An Estimation of Human Capital Loss Resulting from Subversive Deaths Due to the Northern Ireland Conflict

Brian Armour
Western Kentucky University

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Armour,

Brian Samuel

1990
AN ESTIMATION OF HUMAN CAPITAL LOSS RESULTING FROM
SUBVERSIVE DEATHS DUE TO THE NORTHERN IRELAND CONFLICT

A Thesis
Presented to
the Faculty of the Department of Economics
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by
Brian Samuel Armour
December 1990.
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AN ESTIMATION OF HUMAN CAPITAL LOSS RESULTING FROM SUBVERSIVE DEATHS DUE TO THE NORTHERN IRELAND CONFLICT

Date Recommended 8/20/90

Director of Thesis

Date Approved December 20, 1990

Dean of the Graduate College
Conflict entails numerous sacrifices in human resources in addition to loss of life. While it is difficult to appraise the real cost of conflict, one can determine the number of fatalities. It is the primary goal of this thesis to develop an accounting technique by which the human capital cost of fatalities due to the Northern Ireland Conflict may be measured in an accepted unit of account. While the development of a model for measuring human capital loss is in itself an important part of the study, the ultimate objective is to arrive at an estimate of the human capital cost of subversive deaths in Northern Ireland.

In this analysis a representative individual is used to estimate human capital loss. The expected earnings stream over the relevant number of earnings periods, discounted at the appropriate rate of interest and accounting for the probability of death and unemployment within these periods is the definition given to the value of the human capital stock of an individual. The primary data used in this study
is that which recorded fatalities due to the conflict.

Considering that human capital is an important input in the production function and that conflict tends to destroy the more productive portion of the human capital stock, the long-run effect of losses due to continuing strife and conflict are as yet unknown. In the short-run, however, the conflict is known to exert a heavy toll on the Northern Ireland economy. As of April 1990, the total human capital loss estimate of subversive deaths resulting from the Northern Ireland conflict were £186,993,266 for security forces and £400,493,890 for civilians, resulting in a total estimated loss of £587,487,156.
# Table of Contents

Table of Contents ........................................ iv
Table of definitions/Abbreviations ................. vi
List of Tables ............................................ vii

Introduction ............................................. 1

Survey of the Literature ............................... 4
  Survey of Methodology and Estimates ............. 4
  Giffen .............................................. 4
  Eisner ........................................... 6
  The Economic Impact of The Northern Ireland Conflict  .... 7
  Conclusion ...................................... 9

The Basic Model ....................................... 11
  Loss to Whom? .................................. 14

Non-Casualty Data ..................................... 15
  Earnings Data .................................. 15
  Police Earnings Data ......................... 16
  British Army/UDR Earnings ............... 16
  Civilian Earnings .......................... 19
  Mortality Rate ............................... 20
  Discount Rate ................................. 22
  Productivity Rate ........................... 23

Fatality Data ........................................ 24
  Security Force Fatality Data ............... 24
  Police (RUC/RUCR) ........................ 24
  British Army/UDR .......................... 28
  Civilians .................................. 28

Results .................................................. 32

Summary and Conclusions .......................... 38
  Introduction .................................. 38
  Basic Model .................................. 39
  Earnings and Productivity Growth Rate .......... 40
  Mortality Rate .................................. 40
  Discount Rate .................................. 41
  Fatality Data .................................. 41
  Results ......................................... 42
  Conclusion ..................................... 44
Appendix ........................................ 45
  Police Constables ............................ 45
  Civilian Category ............................ 46
Bibliography .................................... 48
Table of definitions/Abbreviations

1. Loyalist - the general term used for a hard-line protestant.

2. Northern Ireland Office (NIO) - mainland administration headquarters for all Northern Irish Affairs since 1972.

3. Republicans - militant nationalists who use violence to further their aims.

4. Royal Ulster Constabulary (RUC) - Police Force of N. Ireland.

5. Royal Ulster Constabulary Reserve (RUCR) - Part-time and Full-time Reserve Police Force.

6. Ulster Defence Regiment (UDR) - The largest infantry regiment in the British Army with a total strength of around 6,200 both full-time and part-time. Its role, like that of other elements of the regular army in Northern Ireland, is to support the RUC in the fight against terrorism.
List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cost of continuation of the Northern Ireland Conflict Per Year</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Police Pay Scales (with effect from 1st September 1989)</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>Ulster Defence Regiment-Permanent Cadre/British Regular Forces (with effect from 1st September, 1941)</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>Number of Fatalities Due to the Northern Ireland Conflict 1969 - 1990</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>Mean Age of RUC/RUCR Fatalities by Rank</td>
<td>27</td>
</tr>
<tr>
<td>6</td>
<td>Mean Age of Army/UDR Fatalities by Rank</td>
<td>29</td>
</tr>
<tr>
<td>7</td>
<td>Human Capital loss estimation of RUC/RUCR Fatalities by Rank</td>
<td>33</td>
</tr>
<tr>
<td>8</td>
<td>Human Capital Loss Estimation of British Army/UDR Fatalities by Rank</td>
<td>35</td>
</tr>
<tr>
<td>9</td>
<td>Total Human Capital Loss Estimations of all Subversive Deaths due to the Northern Ireland Conflict</td>
<td>43</td>
</tr>
</tbody>
</table>
Introduction

With numerous uprisings occurring in what is now called the Republic of Ireland (Eire), most notably the "1916 Uprising," Eire would eventually gain its independence from Britain in 1922 and with this independence: Eire became the State with what was tantamount to dominion status, and the British Crown was still recognized in external affairs. When the Republic of Ireland established itself as a country in 1922, six counties in the Province of Ulster, with a two-thirds protestant majority, opted out of this "Free State" and remained an integral part of the United Kingdom. These counties became a constitutionally distinct part of the U.K., the Province of Northern Ireland, with its own parliament exercising devolved powers and functions at Stormont. This link was severed with Britain in 1949.

For some fifty years the Ulster Unionist Party governed Northern Ireland. The Ulster Unionists were affiliated with the British Conservative Party, and its members of parliament followed the Conservative Party Line in the House of Commons.
In the mid 1960's, with the Civil Rights Movement in America sending shock waves across the western world, the Civil Rights Association formed in Northern Ireland and a series of marches and demonstrations ensued. The Unionist Prime Minister of Northern Ireland from 1963-69, Captain Terrance O'Neill, was sympathetic towards Catholic grievances, but his attempts at reform led to increasing tensions amongst the Ulster Unionist Party, which eventually resulted in a party split in the early 1970's. As sectarian violence erupted throughout the 1970's, the British Government in 1969 deployed the British Army in an attempt to keep the peace between two extremely hostile Loyalist and Republican communities.

In 1972 the parliament at Stormont was dissolved and Northern Ireland was ruled directly from Britain. In the early 1970's the Provisional Irish Republican Army (PIRA), a splinter group of the Irish Republican Army, started and intensified a campaign of terror. In response protestant terrorist groups formed, and violence on either side bred counter violence and "tit for tat" reprisals. By April 1990, 2,797 people, including 878 security force members, have been killed in Northern Ireland since 1969.

The primary goal of this analysis is to develop an economic technique by which the human capital cost of the total destruction of individuals as a result of the Northern Ireland conflict may be measured in an accepted unit of
account. Theoretically, the technique for estimating the cost of human life lost in the conflict is an extension of accepted human capital theory. This technique is developed in detail in section three. While the development of a model for measuring human capital loss is in itself an important part of this study, the ultimate objective is to arrive at an estimate of the human capital cost of subversive deaths in Northern Ireland.

Past studies have attempted to measure the human capital loss due to war. For example, Giffen examines the Franco-German War, and Eisner estimates the human capital loss of the Vietnam Conflict. Unfortunately, a summary report carried out on behalf of the Bank of Ireland is the only available analysis of the cost of terrorism to the economies of both Northern Ireland and the Republic of Ireland.

The results obtained in the model are but a fraction of the cost that the conflict imposes upon, say for example, the area of security. Therefore, it is quite possible to overlook the significance of the human capital loss. Such a possibility is addressed in Birkeli's (1971) study:

"Physical destruction, no matter how complete or how costly can be rebuilt over a short period of time in a healthy economy; this is not the case, however, for the destruction of human capital. Recuperative powers of an economy are very much affected by the stock of capital; hence, the reconstruction after physical damage may well be dependent upon the magnitude of the human capital loss."
Survey of the Literature

In attempting to estimate the human capital loss resulting from war, a basic assumption is that one's capitalized earnings stream is capital and that an individual's death reduces the stock of a nation's wealth. This section summarizes the works of several notable economists who used the human capital concept in their attempts to estimate total economic losses resulting from war. Giffen and Eisner, in their respective works, estimated the value of this loss by placing a monetary value on human life. Additionally, a recent report, prepared on behalf of the Bank of Ireland, is analyzed because it calculates the total cost that terrorism has enumerated on the province of Northern Ireland.

Survey of Methodology and Estimates.

Giffen.

Giffen, in edition one of "Essays in Finance," embarks on a project that will estimate the total cost to the combatants of the Franco-German War (Birkeli, 1971). Giffen recognized both loss of life and disability caused by war as associated costs of war. In order to illustrate his estimates as to the costs of war, the following example is
used: The number of French soldiers' lives destroyed is determined to be seventy thousand. An analysis of this total indicates that 30,000 were killed, 30,000 had partial disabilities and out of a total of 80,000, one-eighth, some 10,000 were invalidated on the average.

Giffen recognized that in order to determine war losses as accurately as possible, human life would have to be attributed a monetary value, and this value in turn would be included in the final estimate. This was accomplished. However, one should note that Giffen believed the estimate he had obtained to be somewhat crude and imperfect, and, furthermore, that the losses in war were not amenable to monetary valuation (Birkeli, 1971). Although, Giffen did in fact estimate a monetary evaluation of such losses, this was excluded from his published estimates of total war costs. Giffen estimated the average age of an individual who lost his earning power as a result of war to be twenty-five years. Additionally, earnings life expectancy was estimated to be twenty years, and the individual was assumed to be earning forty pounds annually. Therefore, an individual's monetary value could be obtained from the following equation:

\[ V_p = \sum R/(1+r)^i \quad i = 1,2,3...,2(1) \]

where:

- \( V_p \) = individuals capital value.
- \( R \) = expected future earnings.
- \( r \) = discount rate.
- \( i \) = the number of earning periods remaining.
The French sold million pound civilians that some 100 resulting eco.
Therefore, as earning power, million pounds. who had their li expected earnings.
Giffen estim their lives destro earnings and life French counterparts German lives destroy pounds. Therefore, the resulting from the Fr and thirty-two million

Eisner.

In the "War and the Still in Vietnam?, Eisne
1970, of the Vietnam War.
total fatalities to be 50.
CORRECTION

PRECEDING IMAGE HAS BEEN REFILMED
TO ASSURE LEGIBILITY OR TO CORRECT A POSSIBLE ERROR
The estimated capital loss which resulted from 70,000 French soldiers' lives being destroyed totalled forty-two million pounds. Also, it was estimated that 200,000 French civilians had their lives destroyed. However, Giffen assumed that some 100,000 individuals would be at an age where their resulting economic value would be of no significance. Therefore, assuming that only 100,000 civilians lost their earning power, the associated capital value totalled sixty million pounds. Note, Giffen assumed that all individuals who had their lives destroyed by the war had identical expected earnings and life expectancy.

Giffen estimated that some 50,000 German soldiers had their lives destroyed, and once again, their expected earnings and life expectancy was identical to that of their French counterparts. The total human capital value of German lives destroyed was estimated at thirty million pounds. Therefore, the total human capital value/loss resulting from the Franco-German War totalled one hundred and thirty-two million pounds (Birkeli, 1971).

Eisner.

In the "War and the Economy," a Chapter of Why Are We Still in Vietnam?, Eisner summarizes the cost, as of May 1970, of the Vietnam War. In his estimation he calculates total fatalities to be 50,067, the total number wounded to
equal 140,286, and the mean disability rate to be 35.6% (Birkeli, 1971).

Eisner in the calculations uses an income estimate, that is: "an annual contribution of national income of males, twenty years of age and over."

An average is then obtained from total labor income in 1969 adjusted by total civilian employment broken into age and sex categories. This average is estimated to be $10,185 per civilian male age twenty and over.

"Eisner further assumes the average individual to have forty earning periods left at the point of death or disablement. Hence, by capitalizing $10,000 (not $10,185) over forty years at a real discount rate of 5% and assuming an annual growth rate of productivity (earnings) of 2%, the present value of the representative individual is estimated to be $231,148. That is:

\[
\text{Average P.V. = Initial Earnings } \sum_{t=1}^{40} \left( \frac{1.02}{1.05} \right)^t,
\]

By multiplying this average by the number of fatalities, the total human capital loss of 50,067 war dead is approximately $11.6 bn. And by multiplying 35.5% of the disabled by the same average, the human capital loss resulting from disability totals $11.5 bn. The total loss in human capital in Vietnam, to May 16, 1970, then, according to Eisner, is $23.1 bn."

The Economic Impact of The Northern Ireland Conflict.

Terrorism and the political instability associated with its reign are costing the Northern Ireland economy IR£ 358 million as indicated by Table 1 (Davy, Kelleher, and McCarthy Ltd. Economic Consultants, 1990). The calculations attempt to ascertain what each economy (N.
Table 1
Costs of Continuation of Northern Ireland Conflict Per Year

<table>
<thead>
<tr>
<th>Costs</th>
<th>1988 IR£ Million</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Security</strong></td>
<td></td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>334</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>398</td>
</tr>
<tr>
<td><strong>Tourism</strong></td>
<td></td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>23</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td></td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>1</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>436</td>
</tr>
</tbody>
</table>

Ireland and Eire) would save following a cessation of the violence. The report highlighted security, tourism, industrial development, energy and transport as the prime sectors, in terms of cost, most effected by the continuation of violence. It also noted that:

"One of the largest hidden costs of the Northern Ireland Conflict may well be the inconvenience to ordinary citizens caused by the activities of terrorists and the response of the security forces to these activities."

The study acknowledges that the greatest cost of the conflict had been in terms of human life, however, no estimate of this cost was given.

"One obvious consequence of civil disturbances is the escalation of security and public order costs. Terrorist activity in Northern Ireland has resulted in over 32,000 shooting incidents, almost 9,000 explosions, and almost 14,000 armed robberies between 1970 and 1988. 2,700 people were killed and almost 30,000 injured in connection with the conflict between 1969 and 1988."

Conclusion

Both, Giffen and Eisner's respective studies, which evaluate human capital loss due to war, are open to criticism. Giffen's difficulties result from the fact that he only employed averages in his calculations. One problem being that he assumed everyone who had their lives destroyed due to the war to be age twenty-five because of inadequate data. Also, Giffen does not employ a growth rate and the resulting use of constant earnings leads to an inadequate estimate (Birkeli, 1971).
Eisner's study is open to criticism in that his use of averages tends to detract from the reliability of the results. A separation of the data into various age groups would undoubtedly lead to more confidence in the final results. Also, if this last suggestion had been incorporated by Eisner, the use of a mortality rate would have been possible. The utilization of life tables in place of the expected life assumption that he used would have contributed to the accuracy of the final estimate (Birkeli, 1971).

The Bank of Ireland report, estimating the economic impact associated with the Northern Ireland Conflict, acknowledges that the greatest cost of the violence has been in terms of the human life destroyed. The report goes on to give statistics of the number of persons killed and injured, but fails to specify the associated costs. Likewise, for the respective sectors which the report focuses upon, there is no breakdown of the costs such sectors endure as a result of terrorist activity and the political instability closely associated with it.
The Basic Model

The model used in this study is based upon the basic human capital loss equation where an individual's human capital stock is assumed to be the present value of their expected earnings stream.

In this analysis a representative individual of a group/sub-group within each category is used for each individual within the respective group, whose human capital was totally destroyed by the conflict. This paper sets out to determine the $i^{th}$ individual earnings capacity and from this the procedure followed is one which estimates their future capitalized earnings stream, and ultimately the resulting human capital loss to the Northern Ireland Economy (See Section Six).

The expected earnings stream over some relevant number of earning periods discounted at an appropriate rate of interest, accounting for the possibility of death and employment within these periods is the definition given to the value of the human capital stock of an individual. The earnings stream or potential earnings stream of the $i^{th}$ individual is dependent upon a person's health and mobility, education and training attained, and the knowledge of the market for his services (Birkeli, 1971).
For this study, however, income at death is either known or approximated (see section 4). Therefore, the basic equation by which to estimate the human capital loss of the $i^{th}$ individual, as a result of the Northern Ireland Conflict, is as follows:

$$VP_i = \frac{(1+g)^n}{1 - (1+d)^n - (1+g)}$$

where:

- $VP_i$ = the present value of the human capital loss of the $i^{th}$ individual (calculated from estimated age of death to retirement age).
- $A_i$ = capitalized earnings stream adjusted for mortality.
- $n$ = number of potential earning periods remaining.
- $g$ = growth rate.
- $d$ = discount rate.

Hence, the estimate of human capital loss is dependent upon the expected capitalized future earnings stream of casualties, the discount rate and growth rate.

Total human capital loss ($K$) may be expressed as:

$$K = \Sigma VP_i.$$  \hspace{1cm} (3)

where:

- $VP_i$ = the present value of the human capital loss of the $i^{th}$ individual.

Note, in equation 2 it is assumed that an individuals earnings (productivity) per annum is subject to a growth rate. This procedure implicitly assumes a constant rate of increase in productivity.
In this study, i is defined as those individuals whose human capital has been totally destroyed by war. The discount rate utilized is of significant importance since slight changes in the rate will produce substantial changes in the final capitalized value. Therefore, caution is of the utmost importance when selecting a discount rate. The capitalized earnings stream of each individual must be adjusted for "normal" mortality. The use of life tables provided by the Northern Ireland Department of Health and Social Services enables one to ascertain the probability of an individual being alive at the end of a particular earnings period. Thus, capitalized earnings are adjusted for mortality prior to their inclusion in equation 2 (refer to Section four and Appendix A).

The approach undertaken thus far is identical to that of Birkeli, with the evaluation of the position of Northern Ireland's human capital stock being a partial equilibrium evaluation. As Birkeli (1971) states:

"We have assumed that the change in the economic status of the number of individuals (casualties) under study does not affect significantly the economic status of the remaining work force; that is, current economic activity is unaffected. This approach implies, for example, that the labor market is unaffected by war casualties and earnings (forgone) can be taken as data. This assumption is not unrealistic for a war the size of the Vietnam Conflict. In a larger war, it might be desirable to devise a general equilibrium model where casual effects can go both ways."

Since Northern Ireland's Conflict is relatively small when compared to the United States involvement in Vietnam,
this analysis incorporates those assumptions previously cited, along with the assumption of full employment.

Loss to Whom?

As Birkeli (1971) states:

Unless a beneficiary exists, there is no loss, for loss is not an absolute, but a relative concept. Although something may cease to exist unless its loss creates a void in someone's space, the loss cannot be recognized. Hence, a man's death is not a loss to himself since, by the event of death, his space is redefined. Loss caused by death, therefore, must be measured in relationship to that which continues to exist in spite of death. We may generally define the "loser" as the potential beneficiary of an individual's life; that is, he who experiences the void when the death occurs.

Since loss from death and disability is many sided, we must define that part of the void or loss that we wish to detect. In our case, the loss is an economic loss in dollars and cents. It is a quantitative measurement of the financial loss incurred by the beneficiaries of the dead and disabled. Emphatically, it is not a measure of the total loss, only that part (large or small) which is quantifiable. Thus, human capital loss is only a partial estimate of total human losses resulting from the total or partial destruction of human lives in war.

For each life destroyed undoubtedly many lives will be affected. However, Birkeli points out that if an individual's survivors are deemed the beneficiaries, which they most certainly are, in the context of this study the issue of "loss to whom" would likely be unnecessarily frustrated. Therefore, in order to simplify this analysis, society as a whole is deemed the beneficiary (Birkeli, 1971).
Non-Casualty Data

The following section organizes the non-casualty data and parameters in order to prepare for their inclusion in the final analysis.

The unavailability of certain data has resulted in the use of approximations for the productivity rate and discount rate variables. Similar to past studies, this study does not attempt to "theoretically justify" the productivity and discount rates chosen. Instead, in the case of the productivity rate an approximation was used. The assumption being that what is true for the sum is true for the individual and vice-versa. The discount rate was chosen based upon rates commonly used in past studies of this nature. The use of approximations and assumptions will likely be criticized. However, in anticipation of this, and to avoid charges of over estimation, an effort has been made to produce a downward bias in the results (Birkeli, 1971).

Earnings Data.

The earnings data used in this study were obtained primarily from the following three sources: Ulster Defence Regiment/ British Information Office, The Royal Ulster
Constabulary-Benevolent Society, and finally, the Annual Abstract of Statistics for 1989 provided information on civilian earnings.

Police Earnings Data.

The RUC Benevolent Society provided information on police earnings according to rank, as indicated by Table 2 (The Police Federation For Northern Ireland, 1990). Calculations were undertaken in order to provide human capital estimations on RUC subversive deaths for all federated ranks. Here, the assumption made was that earnings data after two years at a certain federated rank were utilized in our study (for a more complete explanation, see Appendix A). The earnings figures, effective from September 1, 1989, are gross, neither taxes nor national insurance have been deducted.¹

British Army/UDR Earnings

The UDR and British Army Information Office provided information on personnel weekly pay according to rank as indicated by Table 3 (Ulster Defence Regiment, Headquarters, UDR, 1990). Earnings per annum were obtained by multiplying the rates given by fifty-two. In calculations the average age of privates killed was determined to be 23.3 years.

¹ Due to a lack of information, the Northern Ireland Allowance--hazardous duty pay that individuals receive for working in Northern Ireland--was not considered earnings.
Table 2
Police Pay Scales
(with effect from 1st September 1989)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Current Scale</th>
<th>New Scale</th>
<th>Hourly Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On Appointment</td>
<td>9,063</td>
<td>9,900</td>
<td>4.74</td>
</tr>
<tr>
<td>after 1 year</td>
<td>9,690</td>
<td>10,587</td>
<td>5.07</td>
</tr>
<tr>
<td>after 2 years*</td>
<td>11,406</td>
<td>12,462</td>
<td>5.97</td>
</tr>
</tbody>
</table>

* Entry point for those aged 22 or over who will move to the next point after three years service.

<table>
<thead>
<tr>
<th>Sergeants</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>On Appointment</td>
<td>14,466</td>
<td>15,804</td>
<td>7.57</td>
</tr>
<tr>
<td>After 1 year</td>
<td>15,123</td>
<td>16,521</td>
<td>7.92</td>
</tr>
<tr>
<td>After 2 years</td>
<td>15,654</td>
<td>17,103</td>
<td>8.20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inspectors</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>On Appointment</td>
<td>16,593</td>
<td>18,129</td>
<td>8.69</td>
</tr>
<tr>
<td>After 1 year</td>
<td>17,112</td>
<td>18,696</td>
<td>8.96</td>
</tr>
<tr>
<td>After 2 years</td>
<td>17,784</td>
<td>19,428</td>
<td>9.31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Superintendents</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>On Appointment</td>
<td>25,629</td>
<td>27,999</td>
<td></td>
</tr>
<tr>
<td>After 1 year</td>
<td>26,283</td>
<td>28,713</td>
<td></td>
</tr>
<tr>
<td>After 2 years</td>
<td>26,934</td>
<td>29,424</td>
<td></td>
</tr>
</tbody>
</table>

Source: For Northern Ireland, Pay and Allowances (Royal Ulster Constabulary, Garneville, Belfast BT4 2NX, Northern Ireland).
<table>
<thead>
<tr>
<th>Rank</th>
<th>Weekly (Before Tax) £</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private 21 and over</td>
<td>178.22</td>
</tr>
<tr>
<td>Lance Corporal</td>
<td>220.71</td>
</tr>
<tr>
<td>Corporal</td>
<td>266.07</td>
</tr>
<tr>
<td>Sergeant</td>
<td>288.47</td>
</tr>
<tr>
<td>Staff Sergeant</td>
<td>302.40</td>
</tr>
<tr>
<td>Warrant Officer 01</td>
<td>346.57</td>
</tr>
<tr>
<td>Warrant Officer 02</td>
<td>393.33</td>
</tr>
<tr>
<td>Captain (Daily Rate) *</td>
<td>46.74</td>
</tr>
<tr>
<td>Major (Daily Rate) *</td>
<td>58.66</td>
</tr>
</tbody>
</table>

* Effective from 1st April 1989.

Therefore in this study the private pay rate utilized was for those privates 21 years and older. Note all earnings rates used are for male military personnel.

Civilian Earnings.

It would have been an extremely arduous, if not impossible, task to gather earnings information for each of the 1919 civilians killed as a result of the Northern Ireland Conflict. Therefore, for the purpose of our study, i is defined as those civilians whose human capital has been destroyed by the conflict. Thus, the i\textsuperscript{th} individual's earnings were estimated based upon the following:

1. Since the majority of the Northern Ireland population between the ages of twenty-five and seventy lie in the 25-29 age bracket, it was assumed that the average age of those killed lay in this interval (Northern Ireland, 1987).

2. From the Annual Abstract of Statistics the medium gross weekly earnings of full time employees, in the 25-29 age bracket, equalled £167.75 (U.K., 1989).

The i\textsuperscript{th} individual's gross earnings per annum (Y), as of April 1987, is as follows:

\[ Y '87 = £167.75 \times 52 = £8,717. \quad (4) \]

The earnings data obtained represents 1987 levels, and therefore the rate must be modified to properly reflect 1990
earnings. To adjust the 1987 civilian earnings estimate to an April 1990 estimate equation 5 is applied.

Using the 3% growth rate:

\[ Y'90 = Y'87 \times (1+g)^n \]  
\[ = 8,717 \times (1+0.03)^3 \]  
\[ = \mathbf{9,525.30} \]

Mortality Rate.

Since everyone dies eventually, each person faces the possibility of having their earning periods "truncated" by death. Such a possibility varies with many factors, but most notably age. In calculating the capitalized value of the fatalities resulting from terrorism in Northern Ireland, the possibility expressed above must be incorporated into this analysis. To incorporate the mortality rate, life tables (for 1984-1986) from the Northern Ireland Annual Abstract of Statistics are used (Northern Ireland, 1988). Note, the use of such tables, as discussed in Birkeli's study (1971), results in two major problems:

"Principally, the fact that life expectation prospects continually improve imposes a real barrier to effective calculations...Furthermore, life expectancy differs between sexes and races".

However, similar to the stance taken by Birkeli, these problems have not been incorporated in the data manipulations.
Life tables establish the probability that a person who is alive at the beginning of the year will die before the end of that year. For example, a twenty-year-old male has a probability 0.00130 of dying before he is twenty-one (Northern Ireland, 1988). Mortality adjustment is calculated by multiplying the capitalized value of earnings, given in a particular period, by one minus the probability of dying in that period, divided by two (to agree with the assumption that one dies in the middle of their earnings period) (Birkeli, 1971).

The probability of survival is given in equation (6)

\[ PS_i = 1 - \frac{PD_i}{2}. \]

(6)

where:

- \( PS_i \) = the probability of surviving to the middle of the \( i^{th} \) earnings period.
- \( PD_i \) = the probability of dying in the middle of the \( i^{th} \) earnings period.

This formula adjusts for mortality for one period only. However, with the passing of earning periods the probability that an individual does not survive increases. Therefore, to incorporate this probability into the model one multiplies the current capitalized earnings value times the appropriate \( PS_i \) and, also, times the product of the probabilities of surviving all remaining periods.

The age interval in the current life table is in five year blocks. However, calculations are made on a yearly basis. An example of the method used is as follows:
The calculated PSi for age 30, for example, adequately comprehends that period only. Likewise, the calculated PSi for age 35 adequately comprehends that period only. However, ages 31-34 are neglected by the life tables. In order to incorporate the missing data in the model, the PSi for age 30 is used to represent the PSi's for ages 31-34, respectively, and the PSI for 35 to represent 36-39, and so on. This was seen as the best means by which to obtain as accurate an estimation as possible. While noting that this method may produce a slight upward bias in the final results, this will likely be offset due to the fact that life expectancy has improved since (1984-1986), and life expectation prospects will continue to improve.

Discount Rate.

In implementing a discount rate Birkeli (1971) believed that:

"Choosing the appropriate discount rate is perhaps the most arduous task confronting the researcher."

Pointing to, and deliberating on the debate which raged over whether to employ a social or private rate of discount, Birkeli, in the end, chose neither and opted to use rates that had been incorporated in past studies of a similar nature.

Birkeli's study utilized two separate discount rates, which were 5% and 10%, respectively. Eisner in his study used a rate of 5% (Birkeli, 1971). Therefore, from the
precedent set by these economists the discount rate utilized in this study is also 5%.

Productivity Rate.

The rate of growth (g), or the increase in productivity reflected in the earnings rate, used in our study, is an aggregate rate. The reason for this is as follows (Birkeli, 1971):

Since income is an average income for all races and all levels of occupation, $r$ must encompass several economic variables, variables which influence earnings fluctuation.

Birkeli (1971) points out some of the variables that would tend to influence earnings fluctuation. These, however, are not discussed here. He also notes that it is impossible to pin-point what the growth rate (g) should be. Thus, he employs two rates 2% and 3%, respectively.

In the United Kingdom between the 1950's and early 1960's, total real income growth averaged 2.29% per annum (Cause, 1968). It continued to average between 2% and 3% annually up to 1973, but hence fell and remained below 2% until the early 1980's. Since then the U.K. has had the highest rate of growth among member countries of the EC and income growth has been some 3% per annum, a rate of 3% has been employed in this analysis (U.K., 1988).
Fatality Data.

In order to accurately estimate the human capital loss, the fatality data are classified into two categories—security forces and civilians. Additionally, the security force category was sub-divided into two sections: police (RUC and RUCR) fatalities and British Army/UDR fatalities. Table 4 indicates the total number of fatalities by category per year, from 1969-April 30, 1990.

Security Force Fatality Data.

The data category of prime importance to this study is that which recorded fatalities due to the conflict. The original raw data obtained from the Northern Ireland Office and the Irish Information Partnership are unsuitable for the task at hand. Therefore, numerous other sources were evaluated on the basis of whether the fatality information required for the estimation could be obtained. Both the RUC and British Army were approached for statistics pertaining to security force fatalities and the resulting data obtained from both these sources are introduced here (see Appendix A for an example of their development).

Police (RUC/RUCR).

The police force fatality data have been developed by age and rank. Table 5 shows the number of fatalities by mean
### Table 4

**Number of Fatalities Due to the Northern Ireland Conflict 1969 - 1990**

<table>
<thead>
<tr>
<th>Year</th>
<th>RUC</th>
<th>RUC 'R'</th>
<th>ARMY</th>
<th>UDR</th>
<th>CIVILIAN</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>1970</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>1971</td>
<td>11</td>
<td>43</td>
<td>5</td>
<td></td>
<td>115</td>
<td>174</td>
</tr>
<tr>
<td>1972</td>
<td>14</td>
<td>103</td>
<td>26</td>
<td></td>
<td>321</td>
<td>467</td>
</tr>
<tr>
<td>1973</td>
<td>10</td>
<td>58</td>
<td>8</td>
<td></td>
<td>171</td>
<td>250</td>
</tr>
<tr>
<td>1974</td>
<td>12</td>
<td>28</td>
<td>7</td>
<td></td>
<td>166</td>
<td>216</td>
</tr>
<tr>
<td>1975</td>
<td>7</td>
<td>14</td>
<td>6</td>
<td></td>
<td>216</td>
<td>247</td>
</tr>
<tr>
<td>1976</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td></td>
<td>245</td>
<td>297</td>
</tr>
<tr>
<td>1977</td>
<td>8</td>
<td>15</td>
<td>14</td>
<td></td>
<td>69</td>
<td>112</td>
</tr>
<tr>
<td>1978</td>
<td>4</td>
<td>14</td>
<td>7</td>
<td></td>
<td>50</td>
<td>81</td>
</tr>
<tr>
<td>1979</td>
<td>9</td>
<td>38</td>
<td>10</td>
<td></td>
<td>51</td>
<td>113</td>
</tr>
<tr>
<td>1980</td>
<td>3</td>
<td>8</td>
<td>9</td>
<td></td>
<td>50</td>
<td>76</td>
</tr>
<tr>
<td>1981</td>
<td>8</td>
<td>10</td>
<td>13</td>
<td></td>
<td>57</td>
<td>101</td>
</tr>
<tr>
<td>1982</td>
<td>8</td>
<td>21</td>
<td>7</td>
<td></td>
<td>57</td>
<td>97</td>
</tr>
<tr>
<td>1983</td>
<td>9</td>
<td>5</td>
<td>10</td>
<td></td>
<td>44</td>
<td>77</td>
</tr>
<tr>
<td>1984</td>
<td>7</td>
<td>9</td>
<td>10</td>
<td></td>
<td>36</td>
<td>64</td>
</tr>
<tr>
<td>1985</td>
<td>14</td>
<td>2</td>
<td>4</td>
<td></td>
<td>25</td>
<td>54</td>
</tr>
<tr>
<td>1986</td>
<td>10</td>
<td>4</td>
<td>8</td>
<td></td>
<td>37</td>
<td>61</td>
</tr>
<tr>
<td>1987</td>
<td>9</td>
<td>3</td>
<td>8</td>
<td></td>
<td>66</td>
<td>93</td>
</tr>
<tr>
<td>1988</td>
<td>4</td>
<td>21</td>
<td>12</td>
<td></td>
<td>54</td>
<td>93</td>
</tr>
<tr>
<td>1989</td>
<td>7</td>
<td>12</td>
<td>39</td>
<td></td>
<td>62</td>
<td>93</td>
</tr>
<tr>
<td>1990-to</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>6</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 April</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>177</td>
<td>92</td>
<td>422</td>
<td>187</td>
<td>1,919</td>
<td>2,797</td>
</tr>
</tbody>
</table>

**Source:** Northern Ireland Office, *Number of Deaths Due to Security Situation 1969 - 1990* (Northern Ireland Office, Statistics Branch, Room 8, Dundonald House, Belfast, N. Ireland).
Table 5

Mean Age of RUC/RUCR Fatalities by Rank

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mean Age ($\mu = \Sigma X_i/n$)</th>
<th>Total Number of Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part-time Reserve Constable</td>
<td>41</td>
<td>51</td>
</tr>
<tr>
<td>Full-time Reserve Constable</td>
<td>38</td>
<td>42</td>
</tr>
<tr>
<td>Constable</td>
<td>30</td>
<td>127</td>
</tr>
<tr>
<td>Sergeant</td>
<td>35</td>
<td>29</td>
</tr>
<tr>
<td>Inspector*</td>
<td>42</td>
<td>16</td>
</tr>
<tr>
<td>Superintendent**</td>
<td>51.5</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>269</td>
</tr>
</tbody>
</table>

* includes 1 Chief Inspector
** includes 1 Chief Superintendent

Source: Constructed from information provided by the Police Federation of Northern Ireland (RUC, Garneville, Belfast BT4 2NX, Northern Ireland).
age and rank. At this stage one should note that in Eisner's study an average age was utilized. This was assumed to be 21 years for all casualties, and an average working life assumed to be 40 years was also utilized. However, in reference to these assumptions Birkeli (1971) states:

"Although the use of a mean age of all casualties may not substantially bias the estimate of human capital loss, a procedure of breaking the casualties into actual age groups to be calculated separately would lend more confidence to the final results. Also, if the latter approach had been utilized, a mortality rate could have been properly incorporated in the estimating formula."

Noting Birkeli's criticism of Eisner's approach, in order to obtain an estimate of the average age of death of the $i^{th}$ policeman, the ages of all police personnel, according to rank, were summed to calculate a mean based upon equation (7).

\[
\mu = \frac{\Sigma X_i}{n} \quad i = 1,2,\ldots,n. \tag{7}
\]

where:
\[
\begin{align*}
\mu &= \text{average age of death of } i^{th} \text{ individual, according to rank.} \\
X_i &= \text{each individual's age within a certain rank.} \\
n &= \text{total number of fatalities per federated rank.}
\end{align*}
\]

For example, in the case of police constables the mean age of death was approximately thirty. Thus, along with the other information and assumptions the age variable is employed in this analysis (refer to section 3) in order to obtain a human capital loss estimation for the $i^{th}$ constable, and ultimately an estimation for all police constables (See Appendix A). As previously noted, this same
process is used to calculate the mean age of death for police sergeants, inspectors, etc.

Note, for the purpose of this analysis, retirement age from the RUC is assumed to be age sixty.

British Army/UDR.

Once again the data have been developed by age and rank. Table 6 shows the number of Army/UDR fatalities by mean age and rank. Similar to the police data, in order to obtain the average age of death of the $i^{th}$ soldier, army personnel were classified according to rank, and ages were summed to calculate a mean age as based upon equation 5.

For example, in the case of Lance Corporals the mean age of death was found to be approximately 28. Thus, along with the other information and assumptions the age variable was employed in this analysis (refer to section 3) in order to obtain a human capital loss estimation for the $i^{th}$ Lance Corporal, and ultimately an estimation for all the Lance Corporals killed.

Note, for the purpose of our analysis, retirement age from the army is assumed to be age 55.

Civilians

The fatality data obtained on civilians was most unsuitable for the task at hand. The only information of use was the number of fatalities. To obtain estimations by
### Table 6

Mean Age of Army/UDR Fatalities by Rank.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mean Age ($\mu = \Sigma x_i / n$)</th>
<th>Number of Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>23</td>
<td>319</td>
</tr>
<tr>
<td>Lance Corporals</td>
<td>28</td>
<td>93</td>
</tr>
<tr>
<td>Corporals</td>
<td>31</td>
<td>75</td>
</tr>
<tr>
<td>Sergeants</td>
<td>31</td>
<td>55</td>
</tr>
<tr>
<td>Staff Sergeants*</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>Warrant Officer 2</td>
<td>34</td>
<td>17</td>
</tr>
<tr>
<td>Captain</td>
<td>36</td>
<td>16</td>
</tr>
<tr>
<td>Major**</td>
<td>39</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>609</td>
</tr>
</tbody>
</table>

* Includes 1 Warrant Officer One

** Includes 1 Lt.Colonel

Source: Constructed from information provided by the British Army Information Office, Thiepval Barracks, Lisburn N. Ireland.
combining data from various sources, similar to the course undertaken by Eisner and Birkeli in their respective studies, would undoubtedly be tedious and result in the use of approximations. However, this appeared to be the course to follow. Thus, by combining the data from various agencies the fatality data have been made compatible with the earnings data presented earlier. The data obtained from the various sources are introduced in this chapter. Their development is undertaken in Appendix A.

As previously stated, the Northern Ireland Office Statistics Branch, between 1969 and the 30th of April 1990, has recorded some 1,919 civilian fatalities as a result of the conflict. To draw inferences regarding the average age of death of civilians, the Northern Ireland Annual Abstract of Statistics was reviewed. In particular, the distribution regarding the population's age was scrutinized. Note, an assumption made here was the majority of those killed would be age 25 and over.

For those individuals 25 and over, the 1981 Census and 1987 estimate pointed to the 25-29 age bracket as the grouping which contained the largest percentage of population (Northern Ireland, 1987). Given this information the median age, age 27, was used as an approximation of age of death of the $i^{th}$ civilian. The $i^{th}$ civilian being considered a representative of the civilian category as a whole. And for the purpose of this study $i$ was defined as
those civilians whose human capital has been totally
destroyed by the conflict.

Note, for the purpose of this analysis retirement age
of civilians is 62.5 years.
Results

The data employed in the preceding chapters and Appendix A were transferred onto work sheets. Each sheet contained information necessary to determine an estimation of the human capital loss of the $i^{th}$ individual, given the productivity growth rate, the discount rate and the mortality rate adjustment. Note, each sheet had a value for the mean age of individuals per group (in the case of the security forces each group was constructed on the basis of rank—refer to section five). The data compiled are applied to equation 2, on a category/group basis, and an estimate of the human capital loss of the $i^{th}$ individual per category/group was calculated. Likewise, these estimates, along with the total number of individuals killed per classification were applied to equation 3 and total human capital loss per category/group was calculated. The results of such estimates yield a pound estimate for the civilian and security force categories. Tables 7 through 9 show the total human capital loss for the $i^{th}$ individual and each category/group, respectively.

Table 7 indicates the human capital loss estimation of RUC/RUCR fatalities by rank. One sees the largest total
### Table 7

Human Capital loss estimation of RUC/RUCR
Fatalities by Rank

<table>
<thead>
<tr>
<th>Rank</th>
<th>ith individual's Loss</th>
<th>Total Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part-time Reserve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constable</td>
<td>69,004.25</td>
<td>3,519,216.75</td>
</tr>
<tr>
<td>Full-time Reserve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constable</td>
<td>195,561.07</td>
<td>8,213,564.94</td>
</tr>
<tr>
<td>Constable</td>
<td>246,674.50</td>
<td>31,327,661.74</td>
</tr>
<tr>
<td>Sergeant</td>
<td>296,166.75</td>
<td>8,588,835.76</td>
</tr>
<tr>
<td>Inspector *</td>
<td>262,336.78</td>
<td>4,197,338.46</td>
</tr>
<tr>
<td>Superintendent **</td>
<td>216,996.50</td>
<td>867,968.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>56,714,603.65</td>
</tr>
</tbody>
</table>

* Includes 1 Chief Inspector  
** Includes 1 Chief Superintendent

Source: Constructed from information provided by The Police Federation of Northern Ireland. (RUC, Garneville, Belfast BT4 2NX, N. Ireland).
loss, according to federated rank, to be approximately £31.3 million as that experienced by police constables. The total human capital loss estimation for all RUC/RUCR fatalities is estimated to be £56,714,603.65.

Likewise, Table 8 shows the human capital loss estimation for all UDR/British Army fatalities, by rank. The largest total loss, according to rank, is approximately £60 million and that was experienced by army privates. The total human capital loss estimation for all UDR/British Army fatalities was found to be £130,278,662.60.

The estimates, as set out in Tables 7-9, show that the cost of the total human capital destroyed, due to the conflict, are estimated at £587,487,156.50.

The results of this study are likely to yield many varied and interesting questions with regard to the total impact upon the individual within society and society as a whole. What are the results of such losses on the remaining members of the community? Also, what implications and effects, if any, would the current destruction of the human capital stock have upon future generations in the province of Northern Ireland?

In both Giffen and Birkeli's studies, it was possible to compare their human capital estimations to estimations that appeared in past studies of the same conflicts, respectively. Alas, this study appears to be the sole estimator of the human capital loss due to terrorism in
Table 8  
Human Capital Loss Estimation of British Army/UDR Fatalities by Rank

<table>
<thead>
<tr>
<th>Rank</th>
<th>1th individual's Loss</th>
<th>Total Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>186,843.30</td>
<td>59,603,012.29</td>
</tr>
<tr>
<td>Lance Corporal</td>
<td>220,026.40</td>
<td>20,462,454.91</td>
</tr>
<tr>
<td>Corporal</td>
<td>239,355.00</td>
<td>17,951,625.00</td>
</tr>
<tr>
<td>Sergeant</td>
<td>257,756.45</td>
<td>14,176,604.85</td>
</tr>
<tr>
<td>Staff Sergeant *</td>
<td>241,951.03</td>
<td>4,839,020.57</td>
</tr>
<tr>
<td>Warrant Officer 2</td>
<td>320,908.23</td>
<td>5,455,439.98</td>
</tr>
<tr>
<td>Captain</td>
<td>250,808.63</td>
<td>4,102,938.13</td>
</tr>
<tr>
<td>Major **</td>
<td>269,826.20</td>
<td>3,777,566.83</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>130,278,662.60</td>
</tr>
</tbody>
</table>

* Includes 1 Warrant Officer One  
** Includes 1 Lt. Colonel

Source: Constructed from information provided by The British Army Information Office. (Thiepval Barracks, Lisburn, N. Ireland).
Northern Ireland, thus making any comparison an impossibility. However, the human capital loss of approximately £587.5m, stemming from twenty years of continual conflict, appears small when compared to Northern Ireland security costs. In 1988, alone, it was estimated that the cost in security measures undertaken as a direct result of the conflict were IR£334m. (Davy, Kelleher and McCarthy Ltd. Economic Consultants, 1990) Furthermore, it was determined that Northern Ireland and the Republic of Ireland would, in 1988, have saved IR£436 million if the violence had ended in 1987.

The summary report carried out on behalf of the Bank of Ireland, assessing the economic impact of the Northern Ireland Conflict, indicated that despite high levels of assistance to industry the industrial development program in Northern Ireland had been constantly frustrated because of the levels of violence. Also, the study notes that the potential exists for greater economic opportunities to be fostered on both sides of the border if the various degrees of political alienation between Belfast and Dublin can be resolved.

The calculations undertaken in the Bank of Ireland summary report refer to the cost that violence places upon both economies, Northern Ireland and the Republic of Ireland's economies, and do not include any economic benefits arising from the conflict.
There are many sources of human capital losses and gains resulting from war. On one side of the coin, so to speak, the interruption of schooling, conflicting skills, and technological changes as prime contributors to the human capital loss resulting from war. Alternatively, military training, health care, and technological advances resulting from military research and development are examples of human capital gains resulting from war (Birkeli, 1971).

Although the human capital estimate may not be the largest cost resulting from the conflict, it is, however, a very significant one, and undoubtedly places a substantial burden on the citizens of Northern Ireland.
Summary and Conclusions

Introduction

Throughout the course of history the cost of war, in money terms, has been of prime concern to combatant nations. One need look no further than WW1, and the reparations forced upon defeated Germany to see the significance placed on monetary gains. Whereas the trend in wars past appeared to have been that people were expendable and that physical materials were of prime concern, this view has reversed since WW2 with human loss being of prime importance. As we have become more adept at counting our dead and the resulting human capital losses, we have become more concerned over the number of fatalities. However, in spite of such concerns the number of fatalities due to the conflict increase daily.

This study sets forth a model for the purpose of determining an estimate of the value of human capital loss resulting from Northern Ireland Conflict fatalities. Data collected and employed in the previous sections are applied to a human capital model in order to obtain an estimate of the value of human capital loss.
Basic Model

The expected earnings stream over some relevant number of earning periods discounted at an appropriate of interest, accounting for the probability of death and unemployment within these periods, is the definition given to the value of the human capital stock of an individual. In this study earnings at death are either known or approximated. Therefore, the basic equation by which to estimate the human capital loss of the $i^{th}$ individual, as a result of the Northern Ireland conflict, is as follows:

$$VP_i = A_i \cdot \frac{(1+g)^n}{1 - (1+d)}$$  \hspace{1cm} (8)

where:

- $VP_i$ = the present value of the human capital loss of the $i^{th}$ individual (calculated from estimated age of death to retirement age).
- $A_i$ = capitalized earnings stream adjusted for mortality.
- $n$ = number of potential earning periods remaining.
- $g$ = growth rate.
- $d$ = discount rate.

Hence, the estimated human capital loss is dependent upon the expected capitalized future earnings stream of casualties, the discount rate and growth rate.

Total human capital loss ($K$) is expressed as:

$$K = \Sigma VP_i \hspace{1cm} i = 1, 2..., n.$$  \hspace{1cm} (9)

where:

- $VP_i$ = the present value of the human capital loss of the $i^{th}$ individual.
In this study i is defined as those individuals whose human capital has been totally destroyed by war.

Earnings and Productivity Growth Rate.

The earnings data used in this study were obtained from the security forces and the Annual Abstract of Statistics, 1989. The capitalised police and British Army/UDR data, adjusted for mortality, were placed directly into our model in order to obtain estimates. However, civilian earnings data was given for 1987, and therefore, had to be adjusted to reflect 1990 earnings. A productivity growth rate of 3%, obtained from "Britain 1988" was utilized in the adjustment process (U.K. 1988).

Since earnings forgone by the Northern Ireland civilian fatalities is an average (by age) for all occupational groups, the rate of increase in earnings (g), which is assumed to reflect increases in future productivity, that the fatalities might have experienced, in fact, should reflect all factors that influence productivity (Birkeli, 1971). Also, note, the three percent rate used in the estimate of 1990 earnings for the civilian category, was the same growth rate that applied to all calculations pertaining to i\textsuperscript{th} individual's human capital losses.

Mortality Rate.

Since everyone dies eventually, each person faces the possibility of having their earning periods "truncated" by
death. Therefore, in our estimates to adjust for normal mortality, the expected future earnings stream, capitalised, of the $i^{th}$ individual, was multiplied by mortality probabilities given by life tables (1984-86), for males, published by the General Registrars Office (Northern Ireland, 1988).

Discount Rate.

The objective of this study is to estimate the human capital loss to Northern Ireland's Society. Thus, the employment of a discount rate is imperative to our analysis. The rate employed, 5%, is based on precedent set by Birkeli and Eisner in their respective studies (see Birkeli (1971)).

Fatality Data.

The data category of prime importance to this study was that which recorded fatalities as a result of terrorism in Northern Ireland. Information on security force fatalities was obtained from the British Army and the Royal Ulster Constabulary. From these sources the data received was developed by age and rank. For each rank, respectively, a mean age of death was calculated and used in our model.

The fatality data obtained on civilians was most unsatisfactory for the purpose at hand. However, by combining data from various agencies, the fatality data
developed were compatible to the civilian earnings estimations in section four.

With the assumption that the majority of civilian fatalities were twenty-five and over, the 1988 Northern Ireland Annual Abstract of Statistics pinpointed the 25-29 age bracket as the grouping which contained the largest percentage of population. Given this information age twenty-seven was used as an approximation of the age of death of the i^{th} individual. The i^{th} individual being considered a representative of the civilian category as a whole. And for the purpose of this study, i being defined as those individuals, civilians in this case, whose human capital has been totally destroyed by conflict.

Results.

The results of applying the data described in the previous sections is an estimate, in 1990 pounds, to society of the value of human capital destroyed by mean age, and rank (in the case of the security forces) for the civilian and security force categories. Estimates of the various categories were combined in Table 9, which shows the value of human capital loss of fatalities due to the Conflict. The resulting total loss is estimated to be £587,487,156.50.
Table 9

Total Human Capital Loss Estimations of all Subversive Deaths due to the Northern Ireland Conflict

<table>
<thead>
<tr>
<th>Category</th>
<th>Total Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Security Forces:</strong></td>
<td></td>
</tr>
<tr>
<td>RUC/RUCR</td>
<td>56,714,603.65</td>
</tr>
<tr>
<td>British Army/UDR</td>
<td>130,278,662.60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>186,993,266.25</td>
</tr>
<tr>
<td><strong>Civilians</strong></td>
<td>400,493,890.30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>587,487,156.50</td>
</tr>
</tbody>
</table>

*Refer to Appendix A to obtain the i th civilian's estimated human capital loss.

Conclusion.

There are many factors other than death which may affect a nation's human capital stock, and these could quite possibly develop from the Northern Ireland conflict. Some of these factors, which may result in human capital losses, in war type situations, eluded to by Birkeli (1971) in his Vietnam study, include: the interruption of schooling, conflicting skills and technological changes. Alternatively, Birkeli pointed to military training, health care and technological advances resulting from military research and development which benefit society as examples of potential human capital gains resulting from conflict situations.

Considering that human capital is an important input in the production function and that conflict/war tends to destroy the more productive portion of human capital stock, the long-run effect of losses due to the continuing strife and conflict are as yet unknown. In the short-run, however, the conflict is known to exact a heavy toll on the economy. In 1988, the cost of the conflict, in punts, to the Northern Ireland economy for the security, tourism and energy sectors totalled IR£358m, with security costs alone estimated at IR£334m (Davy, Kelleher, and McCarthy Ltd. Economic Consultants ,1990).
Appendix

In order to illustrate the techniques employed in estimating the human capital loss due to the Northern Ireland Conflict, Police (RUC) Constables, and the Civilian Category are used as examples.

Police Constables

The average age of death of the $i^{th}$ constable was calculated to be thirty (where $n=$retirement age (60) - age of death (30) = 30), with a gross income, after two years service, totalling £12,462 per annum. The capitalised future earnings stream was determined by dividing income per annum by $(i+d)$ the rate of discount (5%), and this yielded a value of £11,868.57.

The mortality rate adjustment necessitated the use of life tables. Life tables estimate the probability that a person who is alive at the beginning of the year will die before the end of that year. In the case of the thirty-year-old $i^{th}$ constable the probability of survival ($PS_i$—refer to Section Four) is found to equal $0.99905$.

The calculated $PS_i$ for age thirty adequately comprehends that period only. Likewise, the calculated $PS_i$
for age thirty-five adequately comprehends that period only. However, ages 31–34 are neglected by the tables. Therefore, in order to incorporate the missing data into the model, I used the PSi for age 30 to represent the PSi for age 31–34, respectively, and for 35 to represent 36–39, and so on. The resulting $i^{th}$ constables capital value adjusted for mortality equalled £10,717.86. This, in turn, applied to equation 2 yielded an estimated human capital loss of £246,674.86. Finally, applying this estimate to equation 3 one obtains a total human capital loss for all constables equal to £31,327,661.74.

**Civilian Category**

The average age of the $i^{th}$ civilian was determined to be 27 (refer to Section Five), with each individual receiving a gross income of £9,526.18 per annum. The capitalised future earnings stream was calculated by dividing gross income per annum by $1 + (1+d)$, and this yielded a value of £9,072.55.

In the mortality rate adjustment process, due to the fact that the life tables are in five year blocks, the PSi for age 25, thus, was used as a representative for the PSi's 27–29, similarly 30 was used as a representative of the PSi's for 31–34, and so forth. The resulting $i^{th}$ civilian's capital value adjusted for mortality equalled £8,034.72. This, in turn, applied to equation 2 yielded an estimated
human capital loss of £208,699.27. Finally, applying the value of our estimate to equation 3 resulted in a total human capital loss for all civilians equalling £400,493,890.30.
Bibliography


