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The life satisfaction approach to estimating the cost of crime: An individual's willingness-to-pay for crime reduction

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Abstract

This paper is motivated by the need to develop an improved model for estimating the intangible costs of crime. Such a model will assist policy makers and criminal justice researchers to compare the costs and benefits of crime control policies. We demonstrate how the life satisfaction approach may be used to measure an individual's willingness-to-pay for crime reduction. Results indicate that property crime in one's local area detracts from an individual's life satisfaction. On average, an individual is implicitly willing-to-pay $3,213 in terms of annual household income to decrease the annual level of property crime by one offence per 1000 residents in their local area. This equates to a per-capita willingness-to-pay of $1,236.

Key words: C21; I31; K42

JEL Codes: Costs of Crime, Property Crime, Life Satisfaction Approach, Cost-Benefit Analysis

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[1] This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) survey. The HILDA project was initiated and is funded by the Australian Government Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the authors and should not be attributed to either FaHCSIA or the Melbourne Institute.

1. Introduction

It is almost 50 years since Martin and Bradley (1964) first clarified the importance of costing crime, detailed its conceptual foundations and outlined pragmatic obstacles to this subject of inquiry. Costing crime allows monetary values to be placed on the direct, indirect and intangible consequences of crime; the latter often proving most difficult to quantify. Now an integral component of evidence-based crime prevention research, costing crime is an important input into the development of effective policy; particularly when undertaking cost-benefit analyses of policies or programs aimed at reducing crime and moderating the effects of crime on individuals and society. The purpose of such an analysis is to quantify societal benefits by combining the outcomes of a program or policy with cost data to evaluate the generated net benefits to society in monetary terms (Manning et al. 2011). It is important that all costs are included in cost of crime estimates in order to allow policy makers to make objective decisions on the allocation of resources to control crime and respond to its consequences. Cost estimates can also be used to develop compensation models for court and insurance purposes.

A variety of methods for estimating the intangible costs of crime can be found in the literature. These include the numerical crime ranking method (Byers 1993; Evans 1981; Phillips and Votey 1981; Roth 1978; Schrager and Short 1980), the quality of life method (Dolan *et al.* 2005; Dolan and Peasgood 2007; French and Mauskopf 1992; Nichols and Zeckhauser 1975; Rice *et al.* 1989; Rosser and Kind 1978; Viscusi and Aldy 2003), the property value (or hedonic property pricing) method (Buck *et al.* 1991; Buck *et al.* 1993; Gray and Joelson 1979; Hellman and Fox 1984; Little 1988; Rizzo 1979; Thaler 1978), willingness-to-pay methods (predominantly contingent valuation) (Baron and Maxwell 1996; Cohen *et al.* 2004; Ludwig and Cook 2001; Viscusi and Zeckhauser 2003), market-based modelling (Bartley 2000), and the life course model (Macmillan 2000). Cohen (2005) and Czabanski (2008) provide detailed summaries of the history of valuing crime, the methods used and their implications.

Despite many applications and decades of refinement, shortcomings in all of the methods remain and no single method is considered superior to the others in all respects. Methods that expand the suite of options for estimating intangible costs, therefore, represent a genuine contribution to the scientific and empirical base.

One method to recently emerge is the life satisfaction approach (Frey *et al.* 2010). This approach has predominantly come out of the economics of happiness literature, which itself reflects a re-evaluation of the epistemological foundations of economics, as seen in 2002 by Daniel Kahneman (a psychologist) and Vernon Smith (the pioneer of experimental economics) together being awarded the Nobel Prize in economic sciences. A comprehensive review of life satisfaction or happiness in economics is provided by Frey and Stutzer (2002) and MacKerron (2012).

The purpose of this paper is to use the life satisfaction approach to estimate the intangible cost of property crime in New South Wales, Australia.[2] Our research reveals how property crime affects an individual's life satisfaction and estimates their implicit willingness-to-pay to decrease the level of property crime in their local government area (LGA).[3] In addition to demonstrating an improved use of this technique for quantifying the costs of crime in monetary terms, this paper has direct policy relevance. Goal 16 of the New South Wales Government's *NSW 2021* 10-year plan has a specific target to reduce property crime by 15% by 2015-16 (New South Wales Government 2012). The model estimated in this paper allows the benefit of meeting this target (as well as the cost of not meeting it) to be calculated.

The paper proceeds by briefly outlining the life satisfaction approach and reviewing existing literature. Data and method form the subject of the next section. Results are then presented, followed by a few concluding comments.

2. The life satisfaction approach

In the context of estimating the intangible cost of crime, the life satisfaction approach entails the inclusion of the crime variable of interest as an explanatory variable within a micro-econometric function of life satisfaction, along with income and other covariates. The estimated coefficient for the crime variable yields first, a direct valuation in terms of life satisfaction, and second, when compared to the estimated coefficient for income, the implicit willingness-to-pay for a marginal change in that variable (Frey et al. 2010).

The approach offers several advantages over other valuation techniques (including many of those used to estimate the intangible costs of crime). For example, the approach does not rely on housing markets being in equilibrium (an assumption underpinning the hedonic property pricing method), nor does it ask individuals to directly value the intangible good (or bad) in question, as is the case in contingent valuation. Instead, individuals are asked to evaluate their general life satisfaction. This is perceived to be less cognitively demanding, as specific knowledge of the good is not required and respondents are not asked to perform the unfamiliar task of placing a monetary value on an intangible good. This is particularly relevant to estimating the cost of property crime, where people's perceptions can contrast starkly with objective crime data (Davis and Dossetor 2010; Weatherburn *et al.* 1996). Further, the technique does not necessarily rely on individual's stated fears of criminal victimisation, something that Michalos and Zumbo (2000) have reported males are reluctant to discuss. The life satisfaction approach also avoids the problem of lexicographic preferences, where respondents to contingent valuation or choice modelling questionnaires

[2] In terms of model estimation, property crime offences have the advantage of being accurately represented in reported crime data. This is because there are few impediments to reporting the crime and in many cases the crime must be reported in order to claim insurance. Reported data for other categories of crime, such as drug-related crime, tends to reflect enforcement effort rather than levels of offending.

[3] A local government area (LGA) is a geographical area under the responsibility of an incorporated local government council, or an incorporated Indigenous government council (Australian Bureau of Statistics 2011).

demonstrate an unwillingness to trade off the intangible good for income (Spash and Hanley 1995). Finally, there is no reason to expect strategic behaviour or social desirability bias to influence valuations as we rely on individuals' assessment of their life satisfaction broadly, rather than a question about crime specifically (Welsch and Kuhling 2009). The welfare effect of crime is inferred indirectly through its impact on life satisfaction.

Within the economics literature there are a small number of existing studies exploring the effect of crime on life satisfaction without seeking to estimate the cost in monetary terms. In an early example, Michalos and Zumbo (2000) seek to explain the impact of crime-related issues on quality of life, life satisfaction and happiness in the city of Prince George, British Columbia; concluding that crime-related issues have relatively little impact. In contrast, in the United States, Di Tella and MacCulloch (2008) find that increases in rates of violent assault adversely affect an individual's self-reported life satisfaction or happiness. However, as noted by Cohen (2008), it might not be appropriate to attribute the entire negative life satisfaction effect to violent assaults, as such crimes are likely to be highly correlated with other criminal offences that were not controlled for in model estimation.

In post-apartheid South Africa, Møller (2005) suggests that fear of crime and concerns about personal safety have a greater influence on life satisfaction than victimisation. Also employing South African data, Powdthavee (2005) provides evidence that, in addition to being a victim of crime, higher regional crime rates lower the self-reported life satisfaction of non-victims; although for non-victims it would take a regional crime rate more than 35 times the average to be equivalent to the life satisfaction effect of being a victim. Using data from the southeast African country of Malawi, Davies and Hinks (2010) illustrate that male heads of household report lower levels of life satisfaction if they have been attacked in the previous 12 months.

Of those authors who use the life satisfaction approach to place a monetary value on the cost of crime, Moore (2006) uses European Social Survey data to estimate that moving from a neighbourhood where it is perceived to be 'very unsafe' to walk alone after dark to a neighbourhood where it is perceived to be 'very safe' is equivalent to gaining an additional per annum income of EUR 13,538.[4] Using data from the United States, Cohen (2008) finds that county-level crime rates and perceived neighbourhood safety appear to have little impact on overall life satisfaction, whereas being the victim of a home burglary has an implicit cost for the household of almost USD 85,000. Frey *et al.* (2009) use life satisfaction data from the Euro-Barometer survey to estimate implied monetary losses caused by terrorist activities in France and the British Isles. The authors calculate the hypothetical willingness-to-pay of residents in Paris and Northern Ireland for a reduction in the number of incidents and fatalities to bring them on a par with the rest of France and Great Britain respectively. Results for residents of Paris suggest an individual on an average income would be willing-to-pay

[4] Unless otherwise stated, all figures are in AUD. As at 9 December 2012, 1 AUD = 0.65 GBP; 1 AUD = 0.81 EUR; 1 AUD = 1.04 USD.

between USD 1,099 and USD 2,149; for residents of Northern Island, willingness-to-pay ranges from USD 5,252 to USD 7,641. Most recently, for Japanese households, Kuroki (forthcoming) finds that being burglarised is equivalent in life satisfaction terms to losing between USD 35,000 and USD 52,500 in annual household income.

Our study extends the literature in four ways: (1) we employ a comprehensive, objective measure of property crime - previous studies have employed variables representing individual victimisation or perceived levels of property crime; (2) we measure life satisfaction on a robust 11-point scale, compared to, for example, the three-point scale used by Cohen (2008). Uniquely, we also: (3) explicitly test the relationship between household income and willingness-to-pay for crime reduction; and (4) investigate the persistence of the negative effect of crime on life satisfaction over time.

2.1 Potential limitations of the method

While there is growing evidence to support the suitability of individual's responses to life satisfaction questions for the purpose of estimating non-market (or intangible) values (Frey *et al.* 2010), some potential limitations remain. Crucially, self-reported life satisfaction must be regarded as a good proxy for an individual's utility. Evidence in support of the use of this proxy is provided by Frey and Stutzer (2002) and Krueger and Schkade (2008). Furthermore, in order to yield reliable non-market valuation estimates, self-reported life satisfaction measures must: (1) contain information on respondents' global evaluation of their life; (2) reflect not only stable inner states of respondents, but also current affects; (3) refer to respondents' present life; and (4) be comparable across groups of individuals under different circumstances (Luechinger and Raschky 2009).

Another limitation to consider when using the life satisfaction approach is the the estimation of the income coefficient. There is some evidence to suggest that people who are more satisfied with their lives earn more (that is, there is a degree of reverse causality). For example, extraverted people are more likely to report higher levels of life satisfaction and be more productive in the labour market (Powdthavee 2010). In the most recent study to investigate this issue, however, Pischke (2011) finds evidence to suggest that the direction of the income–life satisfaction relationship is mostly causal.

There is also a large literature showing that individuals compare current income with past situations and/or the income of their peers. Therefore, both relative *and* absolute income matter (Clark *et al.* 2008; Ferrer-i-Carbonell 2005). As a result, when absolute income is included as an explanatory variable in life satisfaction regressions, small estimated income coefficients are common. This biases the monetary estimate of the non-market or intangible good upwards.

It is also possible that people self-select where they reside. This would bias the crime variable's coefficient (and monetary estimate) downwards, as those least resilient to crime would choose to reside in areas with lower crime rates. In a related issue, it is important to control for the socio-economic status of neighbourhoods, as crime is often concentrated in

low socio-economic areas and residents of these areas often report lower life satisfaction independent of any effect of crime. Thus, if appropriate neighbourhood-level socio-economic controls are not included, the crime variable's coefficient would be biased upwards. It may also be the case that individuals change their behaviour and make defensive expenditures to avoid and ameliorate the impact of local crime on their life satisfaction (Becker 1968). These biases, however, can largely be avoided through the use of individual-specific fixed effects estimation (Frijters *et al.* 2011).

Finally, it is important to acknowledge that there is some debate in the literature about the nature of the relationship between the hedonic property pricing and life satisfaction approaches. Some authors take the view that the life satisfaction approach values only the residual benefits (or costs) of the non-market good not captured in housing markets (Luechinger 2009; van Praag and Baarsma 2005). More recently, Ferreira and Moro (2010) suggest that the relationship depends on whether the hedonic markets are in equilibrium or disequilibrium, as well as on the econometric specification of the life satisfaction function. If the assumption of equilibrium in the housing market holds, then no relationship should exist between the intangible good and life satisfaction, because housing costs and wages would fully adjust to compensate. If however a significant relationship is found, then residual benefits or costs must remain.

3. Data and method

The measure of self-reported life satisfaction, socio-economic and demographic characteristics of respondents are obtained from Waves 2-10 (2002-2010) of the Household, Income and Labour Dynamics in Australia (HILDA) survey. These waves are employed as they contain questions on life events, such as if the individual was a victim of crime. First conducted in 2001, by international standards the HILDA survey is a relatively new nationally representative sample and owes much to other household panel studies conducted elsewhere in the world; particularly the German Socio-Economic Panel and the British Household Panel Survey. See Watson and Wooden (2012) for a recent review of progress and future developments of the HILDA survey.

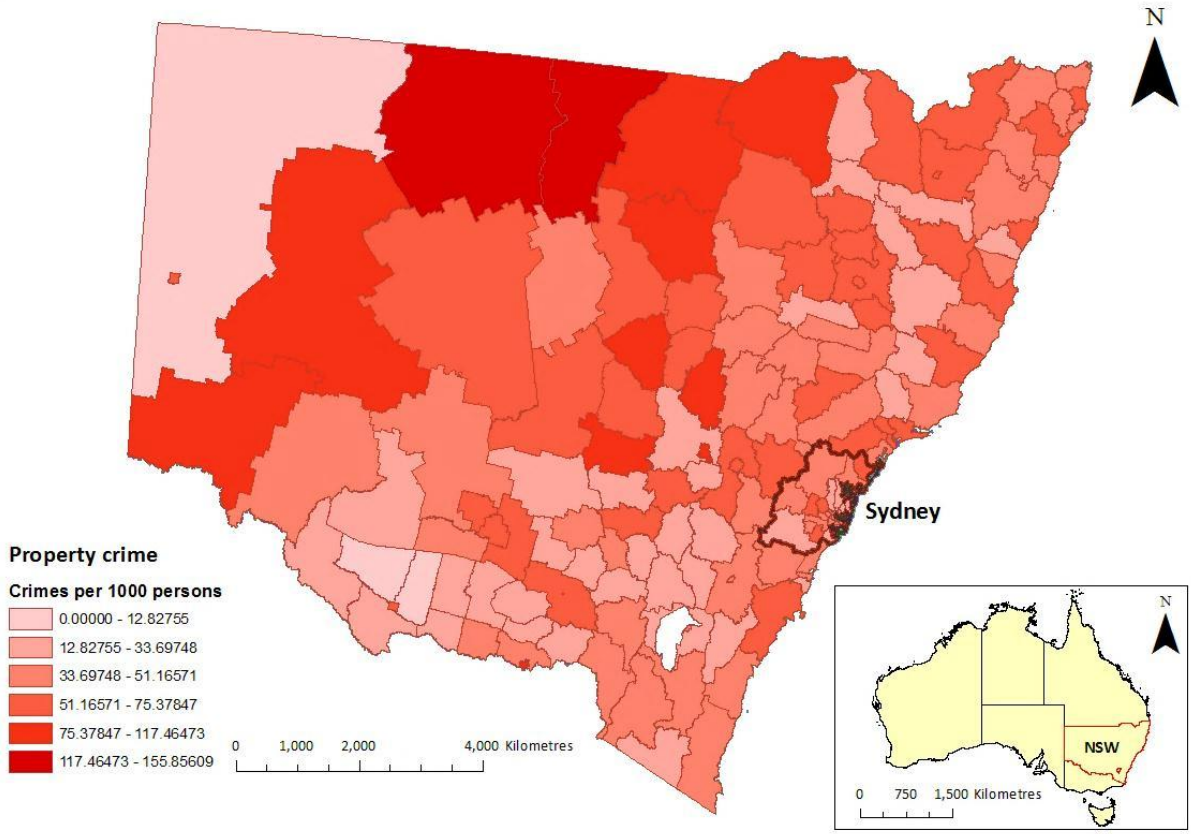
The life satisfaction variable is obtained from individuals' responses to the question: *'All things considered, how satisfied are you with your life?'* The life satisfaction variable is an ordinal variable, the individual choosing a number between 0 (totally dissatisfied with life) and 10 (totally satisfied with life).

3.1 Crime data

The number of crimes per month by offence category for each LGA is provided by the New South Wales Bureau of Crime Statistics and Research (2012). The 'property crime' variable is created by aggregating the number of crimes in three offence categories: theft, arson and malicious damage to property.

One difficulty in linking the crime data to individual observations from the HILDA survey is that the HILDA survey allocates individuals into 2001 LGA boundaries, whereas crime data is grouped by 2006 LGA boundaries. To overcome this, a concordance file provided by the Australian Bureau of Statistics (2012) is used to spatially weight the crime data into 2001 LGA boundaries. The crime data is then expressed in number of offences per 1000 individuals in the LGA. The property crime variable has a mean of 59.7 offences per 1000 individuals, a minimum of 19.4 offences and a maximum of 379.5 offences. Using 2010 data, Figure 1 indicates variation in the number of property offences per 1000 people in LGAs throughout New South Wales.

Figure 1: Property crime per 1000 residents in the LGA (2012)



Source: New South Wales Bureau of Crime Statistics and Research (2012)

3.2 Estimation technique

The first step is to estimate a micro-econometric life satisfaction model where life satisfaction is a function of socio-economic and demographic characteristics, the crime rate for the local area, and other control variables. The model takes the form of an indirect utility function for individual *i*, in location *k*, at time *t*, as follows:

Where stands for the utility of individual *i*, in location *k*, at time *t*; is the natural log of disposable household income;[5] is a vector of socio-economic and demographic characteristics including marital status, employment status, education and so forth; is the number of property offences per 1000 people in the individual's local area for the previous 12 months at time *t*; is a vector of controls, individual specific effects (e.g. gender), and year effects (e.g. year dummies). Finally, is the error term. In the model, the individual's true utility is unobservable; hence self-reported life satisfaction is used as a proxy. Table 1 provides a description of all variables employed.

Table 1: Model variables

Variable name	Definition	Mean (std. dev.)	% value 1 (DV)
Life satisfaction	Respondent's self-reported life satisfaction (scale 0-10)	7.9312 (1.4243)	
Age	Age of respondent in years	46.6667 (17.0415)	
Male	Respondent is male		44.6%
ATSI	Respondent is of Aboriginal and/or Torres Strait Islander origin		1.1%
Immigrant English	Respondent is born in a Main English Speaking country (Main English speaking countries are: United Kingdom; New Zealand; Canada; USA; Ireland; and South Africa)		10.2%
Immigrant non-English	Respondent is not born in Australia or a Main English Speaking country		10.3%
Poor English	Respondent speaks English either not well or not at all		0.5%
Married	Respondent is legally married		56.4%
De-facto	Respondent is in a de-facto relationship		9.5%
Separated	Respondent is separated		3.2%
Divorced	Respondent is divorced		5.8%
Widow	Respondent is a widow		6.0%
Lone parent	Respondent is a lone parent		1.7%
Number of children (0-4)	Number of children aged between 0 and 4	0.1580 (0.4725)	
Number of children (5-14)	Number of children aged between 5 and 14	0.3625 (0.7734)	
Number of children (15-24)	Number of children aged between 15 and 24	0.2205 (0.5864)	

[5] The natural log is employed to represent the diminishing marginal utility of income.

Number of children (25+)	Number of children aged 25 or more	0.0368 (0.2233)	
Below average health status	Respondent has SF-36 physical health summary score below 50 (scale 0-100)		8.6%
Year 12	Respondent's highest level of education is Year 12		5.3%
Certificate or diploma	Respondent's highest level of education is a certificate or diploma		31.9%
Bachelors degree or higher	Respondent's highest level of education is a Bachelors degree or higher		26.8%
Employed part-time	Respondent is employed and works less than 35 hours per week		20.8%
Self-employed	Respondent is self-employed.		6.3%
Unemployed	Respondent is not employed but is looking for work		2.5%
Non-participant	Respondent is a non-participant in the labour force, including retirees, those performing home duties, non-working students and individuals less than 15 years old at the end of the last financial year		31.3%
Household income (ln)	Natural log of disposable household income	10.8565 (1.1483)	
Hours worked	Hours worked per week	24.0303 (21.2709)	
Commute time	Hours commute time to place of work per week	2.7472 (3.9536)	
Others present	Someone was present during the interview		34.8%
Years at current address	Number of years the respondent has resided at their current address	11.0737 (11.7878)	
Major city	Respondent is considered to reside in a major city region as defined by the Australian Bureau of Statistics' Accessibility/Remoteness Index of Australia		63.6%
Medium rise	Respondent resides in a townhouse, or one to three storey apartment		17.8%
High rise	Respondent resides in a four or more storey apartment		2.5%
Other dwelling	Respondent resides in another dwelling type, for instance, a non-private dwelling, a caravan, or a houseboat		1.6%
Renter	Respondent is renting the home or is involved in a rent to buy scheme		22.6%
Rent-free	Respondent resides in the home rent free		2.3%
Victim of property crime	Respondent was a victim of property crime in the past 12 months		3.7%
Victim of violent	Respondent was a victim of a violent crime in		1.3%

crime	the past 12 months		
Gaoled	Respondent was in gaol in the past 12 months		0.1%
Property crime in area (0-12 months)	Number of property crimes per 1000 people in the respondent's LGA in the 12 months prior to the interview	59.7001 (29.4937)	
Property crime in area (0-6 months)	Number of property crimes per 1000 people in the respondent's LGA in the 6 months prior to the interview	30.6821 (15.4304)	
Property crime in area (7-12 months)	Number of property crimes per 1000 people in the respondent's LGA in the 7-12 months prior to the interview	29.0189 (14.2782)	

As shown by Welsch (2006), it is possible to estimate the implicit willingness-to-pay (denoted WTP) for a marginal change in number of offences in the area by taking the partial derivative of the crime variable and the partial derivative of household income, as follows:

Where is the mean value of household income. If discrete changes are to be valued, the Hicksian welfare measures of compensating and equivalent surplus can be employed. In this case, the compensating surplus is the amount of household income an individual would need to receive (pay) following an increase (decrease) in the number of offences in his or her local area, in order to remain at his or her initial level of utility. Compensating surplus (denoted CS) can be calculated as follows:

Where is the initial, and the new level of crime in the area. Similarly, the equivalent surplus is the amount of household income an individual would need to receive or pay in order to maintain his or her level of utility, *if the change did not take place*. Equivalent surplus (denoted ES) can be calculated as follows:

In model estimation, the error term captures unobserved time-invariant individual specific characteristics) such as stable personality traits, as well as measurement errors. This can obscure findings and is critical to the validity of results (Bertrand and Mullainathan 2001; Ferrer-i-Carbonell and Frijters 2004). To circumvent these otherwise confounding influences,

a fixed effects estimator with individual-specific fixed effects for an unbalanced panel is employed (Frijters *et al.* 2011).[6]

While the fixed effects estimator makes the implicit assumption that life satisfaction self-reports are cardinal, many authors (Ferrer-i-Carbonell and Frijters 2004) have shown that estimates of the determinants of life satisfaction are virtually unchanged whether one models the ordinal nature of the variable or treats the responses as cardinal, contingent on individual heterogeneity being addressed appropriately. Further support for the assumption of cardinality and the use of fixed effects estimators is provided in recent literature (Geishecker and Riedl 2010; Kristoffersen 2010).

To ameliorate downward bias in the income coefficient, controls for job-related characteristics such as hours worked and commute time are included; nonetheless it is likely that downward bias in the income coefficient remains.[7] Finally, as we include explanatory variables at different spatial levels, standard errors are adjusted for clustering (Moulton 1990).

In order to identify variation in the crime variable while abstracting from potential spatially omitted variable bias, we employ LGA dummy variables, with the crime variable varying over time as individuals in the LGA are interviewed on different days. In model estimation this serves to control for variation between LGAs in factors such as socio-economic characteristics and levels of policing (Michalos 2003; Powdthavee 2005).

4. Results

The estimated results for the base model (Equation 1) are presented in Table 2. Having been a victim of crime in the previous 12 months has a strong adverse impact on one's life satisfaction, with the effect most pronounced for victims of violent crime. Of most relevance to this paper, number of property crime offences per 1000 residents in an LGA reduces an individual's life satisfaction, with an estimated coefficient of -0.0021 (significant at the 5% level).

In regards to socio-economic and demographic characteristics, the results largely support the existing literature (Brereton *et al.* 2008; Shields *et al.* 2009) and *a priori* expectations. For example, being married or in a de-facto relationship is associated with higher levels of life satisfaction than having never been married, whereas being separated is associated with lower

[6] Fixed effects estimation limits our investigation to time varying factors, as time invariant factors (for example, gender and ethnicity) are not identified. The results of a Hausman test suggest that the random effects estimator is biased and inconsistent, as l_i is correlated with $x_{i,k,t}$; suggesting a degree of endogeneity, a common finding in the literature (Frijters *et al.* 2004). This result is robust to the inclusion of time invariant personality traits (Cobb-Clark and Schurer 2012).

[7] Using Pischke's (2011) rationale for industry wage differentials, an attempt was made to instrument household income using the proportion of individuals in the household in a particular industry for each industry category. Specifically, we included alongside other usual covariates: the proportion of household members not in the work force; the proportion of household members unemployed; the individual's job satisfaction; and occupation controls. However, the instrument proved quite weak and hence was not proceeded with.

levels of life satisfaction. Lone parents are found to have lower levels of life satisfaction, even after controlling for the number of children in the household, which itself (at least for children between the ages of 5 and 14) has an adverse impact on life satisfaction. Below average reported physical functioning confers unequivocally lower levels of life satisfaction.

Having completed Year 12 increases one's life satisfaction compared to having only completed Year 11 or below. Higher levels of education do not confer any significant life satisfaction benefits, perhaps reflecting the fact that the benefits of education flow less through a direct impact on life satisfaction than through its positive effects on the creation and maintenance of human and social capital (Helliwell 2003).

Unemployment reduces an individual's life satisfaction, even after controlling for household income, which enhances life satisfaction. Non-participants in the labour force (including retirees, those performing home duties and non-working students) report a lower level of life satisfaction than full-time employed. Hours worked and commuting time reduce life satisfaction. Finally, we find evidence of social desirability bias, with those completing the survey in the presence of another person reporting higher levels of life satisfaction.

Table 2: Base model results

Variable name	FE estimate (standard error)	Variable name	FE estimate (standard error)
Constant	7.6869***	Self-employed	0.0008
	(0.3718)		(0.0608)
Age squared	-0.0001	Unemployed	-0.2333***
	(0.0001)		(0.0847)
Poor English	0.1610	Non-participant	-0.1415**
	(0.2368)		(0.0560)
Married	0.1660**	Household income (ln)	0.0339***
	(0.0798)		(0.0100)
Defacto	0.1948***	Hours worked	-0.0038***
	(0.0697)		(0.0012)
Separated	-0.3191***	Commute time	-0.0051*
	(0.1067)		(0.0027)
Divorced	-0.1458	Others present	0.0598***
	(0.1117)		(0.0215)
Widow	-0.2292	Years at current address	-0.0032
	(0.1710)		(0.0027)
Lone parent	-0.1973*	Major city	-0.2353
	(0.1094)		(0.1721)
Number of children (0-4)	0.0136	Medium rise	0.0083
	(0.0151)		(0.0369)
Number of children (5-14)	-0.0229**	High rise	-0.1195
	(0.0108)		(0.0912)
Number of children (15-24)	0.0004	Other dwelling	-0.0871
	(0.0136)		(0.0997)
Number of children (25+)	-0.0247	Renter	-0.0034
	(0.0277)		(0.0176)
Below average health status	-0.2619***	Rent-free	0.0187
	(0.0590)		(0.0519)
Year 12	0.2043*	Victim of property crime	-0.1974***
	(0.1079)		(0.0555)
Certificate or diploma	-0.0014	Victim of violent crime	-0.2773**
	(0.0676)		(0.1088)
Bachelors degree or higher	0.0874	Gaoled	-0.1679
	(0.0924)		(0.4253)
Employed part-time	0.0040	Property crime in area (0-12 months)	-0.0021**
	(0.0376)		(0.0010)
Summary statistics			
Number of individuals	2430		
Number of observations	17869		
	0.5883		
R^2 within	0.0368		
R^2 between	0.0183		
R^2 overall	0.0222		

*** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level. Omitted cases are: Speaks English well or very well; Never married and not de facto; Not a lone parent; below average health status; Year 11 or below; Not self-employed; Employed working 35 hours or more per week; No others present during the interview or don't know – telephone interview; Not in a major city; Separate house; Own home; Not a victim of property crime; Not a victim of violent crime; Not in gaol in the last 12 months. Wave dummy variables (where wave 2 (2002) is the base case) and LGA dummy variables (where the most prevalent is the base case).

4.1 Valuation estimates

Following the procedure described in Equation 2, the average implicit willingness-to-pay, in terms of annual household income, to decrease the level of reported property crime by one offence per 1000 residents in the LGA in the previous 12 months is $3,213 (90% confidence intervals of $765 to $5,661). In per-capita terms, given that on average there are 2.6 people living in each household in the sample, the implicit willingness-to-pay is $1,236 ($294 to $2,177). See the Appendix for worked examples of willingness-to-pay calculations.

The implicit willingness-to-pay to meet the New South Wales Government's goal of reducing property crime by 15% can be estimated in terms of compensating and equivalent surpluses. Following the procedures set out in Equations 3 and 4, we find that an individual has a compensating surplus of $22,085 ($6,418 to $32,352) for a 15% decrease in the number of property offences in his or her local area.[8] That is, if property crime was to fall by 15%, an individual could sacrifice approximately $22,000 in annual household income and remain at his or her initial level of utility. The equivalent surplus is $38,461 ($7,324 to $85,976). This suggests, taking the reduced crime rate as the status quo, an individual would require compensation of approximately $38,000 in annual household income to maintain his or her level of utility, if such a reduction did not occur.

To test whether these results truly measure the effect of property crime on life satisfaction and not some spurious correlate, we examine whether the life satisfaction effects vary intuitively with respondents' characteristics. For example, if crime reduction is a normal good,[9] willingness-to-pay should increase with income. To test this, following Levinson (2012) we re-estimate Equation 1 with the inclusion of an interaction between the income variable and the level of crime. To ensure that the property crime coefficient can be interpreted in the same way as before, at the average income, we interact property crime with the difference between the respondent's log income and the mean income in the sample. Estimation results for key variables are reported in the first column of Table 3.

The crime coefficient is unchanged by the inclusion of the interaction, and although the interaction term's coefficient is not statistically significant, the two terms together are jointly significant, and the interaction coefficient is negative. This suggests that higher income individuals are willing-to-pay more for a reduction in crime. Specifically, on average, individuals with a per annum household income of $35,875 (25th percentile) have an implicit willingness-to-pay for a marginal reduction in the level of property crime in their LGA of $2,914, whereas individuals with an income of $90,935 (75th percentile) have an implicit willingness-to-pay of $3,303.

[8] For an LGA at the mean (59.7 offences per 1000 individuals), this is equivalent to decreasing the rate of property crime by approximately nine offences per 1000 individuals per annum.

[9] A normal good is a good for which, other things being equal, an increase in income leads to an increase in quantity demanded.

We expect more recent rates of crime to have a greater effect on life satisfaction. To test this, we disaggregate the property crime variable into: (a) property crime in the area 0 to 6 months prior to the date of survey; and (b) crime in the area 7 to 12 months prior to the date of survey (see column two of Table 3). Results confirm our expectations; crime in the 0 to 6 month period has a statistically significant negative effect on life satisfaction, whereas crime in the 7 to 12 month period has no significant effect. Moreover, compared to the base model, the rate of property crime in the 0 to 6 month period has approximately three times the life satisfaction effect of the rate of property crime over the previous 12 months (estimated coefficient of -0.0066 compared to an estimated coefficient of -0.0021).

We also examine whether victims of crime are more or less affected by the rate of crime in their LGA than non-victims. To do this we re-estimate Equation 1 with the inclusion of an interaction between the level of property crime in an individual's LGA and whether the individual has been a victim of crime in the previous 12 months (see column 3 of Table 3). Results demonstrate victims of crime to be less affected by the rate of crime in their LGA than non-victims. This finding may reflect the relative comparison effect described by Powdthavee (2005), where victims of crime feel less stigmatized by crime, and therefore less psychology affected, when others in their local community have also been victims of crime.

Table 3: Additional results

Variable name	**(1)** **Income effect** **FE estimate** (standard error)	**(2)** **Temporal effect** **FE estimate** (standard error)	**(3)** **Victim of crime** **FE estimate** (standard error)
Property crime in area (0-12 months)	-0.0022** (0.0010)	-	-0.0022** (0.0010)
Property crime in area (0-6 months)	-	-0.0066** (0.0027)	-
Property crime in area (7-12 months)	-	0.0025 (0.0034)	-
Property crime in area x	-0.0003 (0.0004)	-	-
Property crime in area x victim of property crime	-	-	0.0009 (0.0011)
Household income (ln)	0.0551** (0.0252)	0.0338*** (0.0108)	0.0340*** (0.0100)
Summary statistics			
Number of individuals	2430	2430	2430
Number of observations	17869	17869	17869
F-Test (property crime in area = 0; interaction term = 0)	2.5900*	-	2.5600*
	0.5885	0.5884	0.5883
R^2 within	0.0369	0.0370	0.0369
R^2 between	0.0187	0.0183	0.0181
R^2 overall	0.0227	0.0223	0.0221

*** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

5. Conclusion

This paper set out to use life satisfaction data to place a monetary value on the intangible costs of living in areas with differing levels of property crime. In so doing, we provide an example of how policy makers might assess the welfare effects of crime reduction.

Our findings indicate that property crime in one's local area detracts from an individual's life satisfaction and, on average, an individual is implicitly willing-to-pay $3,213 in terms of annual household income to decrease the annual level of property crime by one offence per 1000 residents in their LGA. This equates to a per-capita willingness-to-pay of $1,236.

The results also indicate that crime reduction is a normal good; individuals on higher incomes have a greater willingness-to-pay for crime reduction. Furthermore, the results suggest that it is offences which have occurred in the most recent six month period that have the most detrimental impact on life satisfaction, three times as severe as the average effect of property crime over a 12 month period. Our findings also suggest that victims of crime are less affected by high crime rates than non-victims. Further research using larger, more disaggregated data sets may yield additional insights into the effect of crime on different groups. It may be useful to compare and test directly the effects of perceived versus actual risks of crime on life satisfaction; a question the authors are currently investigating.

From a policy perspective, our valuation estimates suggest that there is strong justification for the New South Wales Government to pursue their target of reducing property crime by 15% by 2015-16. To put this target into context, based on 2010 figures, a 15% reduction would amount to more than 50,000 fewer property offences being reported in that year. As this target is yet to be met an *ex ante* valuation is most appropriate; that is, the current level of utility (or life satisfaction) is the correct point of reference. Therefore, the compensating surplus rather than the equivalent surplus is the relevant measure.

Our compensating surplus estimate suggests that households would be willing-to-pay approximately $22,000 in household income per annum for a 15% reduction in property crime. There are approximately 2.5 million households in New South Wales (Australian Bureau of Statistics 2012), this implies the potential state-wide welfare effect of meeting the target is around $54 billion. This figure dwarfs the $178 million in additional funding over four years the New South Wales Government has budgeted to increase police numbers by June 2014 (New South Wales Government 2012).

In addition to enhancing existing crime prevention measures, improving labour market conditions may be a very effective welfare-enhancing policy, in so far as they make financially motivated crime less attractive (Becker 1968; Kuroki forthcoming; Gould *et al.* 2002). It may also be the case that broader policy reforms to reduce income inequality can go some way to addressing the issue (Fajnzylber *et al.* 2002).

While not the main thrust of this investigation, from a theoretical perspective, these value estimates point towards a substantial residual shadow value associated with crime that is not captured in housing costs or wages. Consistent with earlier life satisfaction valuation literature (Luechinger

2009; van Praag and Baarsma 2005), this finding challenges the validity of the assumption of equilibrium in housing and wage markets, which underpins many models that rely on choice. In this context, the life satisfaction approach may serve as a useful complement to the hedonic method when attempting to value intangible goods.

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