital characteristics that are unavailable in quarterly time series. Variables 2 to 6 compose the National Accounts equation; Variables 8 to 11 compose the GDP by activity equation. Notice that the sum of Variables 8 to 11 is less than one since they compose the gross total value added at basic prices that, together with taxes on products, is equal to GDP.

For data availability reasons, two databases denoted DB80 and DB84 are constructed[15]:

1. DB80 contains panel data for the first seven variables from the foregoing list as measured in eleven OECD countries from 1980:1 to 2003:3.
2. DB84 contains panel data for all variables from the foregoing list as measured in twelve OECD countries from 1984:1 to 2003:3.

For the terror index, the Eckstein and Tsiddon (2004a) index is used. This index calculates the logarithm of 1 plus the average of the following: the number of terror fatalities within the Green Line, the number of terror injuries within the Green Line, and the number of terror events within the Green Line.[16] For the peace process, a subjective index is used. This index assigns the value of 1 to periods in which some peacemaking progress was achieved and 0 to periods of stagnation.[17] For a diagrammatic demonstration of the per-capita GDP and terror variables, see figures A.1 and A.2 in the Appendix.

---

[15] The OECD countries include five countries from Western Europe (Italy, Spain, France, Belgium and Austria), four countries from Scandinavia (Sweden, Norway, Finland and Denmark), Korea and Australia. New Zealand is added in DB84. The OECD website - new.sourceoecd.org provides the OECD countries macroeconomic time series. The IFS database is used for exchange rates and population series. The population density variable was turned quarterly by a simple linear interpolation procedure. The Israeli data is taken from the Bank of Israel, which use the Central Bureau of Statistics as a source, and from the CBS publications. In Israel, GDP by activity aggregates are published only in yearly series. Therefore, a linear extrapolation (which is reasonable on a low volatility data as relative sectorial aggregates) is used. Separation similar to the OECD calculation is done only since 1984. Thus, D80 does not include these variables.

[16] The Palestinian terror database was culled from the Web site of the International Policy Institute for Counter-Terrorism at the Interdisciplinary Center Herzliya (www.ict.org.il) and includes detailed terror actions and consequences. A caveat of this index is the equal weights of the characteristics. For example, the number of injured is usually much higher than the number of fatalities, so the index will be dominated by this characteristic. Eldor and Melnick (2004) show that attacks inside the Green Line are far more lethal than those in the West Bank and Gaza Strip. Thus, it seems reasonable to take into account only the events that occurred inside the Green Line.

[17] Periods 1993:3–1996:2 and 1998:4–2000:3 receive the value of 1 and periods 1996:3–1998:3 and 2000:4–2003:3 receive the value 0.

Results

Four different configurations are used for the construction of the counterfactual paths, two for each DB (DB80 and DB84)—a constrained version (one parameter for each country) and an unconstrained version (one parameter for each pair of country and variable). Throughout this section, all four configurations are presented or the average of the four is presented. Each configuration has its own merits and pitfalls. The constrained versions may be too strict; the unconstrained versions may be too loose. DB80 has too few variables (only seven) while DB84 has too few construction data (42 quarters only).[18] The specific construction rules of the counterfactuals are reported in tables A.2, A.3 and A.4 in the Appendix.

Per-Capita GDP

Throughout this section, the logarithm per-capita GDP differences between real Israel and pseudo-Israel series will be referred to as DIFF. Note that since DIFF is the difference between natural logarithms, it is approximately the percentage of loss/gain relative to pseudo-Israel's per-capita output. The terror index series will be abbreviated to TER and the subjective peace-process dummy variable to PP.

*** Insert Figure 1 around here ***

Figure 1 shows the path of real Israel's real per-capita GDP path (bold line) versus the four different configurations of the counterfactual path. The counterfactual path

[18] In retrospect, it seems that the unconstrained D80 counterfactual rule works the best. The detailed paths of each aggregate will be provided by request.

represents Israel's potential real per-capita GDP path had the country not experienced massive Palestinian terror since 1994:3. Moreover, since during most of the construction period (1980/1984–1994) there were no peace negotiations between Israel and the Palestinians, these counterfactuals should be regarded as Israel's potential real per-capita GDP path had the country experienced neither Palestinian terror nor a peace process.

*** Insert Table 1 around here ***

Table 1 shows that Israel's average potential real per-capita GDP in 2003:3, given that Israel had not suffered terror, is 8.6% higher than the real per-capita GDP actually measured. Furthermore, the average Israeli citizen lost 12.2% in real income relative to his/her potential income in the first three years of the second Intifada. (The real per-capita GDP was 3.6% above its potential just before the beginning of the Intifada and 8.6% below it in 2003:3.) Note that this is a lower bound, since if we were to compare the real Israel only to the unconstrained counterfactuals, which seem to be better approximations in the pre-terror period, the loss would be even greater. Moreover, the potential, as mentioned above, refers to Israel with no peace process. As will be shown, the loss is greater if the potential relates to Israel with a successful peace process.

Using various configurations, we find that the hypothesis that DIFF does not Granger-cause TER cannot be rejected. On the other hand, the hypothesis that TER does not Granger-cause DIFF was rejected in most cases. A Granger causality test with two lags asserts causality from the peace-process dummy to DIFF and rejects opposite causality with 10% significance. Thus, the standard Granger causality tests suggest

unidirectional causality from TER and PP to DIFF.[19]

The estimated model introduces DIFF as the independent variable and includes one lag of DIFF, one lag of TER and the contemporaneous, and two lags of PP. There are three differences between this specification and the specifications introduced by Abadie and Gardeazabal (2003) and Eckstein and Tsiddon (2004a). First, the second lag of DIFF was omitted due to its insignificant coefficient in all configurations. Second, the trend and constant were omitted since if one assumes that the trend and constant of real-Israel and pseudo-Israel should be the same (as supported by the pre-terror per-capita GDP behavior, see figure 1), DIFF should have neither trend nor constant at all. Third, neither paper uses the PP dummy. (Eckstein and Tsiddon report the use of an "Intifada dummy.")

*** Insert Table 2 around here ***

From Table 2, the TER coefficient average across the configurations is –0.0032. Under a naive interpretation of the terror index, the negative sign means that the Palestinian terror caused a significant reduction in Israel's per-capita GDP since the mid-1990s relative to the possible behavior of the Israeli economy in a peaceful environment. The TER coefficient is significantly negative across all counterfactual configurations, even though we controlled for the peace process. The average of the sum of the three PP coefficients is 0.0128. Taking into account the scale of the variables, their weight is of the

[19] Granger causality tests show that PP and its first two lags Granger-cause TER for the period 1994:3–2003:3. The correlation suggests that when the peace process was not stagnating, the intensity of the terror was lower than in periods when diplomatic efforts were not observed. These results arise mainly due to the twelve quarters of Intifada, in which there was no peace process between Israel and the Palestinians. Testing for the period before the Intifada reveals no causality between TER and PP. For deeper investigation of this issue and possible explanations, see Jaeger and Paserman (2005).

same magnitude as TER but evidently leans in the opposite direction.[20] These results reinforce the hypothesis that terror itself is an important determinant in the behavior of the Israeli economy. Thus, the view that the peace negotiations are the only driving force of both the Israeli economy and the terror level can be rejected by those findings.

These results are used to calculate the effect of a shock of terror on the per-capita GDP path. Note that assuming that TER does not Granger-cause PP, the partial effect of the terror index is also the entire effect of the terror on per-capita output. This impulse-response analysis also assumes that there is no serial correlation in terror events (see Frey et al. (2004)).

*** Insert Figure 2 around here ***

Figure 2 demonstrates the effect of an average quarter of terror on an economy that is following its potential path amid a reality of no terror and no peace negotiations. (In this figure, the potential path is the average of the four counterfactual configurations.) Two magnitudes of terror shocks are demonstrated—2.52, the quarterly average index of terror during the entire period investigated (since the first Palestinian suicide bomber) and 4.55, the quarterly average level of terror during the "second Intifada." Thus, in an average "Intifada quarter," the Israeli economy immediately lost 1.4% of per-capita output relative to its potential. After such a quarter, almost a whole terror-free year has to pass in order to reduce the loss to less than 1% and four calm years are needed in order to

[20] To compute, very crudely, the importance of TER, it should be multiplied by 2.52 (the mean of TER during the estimation period) to get –0.0081. Using 4.55 as the terror index (The mean of TER during the "second Intifada"), we get –0.0146.

eradicate the terror effect altogether.[21] Note that the same characteristics would appear if an ongoing peace process were assumed, but the potential level to which the output converges would be 10.45% higher on average.[22]

*** Insert Figure 3 around here ***

Figure 3 shows that, on average, two more years at the 2002:4–2003:3 level of terror and no progress in the peace process would widen the real per-capita GDP gap to more than 10%. On the other hand, if the terror had stopped, the gap would have decreased to 4%, half its rate in 2003:3. The "best-case scenario," evidently, would be one in which the terror stops and substantial progress in the peace process is made. In this case, the gap would be closed in a year and a half and after two years the real per-capita GDP would be 3% higher than the real per-capita GDP of pseudo-Israel.

*** Insert Figure 4 around here ***

One may use these figures to predict Israel's per-capita GDP path. Such a calculation, however, requires an assumption about the predicted growth rate of pseudo-Israel. Assuming that pseudo-Israel had a constant rate of per-capita GDP growth in 2003:4–2005:3 and that this rate is its average rate in the last four quarters of the data, the annual growth rate is predicted to be between 0.45% to 0.85% (Over a longer period—

[21] Impulse responses for longer periods of terror may be calculated as well. Note that this simple model takes no account of non-linear behavior with respect to the terror index, of an economy that, for example, "became used to high levels of terror."

[22] This level may be easily computed from the model by assuming that PP=1 and TER=0 from the present to infinity.

from 2000:1—this suggests an annual growth rate of about 1%). Figure 4 shows that under this assumption, two years of intense terror and no peace process would depress real per-capita GDP by another 1.1% relative to its actual 2003:3 level. Absent terror from 2003:3 onward, the Israeli economy would be able to recoup within two years about two-thirds of its loss relative to the third quarter of 2000, the last Intifada-free quarter. The "best-case scenario" predicts that Israel would reach its pre-Intifada level of real per-capita output in six quarters.

Two important points should be made regarding the results shown in figure 4. First, these predictions are slightly more optimistic than those of Eckstein and Tsiddon (2004a). Since no control over international economic shocks was done in this paper, it might suggest that the difference between the two predictions can be attributed to these shocks. Second, although no formal ending was declared for the "second Intifada", the average terror index in 2003:4–2005:3 is 2.99 (3.51 in the first year and 2.46 in the second) which is significantly lower than the average index in the previous three years. Moreover, no progress was made in the peace process negotiations[23]. As can be seen from figure 4, the actual data for 2003:4–2005:3 are slightly above the average scenario (no terror, no peace process) prediction, which might indicate a good out-of-sample fit of the econometric methodology.

Composition of the National Accounts

Although some studies (see above) have discussed the effect of internal violence on the

[23] During 2005 some unilateral steps where taken by both sides. In March 2005, the Cairo declaration which was accepted by all Palestinians parties stated a conditioned cease-fire with Israel. In August-September 2005, Israel implemented the disengagement plan which included the evacuation of all Israeli armed forces and civilians from the Gaza strip. However, no significant bilateral steps were taken between Israel and the Palestinians during 2003:4-2005:3.

National Accounts aggregates, a complete description of the composition of the National Accounts is absent in the literature. This subsection characterizes the changes that occurred in Israel's National Accounts "pie" due to the country's geopolitical experience in the 1994:3–2003:3 period. The previous subsection asserted that the pie got smaller and that the average Israeli suffered a negative income effect. Now, the change explored is in the portion of each "slice," i.e., a "substitution effect."

*** Insert Figure 5 around here ***

Figure 5 shows that in 1994:3–2003:3 the actual share of *consumption* grew from 53% to 60% while the pseudo-share did not change (45%–46% on average).

The actual share of *investment* peaked in mid-1996 (24%), probably due to immigration from the former USSR, and decreased continuously to less than 17% at 2003:3, while the pseudo-share during this time was almost constant at 18%.

Government expenditure was constant at 29% during the 1994:4–1999:4 period. In 2000, it fell to 27% and remained there until the beginning of the "second Intifada." During the Intifada, the share of government expenditure increased to 31%. The average pseudo-share was at 41% in 1994:3; it decreased slowly to 37.5% in 2000:2 and stayed at this level until 2003:3.[24] Hence, before the Intifada government expenditure had been steady for the most part (while pseudo-Israel's expenditure mainly decreased) and during the Intifada it rose (while pseudo-Israel's expenditure stayed constant).

The share of *exports* followed a similar path in both real and pseudo-Israel until the

[24] The pseudo-Israel constructed by the unconstrained configurations imitated the real Israel quite well until 1994:3 (in which both were at 34%–35%). Then, this counterfactual decreased slowly to 32% in 2000:2 and stayed at this level until 2003:3.

end of 1998. Then actual exports outperformed the counterfactual until the beginning of the Intifada, probably due to a series of remarkable years in high-tech and tourism. In the first year of the Palestinian uprising, exports fell from 45% to 35% and stayed at that level until 2003:3. Pseudo-Israel's exports increased at a 1% average annual rate during the Intifada.

Israeli *imports* behaved much like pseudo-Israel until the end of 2001. From 2002 onward, the actual portion of imports remained constant at 42% of GDP while pseudo-Israel's share climbed to 48%.

This description implies that the Palestinian terror and/or the peace process raised the share of consumption and lowered the share of investment in GDP. It also may have caused the share of government expenditure to grow and that of exports to fall relative to the counterfactual (excluding exports in 1999–2000). The effect of the violence on imports is doubtful; if it existed at all, it was negative and took place only after a year of intense terror. The quantitative characteristics of these effects are calculated by simple regressions and reported in table 3 (see table A.5 in the Appendix for a simultaneous VAR regression for these series, which yields similar results).

*** Insert Table 3 around here ***

Table 3 may be summarized in the following way: intense terror (a successful peace process) increases (decreases) the consumption and government-expenditure portions of GDP and decreases (increases) the investment, exports, and imports portions of output (although the effect of the peace process on investment and imports is

statistically insignificant).

*** Insert Figure 6 around here ***

Figure 6 presents the response of the composition of the GDP to a single quarter characterized by no peace process and an average "second Intifada" level of terror. Notice that apart from investment, which is highly serial-correlated, the shocks to the aggregate portions of GDP decay very fast. (It takes three quarters, at most, for the aggregate portions to recoup half of the deviation.) Figure 6 shows that two quarters after an average "Intifada quarter" of terror, the shares of investment and trade balance in the "GDP pie" are reduced by 0.3% and 0.6%, respectively. Concurrently, the shares of private consumption and government spending increase by 0.7% and by 0.2%, respectively.

Several conclusions may be drawn from these results. First, aggregate private consumption decreases because of the adverse wealth effect of terror and increases due to its larger portion in the GDP pie. This result may explain the ambiguity in the literature concerning consumption in Israel under terror (Fielding (2003a), Eckstein and Tsiddon (2004a)). Looking at the real Israel, it seems that the income effect has been slightly stronger than the "substitution effect" during the "second Intifada." The increase in the share of consumption in GDP may trace to stronger time preferences under political instability and terror. This explanation may be encouraged by the negative effect of an intensive peace process on consumption. An alternative interpretation may be that households did not view the Palestinian uprising as a permanent shock to the economy;

therefore, their permanent income and expenditures did not suffer dramatically. Moreover, since the consumption aggregate that we used included both durable and nondurable goods, nondurable goods probably suffered even less of an adverse shock than the results show. Note that the first alternative enables, theoretically, a total increase in consumption, while the second allow only for total negative effect. Since the actual total effect is negative, it is impossible to prefer one explanation to the other using this argument.

Second, the serial correlation of fixed capital formation may suggest a long memory (as Figure 6 shows nicely). Long memory may emerge from the importance of foreign investors and foreign markets to the Israeli economy. Once they substitute their investments from Israel, it takes a long term process to re-attract them.[25] Assuming that the investment regression is not spurious due to unit root, the effect of terror on the share of investment in GDP is not as small as it looks relative to the consumption share, since the portion of the latter is three times as great as that of the former. Moreover, the sluggishness of the investment causes the cumulative effect of terror on investment (the area between the curve and the X-axis) to be very significant relative to other aggregates. While introducing immigration per capita as an additional explaining variable, both the immigrants' variable coefficient and the peace process coefficient are insignificant in most of the counterfactual configurations (including the average counterfactual). This implies that the "second Intifada" had a significant negative effect on the share of investment even when some aspects of the mass immigration are controlled.

Third, government expenditure seems extremely sensitive, especially to the intensity

[25] See Abadie and Gardeazabal (2005). See also Pshiva and Suarez (2004) for a test of the hypothesis that local investment may decrease due to risk and uncertainty.

of the peace process. A quarter with a high level of terror may immediately increase the share of government expenditure in GDP by 0.7%—quite a drastic upturn if its basic share is less than 30% (as it was before the "second Intifada")—probably due to the immediate need to enhance citizens' security. An anti-cyclical policy, due to a slowdown in the economy inflicted by the geopolitical situation, may also explain this result, although in this case one might expect the effect of terror to be lagged.

Fourth, exports are sensitive to both the level of terror and the intensity of the peace process. Two bad quarters of terror may reduce the share of exports in GDP by almost 1.5%, whereas exports' share may increase 1.4% in a quarter with a meaningful peace process. The probable explanation is the low cost of portfolio substitution by foreign countries. Many results show, for example, that foreign tourists easily change their destinations due to political instability (e.g., Enders et al. (1992), Drakos and Kutan (2003), and Eckstein and Tsiddon (2004a)).

Finally, the duration of the high terror level was severely harmful to imports during the Intifada—possibly due to the diversion of output to local markets (due to the proportional decrease in exports); a decrease in foreign demand due to higher costs and risks of international trade; and the reduction in investment since Israel's imports are known to be investment intensive..

Economic Structure

The common empirical way of viewing an external shock to an economy is by measuring its effect in the short and long terms, both on single unique markets and on macroeconomic aggregates. An alternative empirical view, which is ignored by the

relevant literature, would be to investigate the way various industries in the economy share the burden. The following analysis tries to give a very preliminary answer to the "burden-sharing" question in Israel under Palestinian terror. To perform the analysis, the economy was divided into four broad industries (the standard OECD division)—agriculture (including hunting, forestry, and fishing), manufacturing (including mining, electricity, and gas), construction, and services. Due to data limitations, the pseudo-Israel data in this subsection are constructed on the basis of D84 only.

*** Insert Table 4 around here ***

The data and Table 4 show that the share of *agriculture* in GDP decreased continuously from 3.7% in 1985 to 1.1% in 2000 and since then has held steady at around 1.3%. The pseudo-Israel share fell to 2% in the early 1990s and remained at this level until 2003.

The share of *manufacturing* decreased from 20% in 1984 to 14% in 1996, stayed at this level until 2000, fell significantly in 2000, but recovered to 14% in 2003 due to a continuous increase since 2001. During most of the period since 1984, the share of manufacturing in pseudo-Israel was steady at 18%.

The share of *construction* ranged from 4% to 5% during most of the sample period, except for 1991–1997, when it rose to 6.5%. The share of construction in pseudo-Israel was steady at 5%.

The *services* accounted for 50% of Israel's GDP for most of the 1984–1992 period. After 1992, its share grew gradually and surpassed the 60% level in early 2003 (an

increase of almost 1% per year). Pseudo-Israel experienced a slow average growth of 3.5% during this time—from 50.6% in 1984 to 54.1% in 2003 (0.17% per year).

At first glance, these data lead us to believe that the Palestinian terror and the peace process had little effect on the structure of the Israeli economy. Two other factors seem to be dominant in shaping this structure. The first is the worldwide process of movement away from classical industries such as agriculture and manufacturing to modern industries, which are mostly accounted as services. The differences between real-Israel and pseudo-Israel in the growth rate of the share of services in GDP and in the long-run trend in agriculture and manufacturing show that the assumption of similarity between Israel and the OECD countries may be inappropriate here. The dissimilarity may originate in a lagged process in Israel relative to the developed world until the mid-1990s, followed by acceleration that was possibly caused by the combination of high-tech industry development and mass immigration. While in the case of the National Accounts the similarity assumption is equivalent to assuming that Israel is a small open market that is as sensitive to the world economy as any OECD economy, in the case of industrial aggregates this assumption is tantamount to an assumption that Israel's long term behavior resembles that of the OECD countries. Therefore, the methodology used in this paper may fail to account for fundamental differences among the structures of the economies at issue.

The second factor is the intensive immigration of highly skilled labor from the former Soviet countries. The immigrants' housing demand caused a construction surge in the mid 1990s and their high quality skills, as mentioned, was another reason for the dramatic growth of the services industries on the expense of traditional hard labor

manufacturing. This may be viewed as an internal unique process that took place in Israel between 1989 and 2000. The analysis in this paper studies an internal process that began in 1994:3. Thus, the short-term effects of the most intensive quarters of immigration are included in the construction of pseudo-Israel. Nevertheless, assuming that the structural changes induced by the immigration are long-term, the pseudo-Israel path accounts only for a fraction of this process.

Summing up these two factors, there is a significant difference between the economic structure of Israel and that of the average OECD country during the construction period. Moreover, the counterfactual methodology does not control well for the long term aspects of the mass immigration that Israel experienced in the 1990s. Therefore, it is hard to control for these factors to fully characterize the effects of terror on Israel's economic structure. Nevertheless, on the basis of the descriptive data above, we may offer the preliminary and cautious answer that this effect seems very weak if not nonexistent.

The four series of DIFFs are highly serial-correlated. No method of detrending is suitable since, as noted in the National Accounts subsection, TER and PP should be used to explain the trend. However, unlike the case of the National Accounts (with the exception of investment), the strong correlation is not eliminated when TER and its lags and PP and its lags are used as independent variables.[26] Hence, the results of these regressions are probably spurious. Therefore, no complete regression results, apart from that pertaining to the share of agriculture, may be shown to refute the conjecture that Palestinian terror and the peace process had little effect on the structure of the Israeli

[26] Except of the agriculture equation, the coefficient of the first lag of DIFF is greater than 0.98 and in some configurations even greater than 1.

economy in the past decade.

*** Insert Table 5 around here ***

The regression of the share of agriculture appears in Table 5. In this regression, TER lagged by one period has a small and positive significant coefficient and PP has a small and negative significant coefficient. The interpretation of these results is that in bad times (severe terror and no peace negotiations) the share of agriculture in the economy grows. One possible reason for these results is the switch made in this sector from Palestinian workers to foreign (mostly East Asian) workers, which makes agriculture more stable against these kinds of shocks. Another reason may be the inelasticity of demand for the products of agriculture. Irrespective of the reason for this phenomenon, it is obvious that since the share of agriculture in the Israeli GDP is smaller than 1.5%, these results do not signal a structural change in the Israeli economy due to the Palestinian terror.

The description of the proportions of the various industries in real Israel as against the shares of these industries in pseudo–Israel, and the failure to explain the changes in manufacturing, construction, and services by using the terror and peace-process indices, lead to the conjecture that terror and peace negotiations have little effect on the structure of the Israeli economy and that the industries shared the burden equally. Though the results for agriculture show differently, they do not suffice to refute this conjecture because agriculture accounts for such a small portion of GDP.

Conclusion

This paper used a counterfactual methodology to quantitatively estimate several aspects of the macroeconomic consequences of Palestinian terror for Israel's economy since the mid-1990s. A straightforward technique was used to construct the counterfactual for the Israeli economy out of data on the aggregates of OECD countries.

Israel's average potential real per-capita GDP in 2003:3 in the absence of the "second Intifada" is 8.6% higher than the real per-capita GDP actually measured. Furthermore, the average Israeli citizen lost at least 12.2% of real income relative to potential income during the first three years of the "second Intifada." Predictions show that two years of intense terror and no peace process would lower the real per-capita GDP by another 1.1%, and that if Israel were terror-free from 2003:3 onwards, its economy would be able within two years to recoup about two-thirds of its loss relative to the last Intifada-free quarter. Prediction for two years without Palestinian terror and an ongoing stagnation in the peace process shows good out-of-sample fit to the actual data for 2003:4-2005:3. During the Palestinian uprising, the slices of consumption and government expenditure in the GDP pie grew while the portions of investment and trade balance contracted. These results suggest that the ambiguity in the literature about the effect of terror on aggregate consumption traces to two forces: a negative income effect and a substitution effect that emerges from households' behavior. The study found only weak evidence of an effect of Palestinian terror and the peace process on the structure of the Israeli economy in the last decade. The two factors that seem to dominate the

structure of the Israeli economy are the worldwide process of movement from classical to modern industries and the mass immigration from the former Soviet Union.

Further research should be directed at three distant issues. First, strong and rigorous mathematical and statistical foundations should be established for the counterfactual methodology described in this paper. It seems worthwhile to examine the strength of this methodology on other cases of unique internal processes. The methodology presented here is deterministic and should be developed to account for the dynamic stochastic characteristics of the data. Second, the reaction of the Israeli households to the Palestinian terror is yet to be fully understood although interesting facts arise from the data. Periods of volatile intensity of terror (1994-2000 and from 2004) are substantially different from periods of constant intensive levels of terror (2001-2003). Moreover, it seems difficult, but important to identify whether the behavior which causes the positive "substitution effect" is a result of standard permanent income considerations or of a change in the time preferences of the households. Last, the question of the effect of terror on the structure of the economy is especially important in regard to government policies of compensating terror "monetary victims".

References

- Abadie, A. and J. Gardeazabal, 2003, the Economic Costs of Conflict: a Case Study of the Basque Country, American Economic Review 93, 113-132.
- Abadie, A. and J. Gardeazabal, 2005, Terrorism and the World Economy, working paper.
- Alesina, A., S. Ozler, N. Roubini, P. Swagel, 1996, Political Instability and Economic Growth, Journal of Economic Growth 1, 189–211.
- Arias, A. F. and L. Ardila, 2003, Military Expenditure and Economic Activity: The Colombian Case, Documento CEDE 2003-20, Bogota, Colombia.
- Berrebi, C., 2004, Evidence about the Link between Education, Poverty and Terrorism among Palestinians, Princeton University Industrial Relations Section Working Paper No. 477.
- Becker, G. S. and Y. Rubinstein, 2004, Fear and the Response to Terrorism: An Economic Analysis, working paper.
- Collier, P., 1999, On the Economic Consequences of Civil War, Oxford Economic Papers 51, 168–183.
- Drakos, K. and A. M. Kutan, 2003, Regional Effects of Terrorism on Tourism: Evidence from Three Mediterranean Countries, Journal of Conflict Resolution 47, 621–641.
- Eckstein, Z. and D. Tsiddon, 2004a, Macroeconomic Consequences of Terror: Theory and the Case of Israel, Journal of Monetary Economics 51, 971–1002.
- Eckstein, Z. and D. Tsiddon, 2004b, The Effect of Fear and the Probability of Getting Hurt on the Individual Decision: Theory and Facts from the Israeli Economy,

research proposal submitted to the Sapir Institute (Hebrew).

- Eilam, U., 2005, L'Europe de la Defense, JCSS Memo 75 (Hebrew).
- Eldor, R. and R. Melnick, 2004, Financial Markets and Terrorism, European Journal of Political Economy 20, 367-386.
- Enders, W. and T. Sandler, 1991, Causality between Transnational Terrorism and Tourism: the Case of Spain, Terrorism 14, 49–58.
- Enders, W. and T. Sandler, 1996, Terrorism and Foreign Direct Investment in Spain and Greece, KYKLOS, Vol. 49, 331-352.
- Enders, W., T. Sandler and G. F. Parise, 1992, An Econometric Analysis of the Impact of Terrorism on Tourism, KYKLOS 45, 531–554.
- Fielding, D., 2003a, Counting the Cost of the Intifada: Consumption, Saving and Political Instability in Israel, Public Choice 116, 297–312.
- Fielding, D., 2003b, Modeling Political Instability and Economic Performance: Israeli Investment during the Intifada, Economica 70, 159–186.
- Frey, B. S., S. Luechinger and A. Stutzer, 2004, Calculating Tragedy: Assessing the Costs of Terrorism, Journal of Economic Surveys (forthcoming).
- Heo, U., 1999, Defense Spending and Economic Growth in South Korea: the Indirect Link, Journal of Peace Research 36, 699–708.
- Hess, G., 2004, The Economic Welfare Cost of Conflict: An Empirical Assessment, CESifo working paper Series No. 852.
- Imai, K. and J. M. Weinstein, 2000, Measuring the Economic Impact of Civil War, CID Working Paper No. 51.
- Jaeger, D. A. and M. D. Paserman, 2005, the Cycle of Violence? An Empirical

Analysis of Fatalities in the Palestinian-Israeli Conflict. DP 5320, Centre for Economic Policy Research.

- Knight, M., N. Loayza, D. Villanueva, 1996, The Peace Dividend: Military Spending Cuts and Economic Growth, Policy Research Working Paper 1577, World Bank.
- Krueger, A. B. and D. D. Laitin, 2003, Kto Kogo?: A Cross-Country Study of the Origins and Targets of Terrorism, working paper.
- Krueger, A. B. and J. Maleckova, 2002, Education, Poverty, Political Violence and Terrorism: Is There a Causal Connection? NBER Working Paper No. 9074.
- Londregan, J. B. and K. T. Poole, 1989, Coups D'Etat and the Military Business Cycle, Working Paper No. 368889, Carnegie Mellon University.
- Naor, Z., 2006, Untimely Death, the Value of Certain Lifetime and Macroeconomic Dynamics, Defense and Peace Economics 17, 343–359.
- Nitsch, V. and D. Schumacher, 2004, Terrorism and International Trade: an Empirical Investigation, European Journal of Political Economy 20, 423–433.
- Paxson, C., 2002, Comment on Alan Krueger and Jitka Maleckova: Education, Poverty, Political Violence and Terrorism: Is There a Causal Connection? Princeton Research Program in Development Studies, Paper No. 207.
- Pshiva, R. and G. A. Suarez, 2004, Crime and Finance: Evidence from Colombia, working paper.
- Riascos, A. J. and J. F. Vargas, 2004, Violence and Growth in Colombia: A Brief Review of the Literature, WebPondo Working Paper.
- Saleh, B. A., 2004, Economic Conditions and Resistance to Occupation in the West Bank and Gaza: There is a Causal Connection, Topics in Middle Eastern and North

African Economies 6.

- Sandler T. and K. Hartley, 1995, the Economics of Defense (Cambridge University Press).
- Stroup, M. D. and J. C. Heckelman, 2001, Size of the Military Sector and Economic Growth: A Panel Data Analysis of Africa and Latin America, Journal of Applied Economics 4, 329–360.
- Viscusi, K. and R. J. Zeckhauser, 2003, Sacrificing Civil Liberties to Reduce Terrorism Risks, Journal of Risk and Uncertainty 26, 99–120.

Appendix

*** Insert Figure A.1 around here ***

*** Insert Figure A.2 around here ***

*** Insert Table A.1 around here ***

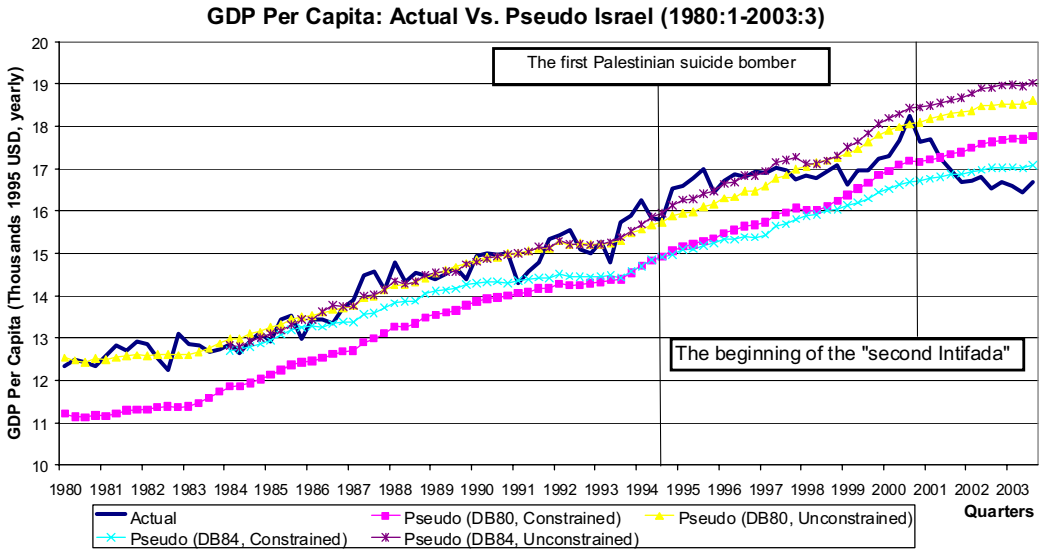
*** Insert Table A.2 around here ***

*** Insert Table A.3 around here ***

*** Insert Table A.4 around here ***

*** Insert Table A.5 around here ***

Figures



<u>Figure 1</u> – GDP per capita: actual Israel vs. pseudo Israel. The Y-axis denotes the yearly levels of per-capita GDP in 1995 USD. The bold line represents the actual path of the Israeli GDPPC path and the other four lines represent the various counterfactual configurations built from the OECD countries data series.

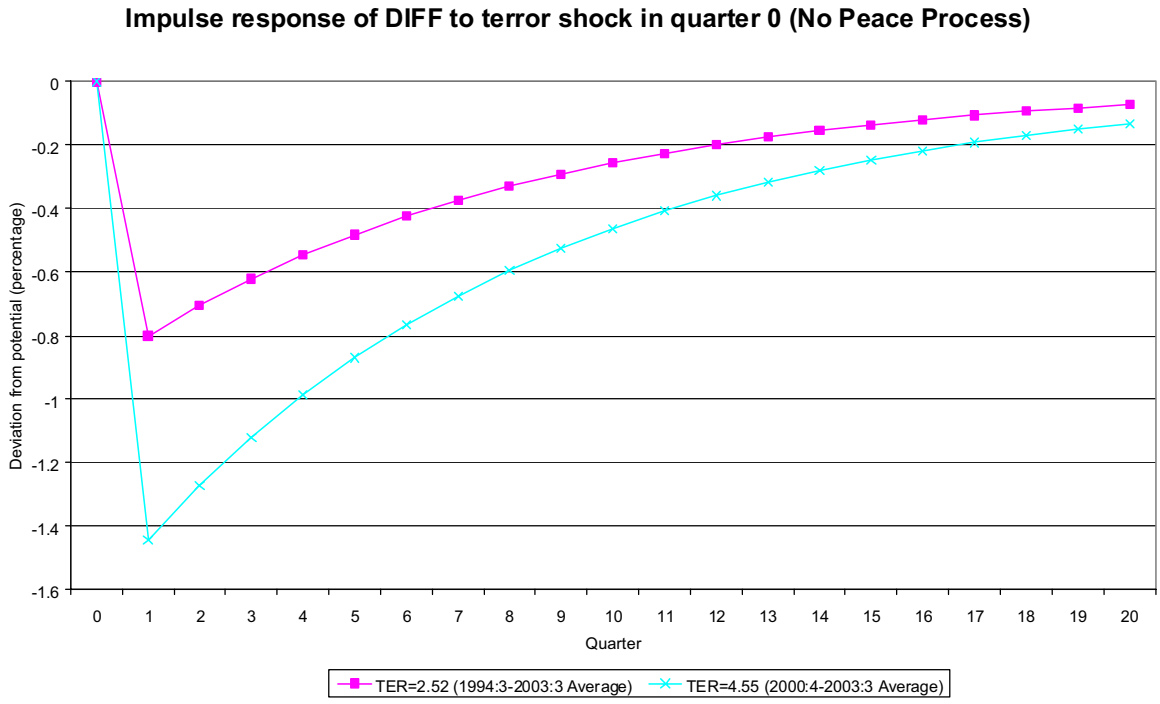
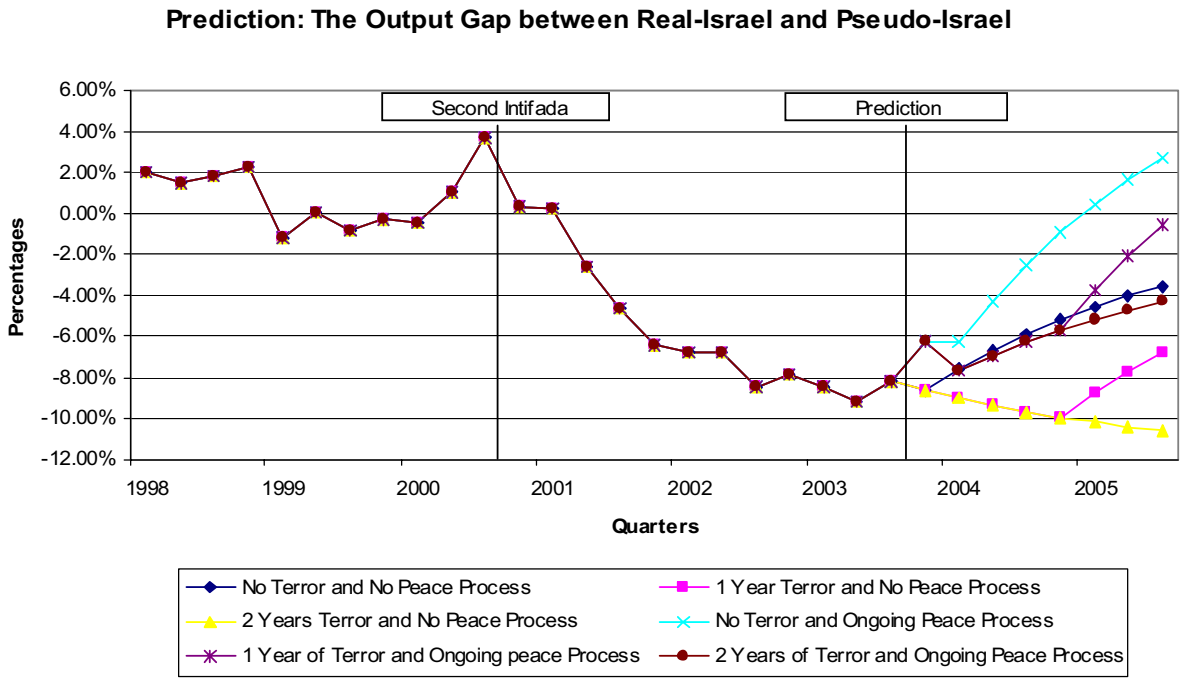


Figure 2 – Impulse response of DIFF to terror shock in quarter 0 (no peace process). The lines demonstrate the average loss of the real per-capita GDP due to terror shock in quarter 0 relative to potential per-capita GDP. Two intensities of shocks are examined: the average terror index from the first suicide bomber attack and the average terror index from the beginning of the "second Intifada." The potential per-capita GDP is constructed using the mean of the four counterfactual configurations.



<u>Figure 3</u> – The output gap between real-Israel and pseudo-Israel. This figure illustrates Israel's predicted loss of real per-capita GDP relative to its potential per-capita GDP under various scenarious of terror length and peace process intensity. The terror level used for predictions equals the average level in the period 2002:4-2003:3. The gap is the average of the gaps as were predicted by the four counterfactual configurations. Note that this presentation does not suggest that these states of the world are equally probable.

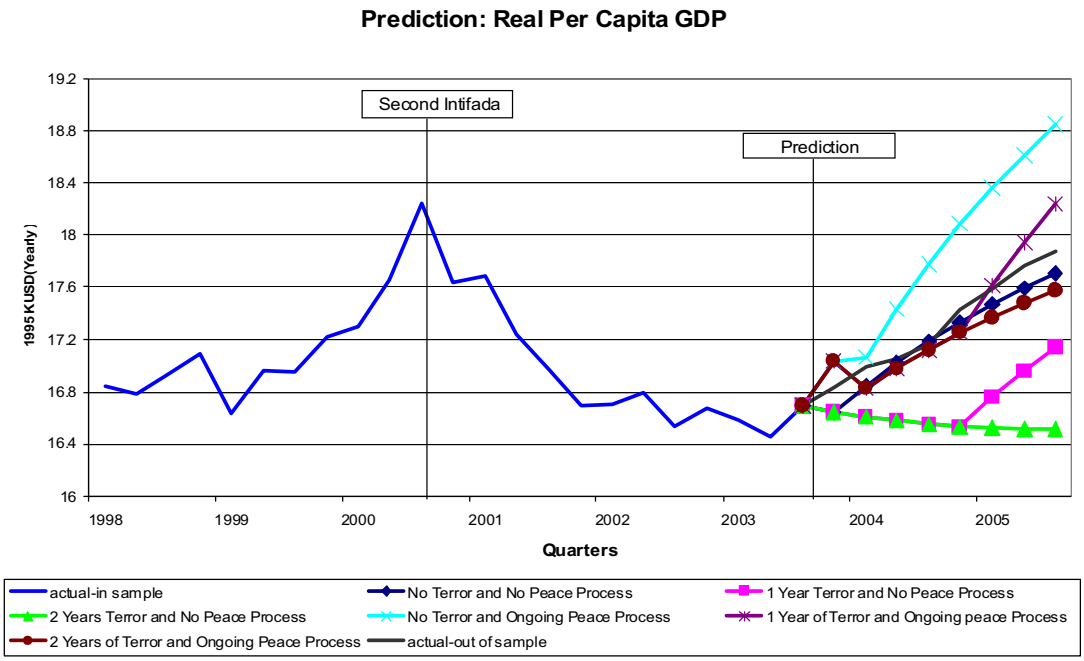


Figure 4 – Prediction: real per-capita GDP. This figure ilustrates the predicted real per-capita GDP path under various scenarious of terror length and peace process intensity. The Y-axis is the yearly rate of per-capita GDP in thousands of 1995 USD. The terror level used for the predictions equals the average level in the 2002:4-2003:3 period. To calculate those predictions, we assumed that Pseudo Israel's per-capita GDP path continues to grow at the same rate as in 2002:4-2003:3. The non-shaped line is the actual per-capita GDP path as was measured in Israel for this period.

Composition of the National Accounts: Actual Israel vs. Average Pseudo Israel

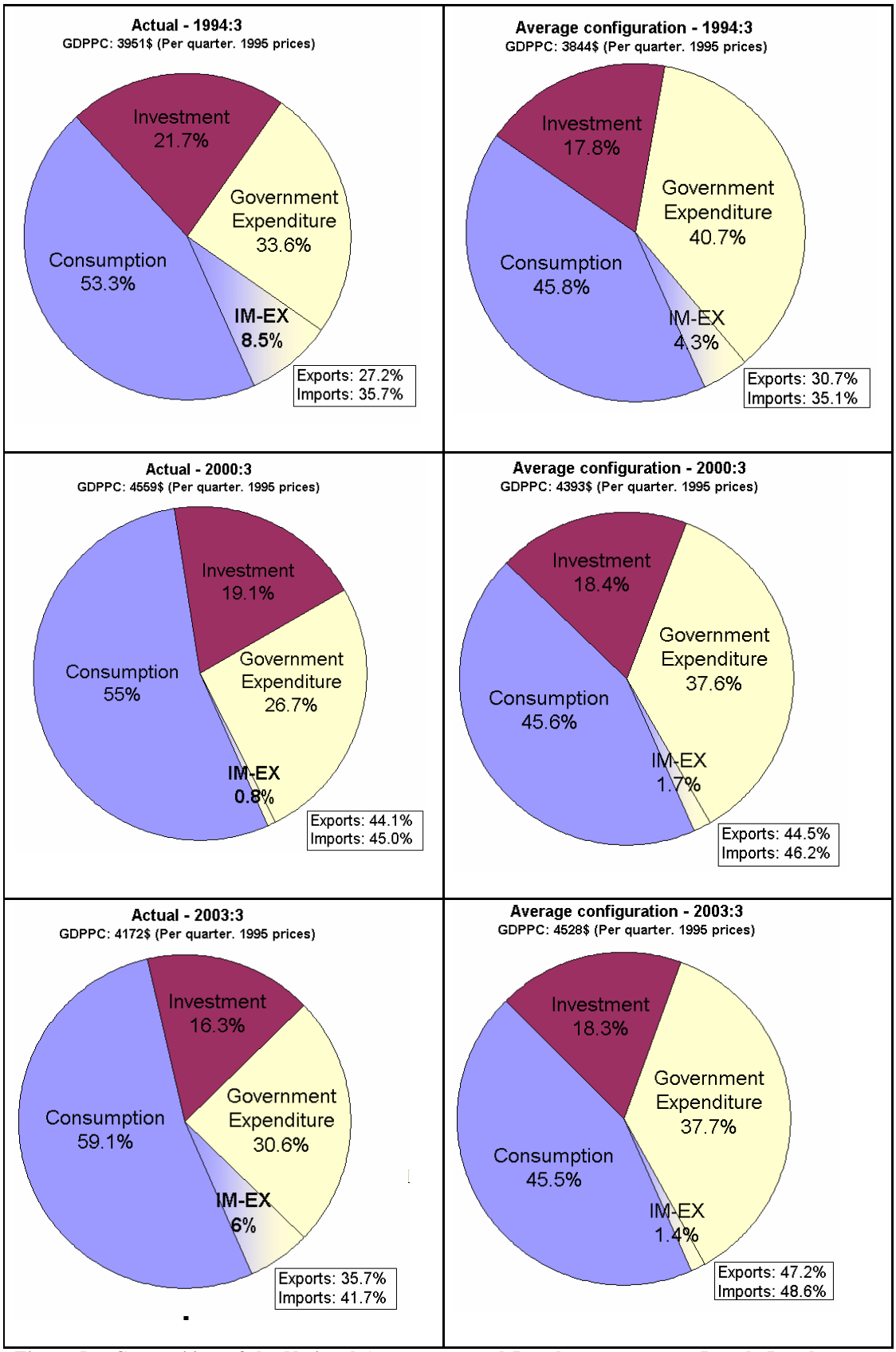


Figure 5 – Composition of the National Accounts: actual Israel versus average Pseudo-Israel. Three points in time are shown: 1994:3, the first quarter after the first suicide bomber attacked; 2000:3, the last quarter before the "second Intifada"; and 2003:3, the last point of the data. Note that the net exports portion is negative. (The area in the figures is an overlap between the consumption and the government expenditure.) The original numbers of the average counterfactual configurations add up to 97% due to rounding; hence they were normalized to add up to 100%. The detailed paths may be provided by request.

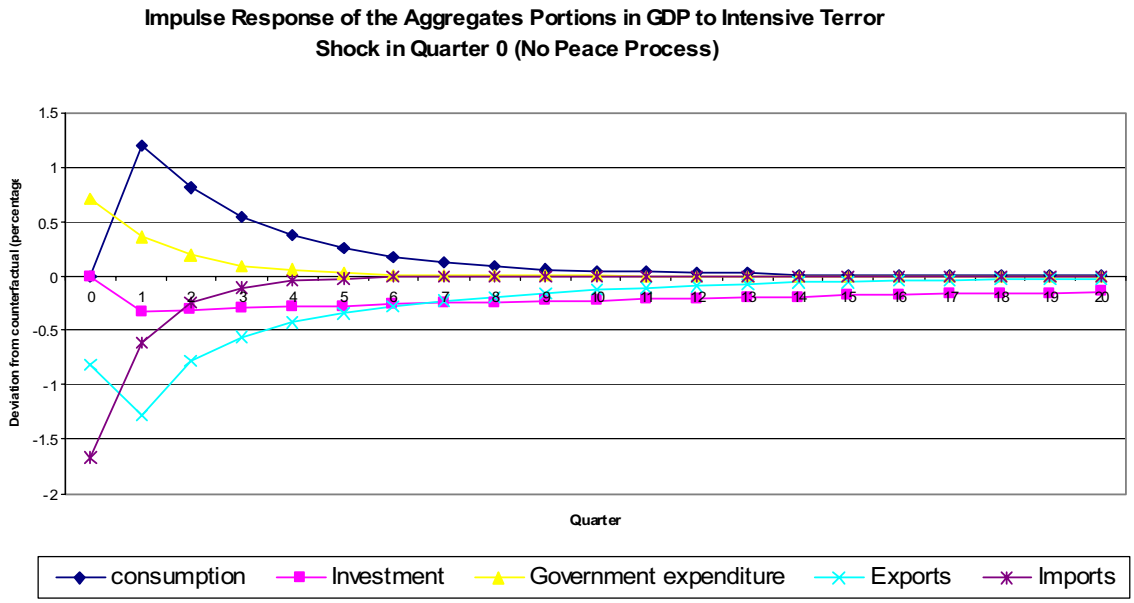
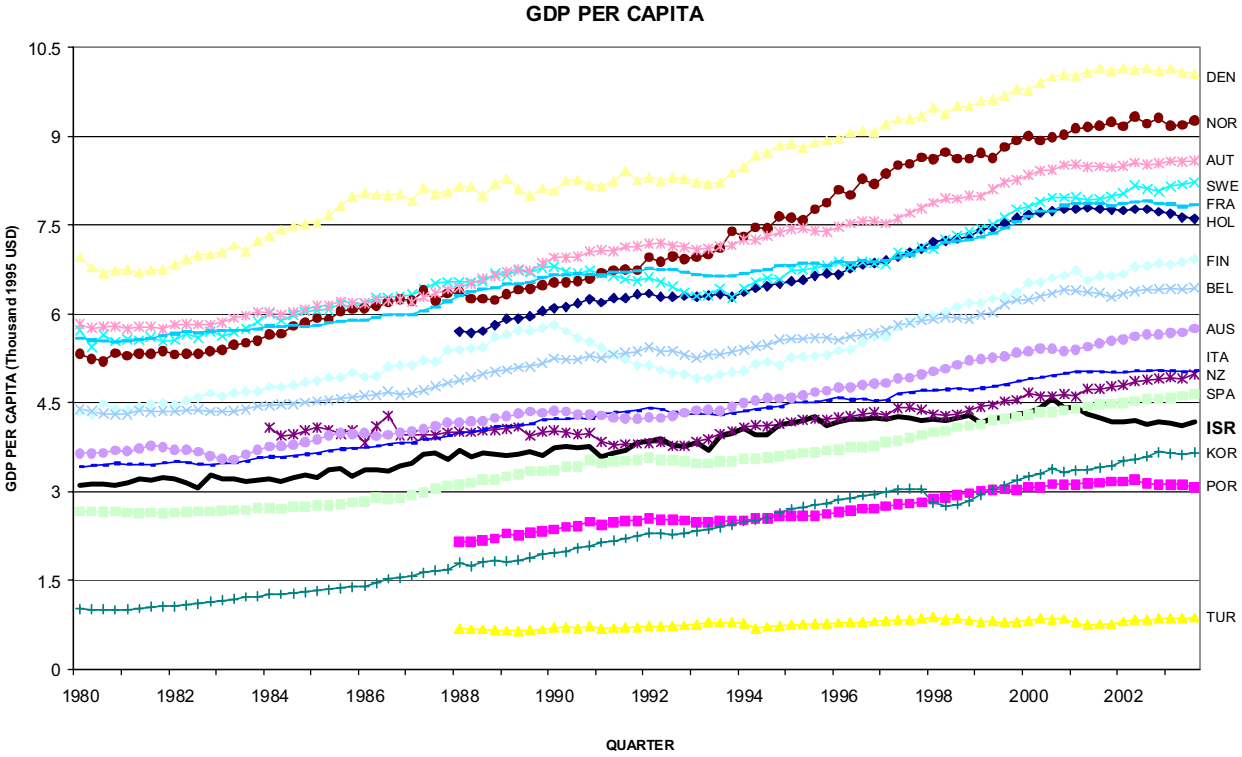


Figure 6 – Impulse response of aggregate portions in GDP to terror shock in quarter 0 (no peace process). The lines demonstrate the deviation of the "slices" of the aggregates in GDP from the pseudo-"slices" due to terror shock in quarter 0. The intensity of the shock is the average terror index from the beginning of the "second Intifada." The deviations were constructed by using the mean of the four counterfactual configurations. The numbers do not add up to zero in each period (taking the negative value of imports) due to the use of different models for each aggregate and the use of the averages of the four simulations. This is not critical because, apart of periods 0 and 1, the sum is less than one-third of 1 percent in absolute value.



<u>Figure A.1</u> – Per-capita GDP In Israel and the OECD members included in the database. The bold line denotes Israel. The Y-axis is the quarterly per-capita GDP in thousands of 1995 USD. Note that data for some countries are available only from 1984/1988.

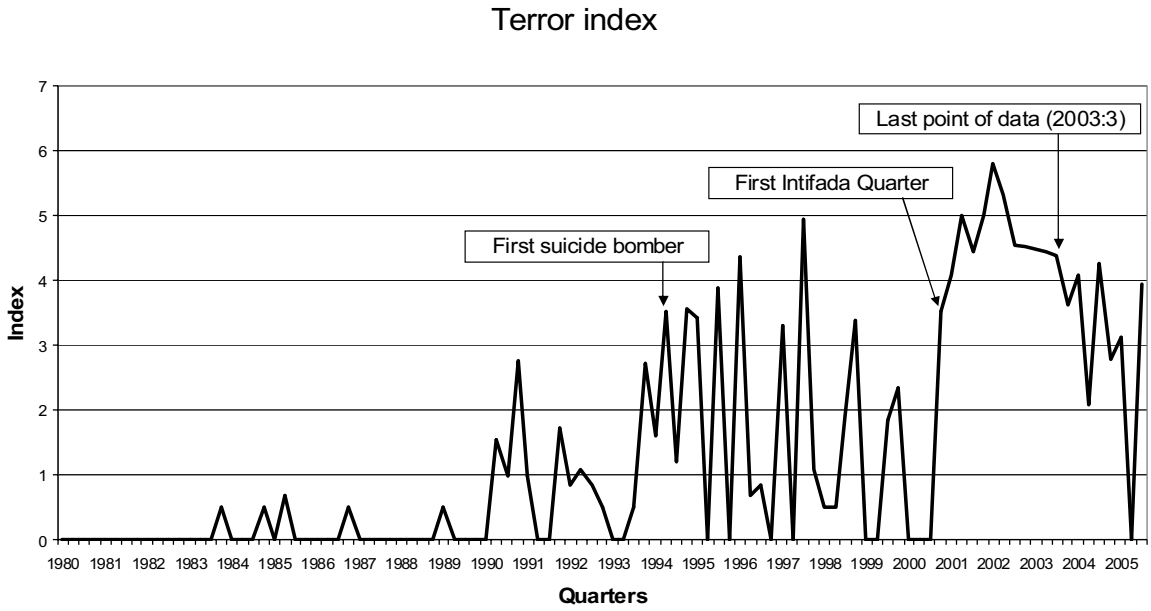


Figure A.2 – Terror index for Israel 1980:1-2005:3. The terror index calculates the logarithm of 1 plus the average of the following: the number of terror fatalities within the Green Line, the number of injured from acts of terror within the Green Line, and the number of terror events within the Green Line. Events in which rockets were fired at southern Israel were introduced into the index only if there were any casualties.

Tables

Table 1 – Per-Capita GDP Comparison: Actual Israel vs. Pseudo Israel

Configuration	1994:3 (First period of evaluation)	2000:3 (Last quarter before the "second Intifada)	2003:3 (End period)
D80 Constrained	14.924	17.178	17.775
D80 Unconstrained	15.743	18.045	18.617
D84 Constrained	14.917	16.683	17.087
D84 Unconstrained	15.947	18.436	19.026
Actual	**15.805**	**18.238**	**16.690**
Counterfactual Mean	**15.383**	**17.585**	**18.126**
Mean Loss	-0.422 (-2.67%)	-0.652 (-3.58%)	1.437 (8.61%)
Max Loss	0.143 (0.9%)	0.198 (1.09%)	2.336 (14%)
Min Loss	-0.888 (-5.62%)	-1.555 (-8.52%)	0.397 (2.38%)

Table 1 – Per-Capita GDP comparison: Actual Israel vs. Pseudo Israel. Three points in time are shown: 1994:3, the first quarter after the first suicide bomber attacked; 2000:3, the last quarter before the "second Intifada"; and 2003:3, the last point of data. At the upper section of the table, for each point in time the GDPPC in thousands of 1995 USD is given on the basis of each configuration, their mean, and the actual data. At the bottom of the table the mean/max/min deviations of Pseudo Israel GDPPC from actual GDPPC are given in absolute values and in percentages.

Table 2 – Per-Capita GDP Regressions: TER and PP explain DIFF

Configuration	DIFF(-1)	TER(-1)	PP	PP(-1)	PP(-2)	R-squared
D80 Constrained	0.8884 (0.0495)	-0.0027 (0.0007)	0.0217 (0.0079)	-0.0285 (0.0105)	0.0209 (0.0078)	0.949
D80 Unconstrained	0.8760 (0.0549)	-0.0039 (0.0010)	0.0244 (0.0081)	-0.0318 (0.0108)	0.0181 (0.0078)	0.943
D84 Constrained	0.8642 (0.0532)	-0.0019 (0.0008)	0.0240 (0.0080)	-0.0290 (0.0107)	0.0237 (0.0081)	0.923
D84 Unconstrained	0.8876 (0.0523)	-0.0042 (0.0011)	0.0227 (0.0080)	-0.0330 (0.0107)	0.0179 (0.0077)	0.946

Table 2 – Per-capita GDP regressions: TER and PP explain DIFF. The independent variable is DIFF (the difference between the actual GDPPC path of Israel and the GDPPC path of Pseudo Israel). The dependent variables are lagged DIFF, lagged terror index, and the peace process dummy and its first two lags. Each counterfactual configuration was estimated separatly. All the coefficients have 5% significant level. The standard errors of the coefficients are in parentheses. Note that when a constant was introduced, the constant was insignificant, the terror index was significant but smaller, and there was almost no change in the peace-process coefficients.

Table 3 – Natioanl Accounts Composition Regressions: TER and PP explain DIFF

"Slice"	Constant	DIFF(-1)	TER	TER(-1)	PP	PP(-1)	R-squared
Consumption	0.034* (0.014)	0.689* (0.109)		0.0026* (0.0011)	-0.0133* (0.0064)	0.0111 (0.0067)	0.770
Investment		0.960* (0.036)		-0.0007* (0.0003)		0.0029 (0.0019)	0.950
Government expenditure	-0.041* (0.010)	0.498* (0.118)	0.0016* (0.0008)		-0.0067* (0.0030)		0.649
Exports	-0.015* (0.006)	0.518* (0.123)	-0.0024* (0.0014)	-0.0027* (0.0015)	0.0136* (0.0054)		0.768
Imports		0.328* (0.148)	-0.0038* (0.0010)			0.0045 (0.0044)	0.366

Table 3 – Natioanl Accounts composition regressions: TER and PP explain DIFF. The table presents the results of five regressions (one for each aggregate) with the same general structure. DIFF is the dependent variable that represents the difference between the size of the "slice" in the data for actual Israel and its size in the average Pseudo Israel series. The lags of DIFF, TER and its lag, and PP and its lag are the group from which the explaining variables are chosen. A constant is included if there was a significant difference between the actual and the counterfactual during the whole period (1994:3-2003:3). By using a VAR system with one lag, consumption, investment and exports, obtained similar results to those shown in this table while the TER coefficients of government expenditure and imports were insignificant; see Table A.5 in the Appendix. (*- 10% significance level).

Table 4 – GDP by Industry: Differences between Actual Israel and Pseudo Israel

Aggregate	Aggregate share in 1994:3	1994:3 (First suicide bomber)	2000:4 (Beginning of Intifada 2)	2003:3 (End period)
Agriculture	1.72%	-0.36%	-0.86%	-0.55%
Manufacturing	15.39%	-2.60%	-4.61%	-3.13%
Construction	6.31%	1.37%	-0.19%	-0.21%
Services	52.39%	-0.49%	4.19%	7.35%

Table 4 – GDP by industry: differences between Actual Israel and Pseudo Israel. The second column from the left describes the share of each industry when the Palestinian deadly violence began. The other three columns report the deviation in the proportion of each industry relative to the average pseudo-Israel share in three points in time: 1994:3, the first quarter after the first suicide bomber attacked; 2000:3, the last quarter before the "second Intifada"; and 2003:3, the last point of the data. Note that the sum of shares is less than 1 because the shares comprise the gross total value added at basic prices, which, together with taxes on products, equals GDP. The detailed paths of the shares of the various industries in GDP will be provided by request.

Table 5 – Share of Agriculture in the GDP Regression: TER and PP explain DIFF

	Coefficient	Standard Error	T-Statistic	Probability of rejection
Constant	-0.00118	0.00053	-2.23923	0.032
DIFF(-1)	0.85158	0.05786	14.71829	0
TER(-1)	0.00009	0.00005	1.77389	0.086
PP	-0.00046	0.00020	-2.28872	0.029
R-Squared: 0.8996				

Table 5 – share of agriculture in the GDP regression: TER and PP explain DIFF. DIFF is the difference between the share of agriculture in the actual Israel data and its share in the average Pseudo Israel series. The lag of DIFF, the lag of TER, and PP are the chosen explaining variables. A constant is included because there is a significant difference between the actual and the counterfactual during the whole period (1994:3-2003:3).

Table A.1 – Pseudo Israel Construction: Multipliers

	DB80	DB84
LNGDPPC	1.233	1.239
C/GDP	1.407	1.25
I/GDP	1.225	1.169
G/GDP	0.454	0.478
EX/GDP	0.975	1.039
IM/GDP	0.822	0.761
DEN	0.659	0.581
AR/GDP	-	1.397
MM/GDP	-	1.095
CN/GDP	-	1.052
SR/GDP	-	1.145

Table A.1: Pseudo Israel Construction: Multipliers. The table shows the multipliers used in the Pseudo Israel construction. The multiplier is chosen so that the first transformed observation of Israel would equal the mean of the first observation in the OECD countries. Thus, each variable has a different multiplier. The multiplier gives a measure of the distance between Israel and the average OECD country at the first period of data. Note that if a multiplier is higher (lower) than 1, it means that Israel was under (above) the average OECD aggregate level at the first point of data.

Table A.2 – Pseudo Israel Construction: Weights of Constrained Configurations

	DB80	DB84
Sweden	0	0
Norway	0	0
Korea	0.173	0.001
Italy	0.066	0.415
France	0	0
Finland	0	0
Spain	0.033	0
Denmark	0.167	0.172
Belgium	0.030	0.085
Austria	0.216	0
Australia	0.315	0.327
New Zealand	-	0
Grade	1.0933	0.99757

Table A.2: Weights of each country in the constrained pseudo-Israel constructions.

Table A.3 – Pseudo Israel Construction: Weights of Unconstrained Configurations using D80

	LNGDPPC	C/GDP	I/GDP	G/GDP	EX/GDP	IM/GDP	DEN
Sweden	0	0	0	0	0	0	0
Norway	0.200	0	0	0	0	0	0.037
Korea	0.033	0	0.078	0.527	0.559	0.430	0.324
Italy	0.055	0	0	0	0.094	0	0
France	0.119	0	0	0	0.032	0	0
Finland	0	0	0	0	0.078	0	0
Spain	0.170	0.288	0	0	0.014	0	0
Denmark	0.053	0	0	0	0.223	0.424	0
Belgium	0.080	0	0.471	0.473	0	0	0
Austria	0.086	0	0.451	0	0	0	0
Australia	0.204	0.712	0	0	0	0.146	0.639
Grade	0.54615						

Table A.3: weights of each country and variable in the unconstrained Pseudo Israel construction using DB80. Note that the GDP-by-activity variables are absent from this database.

Table A.4 – Pseudo Israel Construction: Weights of Unconstrained Configurations using D84

	LNGDPPC	C/GDP	I/GDP	G/GDP	EX/GDP	IM/GDP	DEN	AG/GDP	MM/GDP	CN/GDP	SR/GDP
New Zealand	0.087	0.267	0	0	0	0	0.199	0	0.218	0	0
Sweden	0.115	0	0	0	0.147	0	0.105	0	0.365	0	0.090
Norway	0.114	0	0	0	0	0	0.118	0	0	0	0.171
Korea	0.198	0	0.002	0.476	0.534	0.202	0.276	0.114	0	0.098	0.295
Italy	0	0.351	0	0	0	0	0	0	0	0	0.046
France	0.066	0	0	0	0	0.099	0	0	0.051	0	0
Finland	0.012	0	0	0	0	0	0.106	0	0	0	0.108
Spain	0.028	0.382	0	0	0.029	0.212	0	0	0	0	0
Denmark	0.251	0	0	0	0.290	0.329	0	0.261	0.366	0	0.065
Belgium	0	0	0.763	0.524	0	0	0	0	0	0.902	0.095
Austria	0.084	0	0.235	0	0	0	0	0.625	0	0	0.031
Australia	0.045	0	0	0	0	0.158	0.196	0	0	0	0.099
Grade	0.37144										

Table A.4: weights of each country and variable in the unconstrained Pseudo Israel construction using DB84. Note that the GDP-by-activity variables are included in this database.

Table A.5 – VAR estimation of the Effect of Terror on the Composition of the National Accounts

	C/GDP	I/GDP	G/GDP	EX/GDP	IM/GDP
C/GDP (-1)	-0.0785	-0.02625	0.1914	0.2934	-0.0314
	0.2141	0.1434	0.1721	0.3647	0.4681
I/GDP (-1)	-0.7673**	1.0478**	-0.0398	0.5465**	0.0851
	0.174	0.1165	0.1399	0.2964	0.3805
G/GDP (-1)	-0.5183**	0.0696	0.2273	0.2873	-0.2909
	0.1905	0.1276	0.1531	0.3245	0.4165
EX/GDP(-1)	-0.2159	0.0209	-0.0976	0.5613**	-0.0554
	0.1621	0.1085	0.1303	0.2760	0.3543
IM/GDP (-1)	0.3043**	-0.1625	-0.0499	-0.3574	0.2518
	0.1619	0.1084	0.1302	0.2758	0.354
Constant	0.1029**	0.0031	-0.0889**	-0.0476	-0.0256
	0.0255	0.0171	0.0205	0.0434	0.0557
TER	0.0002	0.0011**	0.0008	-0.0014	-0.0025
	0.0009	0.0006	0.0007	0.0015	0.0019
TER (-1)	0.0035**	-0.0012**	0.0002	-0.0036**	-0.0007
	0.0010	0.0007	0.0008	0.0017	0.0022
PP	-0.0154**	-0.0006	-0.0083**	0.0126	-0.0056
	0.0055	0.0037	0.0044	0.0094	0.012
PP (-1)	0.0088	0.0047	0.0055	0.0045	0.0082
	0.0063	0.0042	0.0051	0.0101	0.0137
R-Squared	0.881	0.9634	0.8054	0.8058	0.4226

Table A.5 – VAR estimation of the Effect of Terror on the Composition of the National Accounts. The system includes five equations, one for the share of each macroeconomic aggregate in GDP. The dependent variables are the differences between Actual Israel and average Pseudo Israel. The explaining variables are the first lag of these differences, the terror index and its first lag, and the peace-process dummy and its first lag. For each explanatory variable, the first row presents the coefficient and the second presents the standard error (- the coefficient is 10% significant).**