

Violent Crime: A Symptom of Wage Inequality

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Abstract

Violent crime plagues the poorest neighborhoods of the United States, often being concentrated amongst minority populations. Despite being closely linked to income, violent crime does not obey the typical rules of revealed rational preferences. This paper builds a theoretical model based on insights from demographic and psychological studies to link violence with wealth inequality through a self-esteem production function, essentially posing violence as an inferior substitute to esteem. The main findings are that violence is more closely linked to relative than objective poverty and that punishment based deterrence may fail to reduce overall crime rates.

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1 Introduction

Violence, violent crime more specifically, is a feature of civilization as old and familiar as civilization itself. Hobbes, inspired by Malthus, assumed rather blindly that violence is indeed older than civilization, stretching back as far as the beginnings of homo erectus himself, if not further. Hobbes and his disciples assumed that it is civilization that has finally harnessed and tamed the nasty and brutish man of prehistory when there is much evidence that the correct story works the other way around. Perhaps it is civilization that has enabled violence in an otherwise peaceful and cooperative species.

When studying violence from an economic perspective, scholars tend to focus on accurately predicting the crimes themselves. Less attention is paid to the personal motivation for each criminal act, or the environment and social circumstances that surround it, except inasmuch as these variables are capable of predicting future instances of crime. Arguably the more important task is not so much to predict the crimes, but to prevent them. This work takes the perspective that criminal acts of violence are anomalies in human behavior resulting from the failure to meet certain psychosocial needs. Using a game theoretic structure combined with a psychologically sound utility function, the model of violent crime presented here accurately predicts levels of violent crime while simultaneously elucidating direct paths to alleviate it through clear and simple policy interventions.

Rather than accept criminal behavior as one end of a continuum of optimizing choices available to the egoistic decision maker, this theory of violence takes the perspective of violent crime being the symptom of an underlying social sickness. In other words, violent crime arises when the socio-economic structure of a population prevents a large enough share of the people from achieving minimum levels of a psychological good. I do not rely on a type distribution wherein a portion of the population derives direct utility from violence and I do not present violent crime as an

alternative source of income either. Violence here is modeled as an inferior method of achieving social esteem, a psychometrically sound variable shown repeatedly to be correlated with aggressive feelings.

Social esteem is the other side of the already familiar concept, self esteem. Psychologists Baumeister, Boden and Smart define self esteem as “a general evaluation of self.” Implicit in this definition is that the evaluator is also the evaluatee – an egoistic concept. The other side of self esteem is what I call *social esteem*, “a general evaluation of one’s self by one’s peers.” Idealistically one’s personal evaluation will match the evaluation made by others. Economists would call this having rational beliefs about one’s quality as an individual. However, much evidence in psychological studies shows that it is very easy for these two measures to diverge. That more than half of a population considers themselves above average drivers is a clear and well established example. The work by Baumeister et al establishes that when one’s personal evaluation of their self is higher than one’s peers’ evaluation, negative feelings often result. Among these feelings, aggression is very common. Most subjects are willing to act aggressively towards the source of the relatively negative feedback, but many are also willing to diffuse their aggression towards an unrelated third party if access to the originator is unavailable.

The majority of violent crime in the United States takes place in particularly poor areas among particularly poor individuals. Rational theories of violent crime would have to explain this fact by postulating that poor people have a higher preference for violent crime [21, 9]. This paper, on the other hand, explains this fact by suggesting that poor people are more likely to experience a discontinuity between their general evaluation of themselves and their perceived evaluations by their peers. In contrast to existing theories of violent crime, the model presented here establishes a causal link between poverty and violence. As such, I am able to make policy recommendations for alleviating crime that are more delicate and less

fiscally cumbersome than the historical “increase policing in poor neighborhoods.” Furthermore I am able to show that the people who do engage in violence are themselves victims in the sense that they will have lower expected utility levels in every possible equilibrium than agents who do not choose violence. Ultimately I am able to make the claim that, because the preference for violence arises directly as a result of poverty, which is itself a result of social structure and government policy, and that violent criminals also experienced decreased utility levels, violent crime is therefore a symptom of an unhealthy society which is wholly preventable and strictly inferior to other feasible outcomes in terms of aggregate welfare.

2 Related Work on Economics and Violence

Violent crime, as defined by the FBI Annual Uniform Crime Report, includes “murder, forcible rape, robbery, and aggravated assault.” Of these crimes, only robbery is defined as having a monetary motive. A robbery is the act of taking property from an individual directly through the use of force or implied force. According to the National Criminal Victimization Survey (2008), one quarter of all crimes of violence¹ produced less than fifty dollars per victimization while the median loss was a mere \$100. These numbers are reported losses by the victims and include both theft and damage losses. Robberies, compared to thefts, and purse snatching or pocket picking, are also comparatively less successful. Only 67.4% of robberies are successful in removing property from the victim while pocket picking is 92.6% successful and theft is 95.2% successful in removing property. Considering that more than half of all robbery targets show resistance, and that half that number again use or threaten force to defend themselves, a robbery is a rather high-risk low-reward endeavor. It is difficult to justify

¹Rape, sexual assault, personal robbery or assault. This category includes both attempted and completed crimes. It does not include purse snatching and pocket picking. Murder is not measured by the NCVS because of an inability to question the victim.

robbery, and furthermore any other form of violent crime, as a simple case of expected consumption maximization.

Without a clear monetary payoff, one might argue that violent crime is outside the realm of economic theory, but there are many features of violent crime which make it an important topic of study by economists. Violent crime is highly costly to society. From 1987 to 1990, the average cost of a single murder exceeded two million (1989) dollars. Taking into consideration lost productivity, and physical and mental damages to the victims, robberies cost victims between \$19,000 and \$25,000 and assaults ranged from \$15,000 to \$22,000 on average [17]. These numbers do not include the cost to society of enforcement or the perpetrator's lost productivity or cost of punishment which would further increase the total cost of each incident. Despite its lack of formalizable economic motivation, violent crimes are very costly to society and merit further investigation.

Violent crime is also highly correlated with variables typically considered of interest to economists. Property crime and violent crime, while distinct concepts, tend to move together in the data. Violence is highly, albeit negatively, correlated with education and socio-economic status [15]. What is interesting is that the negative correlation holds for both perpetrator *and* victim. It stands to reason that the wealthier and more highly educated face higher costs of incarceration if caught and therefore would be less willing to commit crimes; but how does one explain that the wealthy are actually victimized less often? Even if we were to suppose that violent crime is actually motivated by property acquisition, we would expect that the wealthy would have more to be stolen, and thus would be victimized more often, but this is not the case. Violent crimes are for the most part perpetrated by and upon the residents of the bottom rungs of the socio-economic ladder.

To a certain extent, one may argue that higher income enables an individual to afford better personal protection. In addition to being condensed

Table 1: Victimization Rate per 1000 by Income Brackets

Income	Crimes of Violence	Completed	Attempted
White only			
Less than \$7,500	40.9	18.3	22.6
\$7,500-\$14,999	41.3	7.0	34.2
\$15,000-\$24,999	23.9	7.1	16.9
\$25,000-\$34,999	25.1	7.8	17.3
\$35,000-\$49,999	22.2	5.8	16.3
\$50,000 or more	13.6	2.6	11.0
Black only			
Less than \$7,500	57.1	19.7*	37.3
\$7,500-\$14,999	44.0	22.6	21.4
\$15,000-\$24,999	31.0	9.5*	21.6
\$25,000-\$34,999	24.3	12.3*	12.0*
\$35,000-\$49,999	15.4	2.7*	12.7
\$50,000 or more	20.0	6.1*	13.8

Data taken from the 2008 National Crime Victimization Survey. Starred entries are based on fewer than 10 reported cases.

among poorer individuals, violence is also correlated with the general affluence level of entire neighborhoods, with poorer neighborhoods on the whole experiencing lower levels of violent crime. However violence is more variable than non-violent crime, and is not sufficiently well explained by the data. Table 2 shows cross county variation in crime rates and the percentage which can be captured by income variation. If access to protection was the the primary cause for inter-neighborhood variation, then we would expect that both violent crime and property crime would be reduced by similar levels. This is not the case. The notably low percentage of variation explained by income suggests that even if higher income meant higher protection, there is still an even greater effect at work on the manifestation of violent crime.

Even if we accept that money or property are not the primary benefits of violent crime, we would still expect that offenders would seek out relatively

Table 2: Geographic Criminal Variation by Income

Average Within-State, Between-County
Coefficients of Variation for Crime Rates

Murder	Assault	Robbery	Burglary	Theft
1.56	.84	1.68	.54	.59

Percent of Within-State, Between-County
Variation Explained by the Income Distribution

Murder	Assault	Robbery	Burglary	Theft
5.0	6.0	16.0	9.7	19.7

Data from the 2000 FBI Uniform Crime Reports. See [21].

easier targets to lower the cost of the criminal act. Table 3 shows that younger people are in fact more likely to be the victims of violent crimes, and that the rate of victimization decreases with age. Youths under the age of twenty five are more than twice as likely as their older counterparts to be the victims of violent crime. This holds for males and females alike. On the other side of the violent encounter, nearly one half (47%) of all offenders are perceived by their victims to be below the age of thirty. So violence, it seems, is perpetrated on the young by the young – the statistically most physically able and consequently the most formidable demographic.

In this work I focus primarily on the relationship between violent crime and low wages. If violent crime were part of a rational decision making process, we could explain it simply by saying that low wage earning capacity makes acquiring consumption through criminal activity relatively more attractive, but violent crime, with its negligible economic payoff, defies this explanation. Instead I look at how being a resident of a neighborhood with particular socio-demographic features, or a member of a community of a designated socio-economic status, can affect one’s utility of violence.

Table 3: Crimes of Violence by Age

	Age	Total	Number	Rate per 1000
Male	12-15	7741810	388740	5.02
	16-19	8096740	386880	4.78
	20-24	9524820	320020	3.36
	25-34	18662890	508120	2.72
	35-49	30068580	493870	1.64
	50-64	25432750	301030	1.18
	65 or older	15327480	44450	0.29
			Under 25:	4.32
			Over 25:	1.51
Female	12-15	7461780	263880	3.54
	16-19	7764360	205290	2.64
	20-24	9375130	389560	4.16
	25-34	18435960	381400	2.07
	35-49	30525930	509730	1.67
	50-64	26712460	236690	0.89
	65 or older	20262660	65760	0.32
			Under 25:	3.49
			Over 25:	1.24

Data taken from the 2008 National Crime Victimization Survey. Starred entries are based on fewer than 10 reported cases.

I create the connection by specifying how social status is internalized and transformed into self esteem. Membership in more highly ranked social circles provides esteem. When access to this source of esteem is denied, though wage discrimination or other factors, violence provides a substitute source for the desired sense of importance or external feedback.

Within the framework I present, violence will be negatively correlated with aggregate income levels. I also specify the strategic interactions between members of the same community. On a micro-level our intuition regarding wages and income holds at least somewhat better than it does on the aggregate. Individuals observed to have higher wages or to focus on mainstream, legitimate sources of income are singled out for higher lev-

els of violence within their communities. My model presents a trade-off between higher wages and personal safety which is corroborated by other works in the literature.

[21] develops a game theoretic model of the decision to participate in violence, where the motivation for violence is to deter future violence through establishing a reputation for being tough. Based largely on the seminal ethnographies of E. [1, 2], players are endowed with types that are private information and that determine their costs and benefits from violence. They are randomly matched and choose whether to fight or remain passive. Young players have an incentive to fight in order to build a reputation, which can lower their probability of being attacked in future periods. This model generates multiple equilibria that predict different levels of overall violence. In a “street culture equilibrium,” decent types, who have no direct incentive to participate in violence, will attack any opponent with probability one in the first period. When a street culture equilibrium exists, and some other conditions on parameters hold, decent types are violent with positive probability in every other equilibrium as well.

Silverman’s model helps explain why violent acts are often committed in a public setting where reputation can be formed. It also helps to explain why the physically capable, specifically young males, are the most likely to be involved in violence. The young have the greatest incentive to create a reputation, and the tougher one’s opponent is, the easier the reputation is to create. It does less well in explaining the difference in crime rates across socio-economic statuses. Either there are not enough street types to support the street culture equilibrium, or else decent types have too great a cost of participating in violence to have incentive to fight. Both possibilities beg the question: what is it about being poor that makes these features more likely, and therefore the environment more conducive to violence?

A related work, though not directly focused on violence, focuses on peer

group interactions in a school setting. [3] develop a model wherein individuals attempt to advance their future economic status through education or similar activities, but may be shunned by their peer group for doing so. Acceptance by the peer group increases the marginal utility of leisure and the peer group seeks to only accept individuals whose type is compatible. Skill determines one's marginal productivity to firms. When choosing how much education to invest in, individuals face a trade-off between signaling their skill level to future employers, or signaling their compatibility to the peer group. In a separating equilibrium, conditional on having the same skill level, individuals with the desired social type invest in less education and receive lower wages but in exchange are accepted by the peer group with higher probability.

The observations that motivated this work were the distributionally lower performance levels of minority students in grade school as well as the increased likelihood of behavioral problems. Not only do minority students exhibit lower school achievement, but the support of the distribution of white versus black performance is nearly disjoint. Various studies have been carried out looking at the effect of peer groups on different life outcomes and at various stages of development. From middle school through employment, there is evidence that individuals emulate the behaviors of their peers, with acceptance into a better performing peer group associated with lower crime and higher wages [11, 19, 4]. [3] establishes a mechanism which links the current desire for acceptance with both current and future performance.

Both of these works look at how individuals are willing to take self destructive actions in order to achieve respect or acceptance from their peer group. The latter work focuses on shunning which is a mild form of aggression and is one of many ways that a group might indicate rejection of an individual. Escalation could involve bullying or even assault, and cases of such school violence are not rare. Furthermore students who grow

up in such an environment learn that activities that lead to income and economic stability also lead to social isolation. They learn how to resolve social conflict through anti-social behavior and practice denying the rights of other individuals. The latter behavior is a prime indicator for current and future delinquency [18, 12].

Both of these works advance our understanding of the determinants of aggressive behavior that are outside the traditional cost-benefit approach. Both are models of social interaction where players care about how they are perceived by others in their environment. In the [21] framework, players have an instrumental value of how they are perceived in terms of reduced future violence, whereas in the [3] framework, players care directly about being socially accepted into a relevant group. I further this line of research by looking at how social interactions can affect a person's willingness to perform violence through his or her ego. I do this in a way that formalizes well established psychological findings on self esteem and aggression as well as sociological work on the mechanics of inter personal violence.

3 The Payoffs of Violent Crime

If violence is not a means to directly increase one's utility, then what are the motivations that lead people to violent crime? Like other works on the subject, the argument that I will make is an instrumental one. In particular, humans have a need to feel as though they are respected by their peers in a way that coincides with their own personal evaluation of themselves. If a person has very high self esteem, then that individual would have reason to expect to be generally successful in life, as well as to be looked up to by others. When the outcome of life events, such as one's employment, are realized in conflict with this positive view of self, individuals face a choice. They can either accept the outcome and update their beliefs about their own quality, or they can take steps to enforce their prior on their

peers. Psychological findings tell us that a negative update of self esteem is very painful while sociology tells us that violence is difficult to carry out. Violent crime can then be understood as individuals who, lacking the social validation afforded by a high wage job, choose to resolve a trade off between lowering their self esteem, or risking punishment and personal injury, by carrying out violence on their peers.

3.1 Esteem, Egotism and Narcissism

Self esteem can be thought of as a “global evaluation of one’s goodness” [7]. It is important for people to have a positive view of themselves for many reasons, but perhaps the most salient is that it is pleasant and gives individuals a sense of control over their lives, which [20] has shown to directly enhance well being. Self esteem can in some ways be considered as a kind of consumption good. More self esteem raises utility while less self esteem lowers it.

Self-esteem might also be considered as a dimension of one’s type space. In addition to contributing to our sense of well-being, self-esteem also tells us what we should believe about our quality as people. Psychology has already categorized some esteem types. In addition to “high” and “low” self-esteem, individuals may also be characterized along a narcissism dimension. Narcissism, or narcissistic personality disorder, exhibits an unusually high resistance to downward self-esteem adjustments. The narcissist thinks of him or her self as entitled to respect and resources above and beyond other individuals. He also views himself as having better than average performance across activities in general, as opposed to being particularly skillful in a few areas of specialty. One might summarize the narcissist as having a global evaluation of self that is *defined* as being higher than his or her evaluation of others.

It is important for individuals to feel good about themselves on a global level, but it is also important for individuals to believe that their conclusions

are somehow grounded in reality. In this sense, self-esteem might also be appropriately thought of as a prior belief about one's type which is subjected to updates based on realizations of information over time. While [20] tells us that people need some objective basis on which to ground their beliefs, it is not necessarily the case that self-esteem beliefs should update in a Bayesian way. Unlike a typical Bayesian posterior, the same event may lead to different esteem states in different individuals, even after experiencing the same histories because some people are simply more resilient to failure and thus are capable of experiencing more repeated failures before needing to update their opinions of themselves. Others, like the narcissist, might choose to take actions which negate the realizations of negative information about themselves.

This article takes the approach that violence is a method of negating negative feedback about one's self. Individuals will be thought of as having two dimensions of self-esteem. One will control the objective quality of an individual. It will control their success rates in employment, and it will contribute to the distribution of signals that individuals receive about themselves. The second dimension will be the narcissistic dimension. More narcissistic individuals will face higher psychic costs of adjusting their beliefs downwards. In a strategic equilibrium, narcissistic individuals will be observed to act more violently than modest individuals, though their measurable levels of self-esteem may not necessarily be higher or lower.

3.2 Aggression and Violence

Aggression is defined as "acts intended to harm others," and includes both physical and verbal acts [5, 14]. Violence, is a more restricted behavioral category that only considers actions that cause or threaten to cause physical harm. The theory of "threatened egotism" says that when one's self esteem is higher than one's measurable personal qualities can justify that individuals respond aggressively, and focus that aggression as much as possible

on the source of the conflicting signals [13]. Several features of the data on violent crime can be explained by looking at how aggression and violence can be used as a substitute source of self esteem.

A review of psychological research on self esteem and violence carried out by [8] finds that violent people tend to hold inflated views of themselves considering themselves as superior to others, and it seems that violence is used by both individuals and groups to raise their self esteem back up to those inflated levels after suffering some hurt or insult [6]. In laboratory settings, Baumeister and Bushman (1998) tested whether basic measures of self esteem were good predictors of aggressive behavior among college aged students. They found that while self esteem levels were not significantly correlated with aggression, narcissism combined with personal insult led to high levels of retaliatory aggression. This finding is corroborated by the later study by Barry et al. (2007) of aggression in young adults (ages nine to twelve), which found that while low self esteem was positively correlated with aggression, when narcissism was controlled for, the correlation became insignificant.

Psychological findings overwhelmingly support the idea that violence and aggression can raise self esteem levels. However the people who make use of violence as a means to achieve esteem tend to be those whose base esteem type is already at an inflated level. Violence is a difficult and costly mechanism for achieving self-esteem and those whose general opinions of themselves are low would, quite rationally, not anticipate success. Think of violence as a lottery. After an insult is suffered, an individual can take the risk to attack. If the opponent is stronger, the insult is further solidified, but if not it is invalidated. People with low self-esteem would place low probability on their ability to overwhelm their opponent and thus would not engage in violence even if it had the potential to raise their general views of themselves.

To the extent that human beings are social creatures, whether violence is

legitimate or not, it is difficult to carry out. At a fundamental level, violence is similar to what is known in sociology as an interaction ritual. Interaction rituals are behaviors performed in groups that lead to a common emotional state. Examples of interaction rituals include church attendance, sex, and watching spectator sports. The behaviors in a violent interaction that lead to the common state are boasting, gesturing, and making verbal threats. What differentiates violence from other interaction rituals, however, is that the common emotional state that the ritual generates is one of fear, which leads to inaction. Violence is therefore difficult to carry out as the emotional state it generates leads individuals to avoid actual direct conflict. When it does happen, it is generally incompetent and short lived [10].

When opponents perceive themselves as evenly matched, encounters tend to disintegrate into bluster and gesturing, which is more frightening than dangerous. Perhaps nominal blows might be exchanged in a street fight, but little true damage is inflicted. When situational factors lead one person or group to feel as though they have an advantage over a weakened opponent, violence is more likely to break out. A display of weakness might be attempting to run away or covering one's face or body in a defensive pose. Alternatively, superiority could be the introduction of a weapon.

Because the prevailing emotion in a violent encounter is one of fear, participants seek the most expeditious way to end a conflict once it has begun. Conflicts may end when the first blow is landed, with the victorious party claiming that further violence would be dishonorable – a sort of “don't hit him when he's down” mentality. In other cases the period of bluster extends until both parties' fear disintegrates into boredom. Threats of future violence may be sufficient to end the encounter. In some cases, the shift in power dynamics comes so quickly that the advantageous party falls into what Collins refers to as a forward panic, where individuals lose control of their own actions in an explosion of violence beyond what the initial conflict may have justified. Police brutality is often a case of forward

panic with exhaustion as the concluding factor. Mob violence and assault over minor social trespasses may be examples of forward panic as well.

One final, and interesting case for that of violent crime, is the presence of an audience. The actual fighters may synchronize their emotional states with that of the audience so that the victor is determined by the approval of the onlookers, independent of actual physical dominance. The interaction between the audience and the participants is particularly important because it adds a certain ambiguity to the outcome of a fight. One might be inclined to assume that the larger, stronger, or meaner party is going to win a fight, but when there are onlookers, the winner is the one who is more emotionally synchronized with the audience. This lends support to the assumption made in [21] that the belief about a fight, or more directly the ability of a fight to generate reputation for the players, is uncertain even if both players know that a fight did in fact occur. We may also conclude that non physical factors play into the outcome of a fight, such as personal confidence or even charisma.

4 A Model of Violent Crime

Consider a model where a unit mass of individuals lives for two periods. They derive utility from consumption and esteem. In the first period of the game, individuals take actions that determine their income levels. In the second period of the game, players are randomly matched with each other and decide if they will be aggressive towards their opponent or not. Both first and second period actions contribute to final consumption and esteem levels.

At the beginning of the game, players learn their two dimensional types. Each player is either high skilled or low skilled, where skill level determines the cost of education as well as the productivity of labor. For skill type $k \in \{l, h\}$, the cost of education level $y \in \mathbb{R}_+$ is $c_k(y)$. The cost function

satisfies the basic single crossing properties with $c_k(0) = 0$, $c_k(y) > 0$ for all $y > 0$, and for all $y \in \mathbb{R}_+$, $c_l(y) > c_h(y)$, and $c'_l(y) > c'_h(y)$. Skill types are distributed randomly with the probability of a player having high skill equal to p , and low skill equal to $1 - p$.

Personality types are distributed independently of skill. Individuals are either narcissistic or modest: $t \in \{n, m\}$, with the probability of a narcissistic type equal to q . A narcissistic type begins the game with a high personal global assessment, $e_0 = 1$ while a modest type begins with low assessment, $e_0 = 0$. Personality types will determine how social messages are processed. Externally generated esteem can be objectively high or low, but will be processed into the utility function relative to the period zero global assessment of self determined by the personality type.

Risk neutral firms compete for labor by offering a wage schedule $w(y)$. Profit to each firm for each unit of labor is the expected productivity conditional on education level, less wages. Because I am not interested in the behavior of the firms, I assume that they are perfectly competitive and make zero profit. Thus we may consider only one wage schedule for which $w(y) = \mathbb{E}(k|y)$. Individuals receive their wages at the end of the first period. If a player's wage is high enough, specifically if it exceeds $\bar{w} \geq 0$, then they receive high external feedback, $e_1 = 1$. Otherwise, their feedback is low: $e_1 = 0$.

In the second period, players are randomly matched and observe the wage level of their opponent. They then engage in the following simultaneous play game. Each player chooses whether to *<fight>* or remain *<passive>*. Passive players receive low second period feedback $e_2 = 0$ while players who fight receive positive feedback $e_2 = 1$. Note that the feedback is contingent on the action being aggressive, and not on the response of the opponent. Physical payoffs, however, will depend on the reaction of the opponent.

Utility is received at the end of the game and is derived from consump-

tion x and esteem z . Let x be wages less investment costs less fighting costs:

$$x = w - c_k(y) - v(A_1, A_2)$$

where v is the non-esteem based payoff from the stage game outcome (A_1, A_2) . Esteem, z , is generated by personality type and external feedback. Let E_t be the set of feedback messages from period 1 and period t . In each period of the game, players select an external evaluation e_t^* from E_t . Total self esteem is calculated by

$$z = \sum_t \min\{\underline{r}(e_t^* - e_0), \bar{r}(e_t^* - e_0)\}$$

for $0 \leq r_+ \leq r_-$. Utility is

$$u = x + z.$$

The solution concept in this model is Perfect Bayesian Equilibrium in symmetric strategies. A strategy for player i is a mapping $\dot{y}(k, e)$ from types into education level, and a choice of action g which, for each wage pair (w_i, w_j) and esteem type e , selects an action in $\{fight, passive\}$, where w_j is the wage level of i 's opponent. Let Σ' be the set of all strategies and $\sigma = (\dot{y}, g)$ be a strategy profile. The set of symmetric strategies is $\Sigma \subset \Sigma'$ such that for each $\sigma \in \Sigma$, $\dot{y}_i(k, e) = \dot{y}_j(k, e)$ and $g_i(e, w_i, w_j) = g_j(e, w_j, w_i)$ for all $i, j \in I$.

Let Ω be the set of all wage profiles ω , and let ρ be a belief function which assigns probability $\rho(y) \in [0, 1]$ to the outcome $k = h$ given y . Let π be a belief function which assigns probability $\pi(w) \in [0, 1]$ to the outcome $e = n$ given wage w . The vector $(\rho, \pi, \omega, \sigma)$ is a Perfect Bayesian Equilibrium in symmetric strategies if ρ is consistent given σ , π is consistent given ω , and σ is sequentially rational given ρ and π .

5 Levels of Violence and Aggression

In the second period all players receive the same physical utility as a result of the stage game outcomes. However, depending on their personality types and wages, their esteem incentives will vary. A player who has achieved the reference wage will have no esteem benefit from violence. On the other hand, a narcissistic type who has yet to receive positive feedback faces a loss to his or her self evaluation and will have maximal incentive to fight. I will refer to any player who has achieved the reference wage as a *validated* player. A modest type with below reference wages is a *neutral* player and a narcissistic type with below reference wages will be a *unvalidated* player. The combined physical and esteem based payoffs of each of these three types is displayed in Figure (1).

		Validated	
		<i>F</i>	<i>N</i>
<i>F</i>		$r_+ - a$	$r_+ - c$
<i>N</i>		$r_+ - b$	r_+

		Neutral	
		<i>F</i>	<i>N</i>
<i>F</i>		$r_+ - a$	$r_+ - c$
<i>N</i>		$-b$	0

		Unvalidated	
		<i>F</i>	<i>N</i>
<i>F</i>		$-a$	$-c$
<i>N</i>		$-r_- - b$	$-r_-$

Figure 1: The columns are the actions of the opponent. Entries are payoffs to the row player.

The best response of a validated player in the stage game will always be to not fight. The enduring nature of socio-economic validation guarantees high esteem in both periods. Because fighting is inherently costly,

validated players have no benefit from fighting and remain passive against all opponents.

Unvalidated players have the highest incentive to fight because they face a painful devaluation of their self-esteem if they do not. Gaining esteem in the second period increases overall utility by r_- while a neutral player only gains $r_+ < r_-$. This result obtains from the loss-aversion built into the esteem function. A narcissistic type can never achieve social esteem which is higher than their own self esteem whereas a modest type can never receive feedback which is lower than their own self esteem. This dynamic is nicely supported by the findings of [] that incarcerated violent criminals tend to suffer from particularly high fluctuations in their esteem levels compared to non violent criminals or the general population.

Assumption 1.

$$c < r_-$$

Assumption 1 states that the cost of fighting the most passive opponent is never larger than the cost of unvalidated high self esteem. This is a necessary condition so that in at least some equilibria, violence will result with positive probability.

Assumption 2.

$$r_- + b \leq a$$

Even a player with maximal incentive to fight prefers not to fight an openly aggressive opponent. Recall that individuals are only willing, and moreover capable, of overcoming fear and doing violence on another individual if they believe that they possess some advantage over the other player. If, however, they believe that their opponent is committed to fighting, then their opponent has an advantage and violence becomes more difficult.

The existing theory on violence is moot regarding the relationship of r_+ and c . If $r_+ > c$, then we are assuming that violence is intrinsically satisfying despite its physical risks. Because r_+ is interpreted as the emotional boost received by an individual who is neutral regarding their own self evaluation but whose external evaluation is positive, a relatively large value of r_+ would imply that even socially well adjusted and emotionally healthy individuals feel better about themselves when they are violent. That said, if $r_+ < c$, then neutral players are never violent. To the extent that some otherwise well adjusted individuals do, on occasion, commit acts of violence, we may not want to *ex ante* rule this possibility out. I will revisit this relationship briefly.

Let λ be the probability that a player believes his or her opponent will attack. The value of λ at which a player is just willing to fight is a measure of their *aggression level*. Players' aggression levels can be ranked according to their esteem state at the start of the second period. Validated players are never violent. An unvalidated player is indifferent between fighting and not fighting when the probability of being attacked is λ_u :

$$\lambda_u = \frac{r_- - c}{a - b - c}. \quad (1)$$

Similarly, neutral players find it optimal to fight when the probability of being attacked is no larger than

$$\lambda_n = \frac{r_+ - c}{a - b - c}. \quad (2)$$

Result 1. *Players are rankable in their aggression levels with a greater difference between social esteem and personal esteem leading to higher aggression: $\lambda_n \leq \lambda_u$ and $0 < \lambda_u$.*

An unvalidated player in this model is similar to the personality types of "high but unstable" self esteem noted in the psychological literature. Compare these players to validated players with the narcissistic personality type.

Because the latter can rely on their income as an indicator of esteem, their self esteem levels will remain relatively constant. The unvalidated types, however, must generate esteem from each personal encounter. Because they are more motivated than modest types to acquire positive external signals, they will, on average, exhibit higher self esteem levels, however those levels will change according to their most recent social encounter.

Violence is aggression in action. Where aggression measures a player's willingness to fight, violence is the likelihood in equilibrium that a player actually chooses *fight*. Within any given equilibrium, more aggressive players will, on average, be more violent. This follows from the fact that both neutral and unvalidated players will have the same wage level in every equilibrium and will therefore appear identical to their opponents. Both of these interim types are attacked at the same rate, but the unvalidated players being more aggressive, are more willing to return fire. In any circumstance where a neutral player is willing to attack with positive probability, the unvalidated type attacks with certainty.

Lemma 1. *Denote the probability that a player with esteem type e and own wage v who is matched with an opponent of wage w chooses to fight by $\phi_{e,v}^w$. In every equilibrium such that $\phi_{m,v}^w > 0$, $\phi_{n,v}^w = 1$.*

Proof. Denote the probability that a player with wage w is attacked when matched with another player of wage v by $\Phi(w, v) = p\phi_{n,v}^w + (1-p)\phi_{m,v}^w$. If $\phi_{m,v}^w > 0$ then it must be that $\Phi(w, v) \leq \lambda_n < \lambda_u$ so that narcissistic types have a strict incentive to fight: $\phi_{n,v}^w = 1$. \square

Aggregate levels of violence will depend on the distribution of validated and unvalidated types in the second period. A lower value of \bar{w} will increase the share of validated types and therefore decrease the share of players willing to fight. The most interesting case is when some players achieve the reference wage level and other players do not. Those who do are known to be non violent. Among the players who do not achieve the

reference wage, the likelihood of attack will depend on the distribution of modest and narcissistic types within each wage category.

We can think of \bar{w} as a culturally determined cutoff above which wages indicate “success,” and below which they indicate “failure.” Achieving a socially acceptable level of success would boost esteem through the praise and respect of one’s peers. For a narcissistic personality type, we can add the interpretation that achieving the reference wage level makes a player better than those who do not achieve it. It is not necessary that \bar{w} be determined within the model, or that the relevant society which determines the cutoff be composed entirely of the players in the model. When we think of crime ridden neighborhoods, we don’t think of entire countries being sunk in a cesspool of violence and poverty. On the contrary we think of ghettos — culturally and economically segregated communities within a larger more affluent society. Note the distinction here between violence and violent crime. War is violence and it is prevalent in many impoverished countries, but war is not criminal. The incentives that drive wars among and between impoverished nations are very different from those that drive interpersonal criminal violence.

When the reference wage level is higher than the productivity of the highest skill types, no player can achieve socio economic success. A model with this specification may be interpreted as representing an inner city or impoverished neighborhood within a larger, more affluent society. No member of this society will be validated in the second period and every player will be violent with positive probability. A *wage excluding equilibrium* is one in which $\bar{w} > h$ and no player validates in the first period.

At the other extreme, the reference wage might be so low as to allow all players to validate themselves through employment. This scenario, which I will refer to as a *wage including equilibrium* will exhibit zero violence in the second period. We can interpret a model wherein all players, even those with low skill levels, are able to validate themselves through wages as rep-

representing a relatively affluent community, perhaps one in which earnings are high enough that individuals finding themselves in want of external validation need only to look at their median income compatriots to find it.

Intermediate values of \bar{w} will lead to the most interesting second period behavior as players will be able to learn some information about their opponents' willingness to fight. This work does not attempt to explain the source of the reference wage level, though the average productivity in the community, $\bar{w} = ph + (1 - p)l$, provides an interesting interpretation. A wage above this reference validates a player as having "above average skill." Evidence suggests that people enjoy thinking of themselves as above average, so this is also a reasonable cut off for esteem feedback [16]. If some players achieve the wage cutoff and others do not, then the resulting equilibrium is referred to as a *wage separating equilibrium*.

As firms are perfectly competitive and profit maximizing, the wage schedule paid must reflect the expected productivity of the players. With a pooling schedule, all players receive the same wage regardless of skill: $w(y) = qh + (1 - q)l$ for all y education levels invested in with positive probability. If $\bar{w} > qh + (1 - q)l$, we will observe a wage excluding equilibrium. Otherwise, we observe a wage including equilibrium. When the wage schedule allows for separation, there will be a positive mass of players with wages equal to h , and above \bar{w} . These players will be known by their opponents to fight with zero probability. The remaining population will be either neutral or unvalidated depending on their personality type.

Lemma 2. *In every equilibrium, players will either perfectly pool on low education, or perfectly separate according to their productivity levels.*

Lemma (2) says that no equilibria will exhibit partial pooling in the first period. We might expect that players with the same productivity type but different esteem types would have different incentives to invest in education such that partial pooling occurred in equilibrium. For example, it might be the case that the narcissistic type who has the highest demand

for violence in the second period would be more willing to distinguish himself with a higher wage than a modest type of the same skill level. All players, however, face the same disutility of being attacked so that if a narcissistic player finds it optimal to choose a separating level of education, then the modest type will also find it optimal. A formal proof of this result is available in the appendix.

Lemma 3. *In both wage separating and wage excluding equilibria, the conditional likelihood that a player with wage w has a narcissistic personality type is equal to the unconditional distribution p of narcissistic types.*

Because personality type neither contributes to productivity or reduces the cost of education, wages are not informative for personality type. To the extent that second period play influences the education choice, we might expect the wage level to correlate with personality type. However, by lemma (2), if the wage schedule is not perfectly separating, then it is perfectly pooling. In both cases the conditional likelihood that an opponent is a narcissistic personality type is equal to the unconditional probability p .

5.1 Violence in relative poverty

In a wage excluding equilibrium, no player validates their esteem through wages so that all second period types are either neutral (modest) or unvalidated (narcissistic). If players pool on their education levels, then every player has the same wage and is attacked with the same likelihood as every other player. Let ϕ_e be the probability that a player with esteem type e chooses to attack. By lemma 1, it follows that if neutral players fight with positive probability, then unvalidated players will choose to fight with unit probability. Such an equilibrium exists only if $p \leq \lambda_n$. For larger values of p , neutral players are passive while unvalidated players choose a mixed action.

Result 2. *In every wage excluding equilibrium, violence occurs with positive probability. Furthermore if the share of narcissistic personality types is small enough, all players exhibit non-zero aggression levels.*

When players separate on their education level, some players will have high wages and some players will have low wages, but all players will have non-zero aggression. While the different wage levels do not change the incentive to fight, they do enable coordination. In a symmetric pairing, the information sets are identical to the pooling case and either $p \leq \lambda_n$ and all players are violent with positive probability, or $p > \lambda_n$ and only unvalidated types are violent. In an asymmetric pairing, multiple equilibrium strategy profiles are possible: players ignore the wage information, high wage players are passive, or low wage players are passive. Figure (2) shows the equilibrium probabilities of attack by the column player when matched with the row player for the case when L -types are passive in the asymmetric pairing.

$$\Phi(w_1, w_2)$$

	L	H
L	p	1
H	0	p

Figure 2: The case when L -types are passive and $p \in (\lambda_n, \lambda_u)$

If wage provides no information about esteem type or aggression, it would be rather ad hoc to attempt to select one type of coordination over the other. However evidence from impoverished and crime-ridden neighborhoods suggests that it would be more likely that the higher wage, or more schooled, players are the most subjected to violence. Indeed as the cost of violence relative the the esteem benefit received by neutral players grows, their aggression level also reaches a negligible size. In order to simplify the remaining analysis and eliminate purely coordination based multiplicity, I will assume from here on that neutral players prefer passivity

against all opponents.

Assumption 3. *Neutral players never prefer to fight: $r_+ < c$.*

In a wage separating equilibrium, suppose that all unvalidated players attack other low wage players with probability ϕ . Because neutral players, also having low wages, attack with zero probability, the probability that an unvalidated player is attacked when matched with a low-wage opponent is ϕp . By symmetry, it follows that in equilibrium, $\phi = \lambda/p$ when $p \geq \lambda$ and one otherwise. For ease of analysis, I will consider only models for which $p \geq \lambda$.

Lemma 4. *In every wage separating equilibrium,*

1. *High skilled players are never violent.*
2. *Low skilled players with modest personality types are never violent.*
3. *Low skilled players with narcissistic personality types fight high wage earners with probability one and low wage earners with probability $\lambda_u/p \leq 1$.*

Proof. (a). A high skilled player receives wage $w = h > \bar{w}$ so that $e_1 = 1$. If this player has a narcissistic personality, then he becomes neutral in the second period. Otherwise she becomes validated. Under the assumption $r_+ < c$, both neutral and validated players are passive with probability one.

(b). A low skilled player receives wage $w = l < \bar{w}$. If this player has a modest personality type then he or she is neutral in the second period. Neutral players are passive with probability one.

(c). A low skilled player with a narcissistic personality type becomes unvalidated in the second period because $e_0 = 1$ and $e_1 = 0$. This player has the greatest incentive to generate social esteem in period two through violence. If an opponent has a high wage, then by (a) and (b) above, the probability that he or she will fight is zero, so the best response is to fight with probability one. A low wage opponent fights with probability ϕ times

the conditional probability that the player is narcissistic p . The indifference condition on unvalidated types requires that $\phi = \lambda/p$. \square

Result 3. *In a wage separating equilibrium, higher wages lead to a (weakly) higher probability of being attacked.*

Using the best responses calculated above, we can infer the probability that a player is attacked in the second period. For a high wage earner, the probability to be attacked is equal to the probability that he or she is matched with an unvalidated opponent. Recall that a high wage is perfectly correlated with passivity in the second period. Thus the probability that a high wage earner is attacked in the second period is equal to the share of unvalidated players, $p(1 - q)$. Low wage earners are attacked only when they are matched with unvalidated players who choose to fight. That is, the probability to be attacked conditional on having low wages is equal to $\lambda(1 - q)$. Because $p \geq \lambda$, having a higher wage leads to a higher probability of being attacked.

Result 4. *Equilibria are violence rankable with wage excluding equilibria exhibiting the greatest levels of violence, followed by wage separating and wage including equilibria, which are non-violent.*

Recall that when all players are able to validate themselves through their wage earnings, there is no incentive to fight in the second period. Fighting is costly and the only benefit of fighting is esteem, which becomes irrelevant when wages generate positive external feedback.

Lemma 5. *In a wage including equilibrium, violence is zero. In a wage separating equilibrium, the instance of violence is*

$$\begin{cases} (1 - q)(qp + (1 - q)\lambda) & \text{if } \lambda < p \\ (1 - q)p & \text{otherwise} \end{cases}$$

while in a wage excluding equilibrium, violence is

$$\min\{\lambda, p\}$$

Clearly an including equilibrium exhibits the lowest instance of violence.

Result 5. *In the second period, conditional on skill, players with modest personality types have strictly higher utility than players with narcissistic personality types.*

Looking to the first period when individuals choose the level of effort they will invest in their future wages, we can expect that the increased likelihood of assault that accompanies a higher wage would provide a disincentive to invest. However, because investment in education leads to a higher likelihood of esteem validation through wages, the ultimate effect will depend on the costs of both fighting and being attacked.

In a wage separating equilibrium, investment levels reveal individuals' skill types with certainty, and firms pay the exact productivity of each worker. With four types of players, narcissistic and modest with high and low skill, there are four incentive compatibility constraints necessary to characterize the equilibrium. Let $u_e(\text{type})$ be the expected continuation payoff to a player with personality e and second period type as specified.

$$l - r + u_n(\text{unv}) \geq h - c_l(y^*) + u_n(\text{val}) \quad IC_{(n,l)}$$

$$l + u_m(\text{neu}) \geq h - c_l(y^*) + u_m(\text{val}) \quad IC_{(m,l)}$$

$$l - r + u_n(\text{unv}) \leq h - c_h(y^*) + u_n(\text{val}) \quad IC_{(n,h)}$$

$$l + u_m(\text{neu}) \leq h - c_h(y^*) + u_m(\text{val}) \quad IC_{(m,h)}$$

Recall that from result 5, conditional on having the same wage level, the second period utility to a narcissistic personality type is always lower than the corresponding utility for a modest type. Specifically this implies that $u_n(val) < u_m(val)$. This follows from the fact that a narcissistic personality type expects high feedback, and thus does not receive a utility increase from positive feedback. It also holds that the second period payoffs to an unvalidated player are lower than those of a neutral player: $u_n(unv) < u_m(neu)$. It is clear, then that $IC_{(n,l)}$ implies $IC_{(m,l)}$. Similarly, $IC_{(m,h)}$ implies $IC_{(n,h)}$.

Result 6. *Narcissistic types have stronger incentives to achieve high wages than modest types.*

Because a narcissistic personality type experience a decrease in esteem for each period that he or she is unvalidated, holding the second period likelihood of attack constant, not achieving the reference wage \bar{w} is more painful to a narcissistic type than a modest type as the modest type requires no esteem adjustment. Relative to a standard signaling model, in order to achieve perfect separation, the investment level sufficient to garner high wages must be higher when esteem is considered. This result corroborates the findings in Austin and Fryer's "Acting White" where the presence of a social group substitutes for esteem, but contributes to utility in a similar fashion.

Solving the incentive compatibility conditions, a wage separating equilibrium exists if there is a $y^* > 0$ such that $w(y) = h$ for $y \geq y^*$, and $w(y) = l$ for $y < y^*$ and

$$c_h(y^*) - r_+ \leq (h - l) - (1 - q)(p - \lambda)b \leq c_l(y^*) - r_- - r_+ \quad (3)$$

Relative to a standard signaling model, the second term is adjusted for the affect of wages on second period social interactions while the first and third terms are adjusted to account for the effect of esteem. The benefit of a

boost in self esteem to a modest type offsets some of the cost of investing in education while the downward adjustment endured by the narcissistic type increases the cost of investing for low skilled players necessary to support separation.

6 Policy Implications

This paper took a new approach to understand the economics of violent crime by incorporating several well established features of psychological and sociological literature. Violent crime on the whole has little to no direct monetary payoff and carries high risk of physical loss as well as punishment from enforcement. Furthermore violent criminals often choose relatively poor and potentially violent individuals as their targets. These puzzling aspects of violent crime make it difficult for economists to use conventional techniques to understand these correlations.

Breaking away from the traditional methods of analyzing crime, I incorporate a psychological variable directly into the utility function, selecting its functional form to precisely capture key interdisciplinary findings. Self esteem, an individual's general valuation of self, is affected by external feedback. Individuals exhibit a status quo level of esteem relative to which positive feedback is asymmetrically less beneficial than negative feedback. Negative feedback produces negative affect which in turn leads to increased aggression on the part of the recipient. To formalize these findings, I specify an esteem generating function which is parameterized by personality type, that is, the status quo esteem level, and which exhibits loss aversion. Aggressive behavior enters into the esteem function as a positive feedback message.

I then go on to specify the non-esteem related costs and benefits of aggression. Violence is known to be difficult to carry out as those faced with potential violence experience fear and consequently inertia. The higher

the potential threat, the higher the fear. In addition to fear, there are the anticipated physical damages. While most violent encounters involve trivial injuries, a small share exhibit the “tunnel of violence” effect wherein a sudden change in the environment can tip the balance of fear sending one party into a gross over use of force. Combining esteem and non-esteem payoffs I produce a model wherein a greater devaluation of self-esteem leads to greater incentives for violence, but lower over all utility.

Finally, to solidify the link between wealth and violence, I take demographic observations that a lack of resources leads individuals to focus on garnering esteem, or respect, through physical dominance of their peers. I interpret the converse of this observation to mean that when resources are abundant, individuals prefer not to acquire esteem through violence. Formalizing this notion, I allow wages to be an additional source of self esteem for the players in my model. In keeping with the idea of positive feedback being a relative notion, I specify a cut-off wage above which individuals receive positive feedback, and below which the feedback is negative. This reference wage can be thought of as a socially imposed measure of economic success.

Using self esteem as a hinge, this paper is able to explain how income is linked to violent crime, increasing our understand of the motivations for crime and implementing a new interdisciplinary method for understanding economic phenomena. Both crime and income are capable of producing esteem and individuals choose based on the costs of each option – effort in education or damages from violence. When access to wages is restricted, as a result of social discrimination, low investment in infrastructure or economic recession, violence increases. However, because the violence does not provide a source of wealth, affecting utility through esteem, it is possible to reduce crime levels by providing less socially costly sources of esteem.

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