Forum

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Crime and the Beta Coefficient*

Cloninger and Marchesini (1995) have proposed a novel application of a concept which has gained currency in the financial markets over the last 35 years. In his original essay Markowitz (1959) suggested that the premium an investor expected to earn over the risk-free rate of return should be related to the premium expected to be earned by the average investment. If the expected return to the specific asset increases more than the increase in the return expected to be paid by a market aggregate, then the asset is understood to be risky. An asset which is thought to be less risky than the market will command a smaller increase in its premium over the riskless return than the increase expected in the market as a whole. The exact numerical relationship between the specific asset and the overall market is termed the beta coefficient. Risky assets have betas greater than one, less risky assets have betas smaller than one. The construct which systematizes these relationships is known as the capital asset pricing model.

The leap from the financial beta to the study of crime seems quite intuitive. Instead of positive returns, economic agents earn negative returns when they are the direct or indirect victims of crime. The size of the negative return can be implicitly measured by the percentage change in the underlying crime indexes. If the crime index for robbery rises more than in proportion to the rise in the general crime index, then we will observe a crime beta for robbery which exceeds one. The community will be at risk of observing disproportionate increases in robbery as the general crime index rises. One could, as Cloninger and Marchesini have, make interesting comparisons between communities and between crimes.

Returns to a Portfolio

What seems so intuitive and what may produce what appear to be interesting numerical results may rest on shaky foundations. To see this, it is necessary to review in somewhat more detail the original capital asset pricing model (CAPM).

The most essential assumption of the CAPM is that financial markets are efficient. In order for markets to be efficient, there must be many securities traded by large numbers of buyers and sellers. There are so many buyers and sellers, in fact, that no one of them can affect the price. These buyers and sellers

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are well informed and must share a common model of expectations about the performances and risks of individual securities.

The transaction costs associated with trading in the markets must be nonexistent. For example, brokerage fees must not induce distortions in buying and selling prices which produce opportunities for arbitrage.

The restrictions on investing in the market must be negligible. In the model agents must be able to borrow and lend at the same rate. Anyone who has a margin account knows that this isn't so. They also know that there are both legal and brokerage rules imposed on the holders of such accounts.

In the CAPM there must be no tax-induced distortions. One example would be a difference between the capital gains tax rate and the income tax rate.

There are two types of assets traded on the efficient markets by these well-informed economic agents. One asset is the riskless asset or security which pays a return of r_f. If you are willing to hold it until maturity, a U.S. government obligation is a risk-free asset.[1] The other type of asset includes the risky securities issued by firms and which pay a return of r_j, $j = 1, 2, \ldots, n$. These risky assets can be purchased individually or easily combined in different proportions to make up a portfolio. The portfolio which includes every asset available is known as "the market" and pays a return equal to r_m.[2]

The empirical model used to test the CAPM, which is a model of ex ante returns, is based on using ex post time series data to estimate the parameters of $r_{jt} - r_{ft} = \alpha_j + (r_{mt} - r_{ft})\beta_j + u_{jt}$, where u_{jt} is an error term.

In the theoretical ex ante model the intercept, α_j, should be zero. It may be nonzero due to market imperfections, disequilibrium in the market, statistical problems, or because there is some price appreciation in the jth asset during the period under study. When $\beta_j > 1$, then stock j is said to have more systematic or unavoidable risk than the market. If $\beta_j < 1$ then stock j has less systematic risk than the market.

Over the years there have been many empirical studies of the validity of the parameter restrictions implied by the CAPM. These results are surveyed in almost every undergraduate finance book (Brealey and Meyers, 1984). The model has not stood up well to testing over many different financial markets and periods, but remains popular as a rough indicator of the riskiness of stocks.[3]

Crime as a Return to a Portfolio

In the local community there are two parties to any crime; the criminal and the victim. With some interpretations there is a market for crime. Some individuals, namely criminals, supply crime to the market. Some individuals, victims, "demand" crime. In any given community there may be many of both

[1] It is risk free insofar as you will get back your original investment plus the contractual rate of interest. There remains interest rate risk. By holding the government obligation, you will possibly have to forgo higher rates on other issues while waiting for yours to mature.

[2] By owning shares in a stock market index mutual fund one can own a security which consists of every equity issue traded on the corresponding market.

[3] For example, ValueLine regularly publishes estimated beta coefficients for many companies.

types of market participants. Unless criminals and their victims are perfectly mobile and understand geographic and intertemporal substitution of economic activity, both licit and illicit, the plausibility of the large numbers assumption necessary for the CAPM is suspect. Nevertheless, the motivation for the CAPM as a paradigm for characterizing crime can be motivated from either side of the market. Whether or not it is a plausible paradigm deserves some scrutiny.

The criminal is making a portfolio decision to the extent that he or she is investing in human capital of different types which equip him or her to engage in different activities, some of which are illegal. The legal activities entail some possibility of unemployment, so there is some risk involved in acquiring human capital which prepares one for the legitimate world of work. Human capital intended to prepare one for crime is also risky since one could be arrested, convicted, and incarcerated as a result of practicing one's trade. There are many types of crime for which one could train and between which one could substitute. The criminal then builds a portfolio of human capital types which allow him or her to earn different rates of return from combinations of legal work and types of crime. However, the criminal has no riskless asset in which he or she can invest. Thus, there is no possibility of diversifying so as to drive unsystematic risk arbitrarily close to zero, as in the CAPM model.

At least two of the assumptions of the CAPM are clearly problematic for the supply side of crime. The criminal faces differential tax rates which induce a change in the preference for types of income. Unless one interprets incarceration as an uncertain tax, the criminal pays no tax on his or her illegal income. In any event, the marginal tax rates on legal and illegal income will differ, altering the criminal's decisions at the margin.

Furthermore, all participants in the market do not agree on the riskiness associated with acquiring the human capital which would make one a better housebreaker, for example. Nor do all participants agree on the model used for expectations formation. Those who seek legal income are risk averse. Those who seek illegal income are at best risk neutral (Buck et al., 1989).

When viewed from the "demand" side there are also problems with the application of the CAPM to crime. The use of the CAPM to characterize crime means invoking an extreme form of the Tiebout hypothesis. In its original form (Tiebout, 1956), the hypothesis stated that homeowners revealed their preferences for publicly provided goods by voting with their feet. In the present case the publicly provided good is community security, which produces an absence of crime. The transaction costs associated with changing one's place of residence can be substantial. Given the lumpiness of home ownership and requirements which must be met to qualify for a mortgage or a lease, there are substantial restrictions on investing in assets which result in a given expected level of crime. Thus there are substantial barriers to investment.

The tax code provides substantial incentives for home ownership through the home mortgage deduction provision, quite apart from the risk of victimization. Losses due to victimization are insurable ex ante and are compensated ex post as a deduction on one's income taxes. Hence insurance and taxes will distort risk taking by investors.

The problem of constructing a portfolio which could produce a particular expected crime return is problematic for the homeowner. To begin with, there

is no risk-free asset.[4] Even if there were such an asset, only a small segment of the population could buy it since it surely is not divisible.

Beyond the risk-free asset is the question of the appropriate definition of the aggregate return in the market. Is there a composite index of all assets which can be averaged to produce a market rate of crime? In the Cloninger and Marchesini paper the market rate of crime is modeled by regional and national crime indexes. This suggests that there are regional and national markets for crime. In order for this to happen, there must be a condition of costless spatial mobility of criminals who can respond to varying opportunities around the country and about which they are well informed.

It is conceivable that one could diversify away from property crime by holding shares in many different communities, but such markets don't yet exist. Even if they did, one must live somewhere. The idea that one could diversify away from the possibility of bodily harm from rape or assault is implausible, especially since the underlying assets which produce rates of crime are inherently indivisible.

In the simple CAPM any given expected rate of return is available to any market participant. This is assured by the divisibility of the underlying assets. The ability to diversify or purchase a less risky asset is independent of wealth. This just is not the case with respect to crime. It should be readily apparent that more wealthy individuals can purchase lower crime rates by purchasing more expensive assets. This is not the same as diversification.

Crime Betas and Public Policy

Can betas be used to identify community characteristics which produce a lower risk environment? There are actually two ways to answer the question.

The first answer hinges on the technical construction of the beta coefficient. Recall that beta measures the covariance between the expected premium earned by the jth security and the premium earned by the market average. If there are n securities in the market, including the risk-free asset, and one estimates a beta coefficient for each one of them, then the sum of the beta coefficients must be equal to the number of securities. The same is true for properly constructed crime betas. Some communities must be more risky than, say, the state. A given community must have some of its particular crime betas below one when the market is defined as its own aggregate crime index.

The policy implication is now quite troublesome. Suppose that East Gibip is found to have the lowest beta of all communities in the state, which has impenetrable borders. All communities implement programs which exactly mimic the anti-crime activities of East Gibip, but relative wealth, incomes, and licit employment opportunities across communities do not change. Ex post there will still be betas above and below one since the relative costs and benefits of crime between communities will not have changed, although the overall level of crime may be reduced. In this context the betas have not been informative in the design of public policy.

Consider the possibility of computing betas for each of the FBI crime categories for a given community, which we assume to be closed to the outside for

[4] Cloninger and Marchesini confuse the issue somewhat by trying to make a connection between a beta equal to zero and an asset which pays a riskless return.

simplicity. It is found that the beta for burglary is quite high. In response the community devises an anti-burglary campaign, which proves to be effective. Criminals respond to the new campaign by substituting away from burglary to, say, robbery. Alternatively the burglar could make an intertemporal substitution and wait for the community to once again become less watchful. Finally, let the community be open to the outside. Now the criminal has the opportunity to move to the next town over. Observationally, the beta for burglary will go down and that for robbery will rise. By itself did the CAPM analysis suggest these sorts of substitutions by the criminal?

The second answer to the policy question hinges on the merits of the CAPM as a statistical model. The assumptions used in the financial development of the CAPM obviate any discussion of the stationarity of the returns of the market and the individual security. Nor are cointegration and error correction relevant to the financial model. However, in the crime application all three issues become relevant. There is no reason to believe that rates of growth of crime indexes are stationary in the statistical sense. In the presence of nonstationary data, ordinary least squares is not efficient. Undoubtedly the growth rate of the crime index for, say burglary, has a long-run relationship to the aggregate measure. The two series are said to be cointegrated, and the result of a CAPM type regression is spurious results. Finally, because of the substitution possibilities mentioned above, the time series observations on burglary are not likely to wander very far for very long from the aggregate observations. This suggests an error correction mechanism not captured in the application of the CAPM to crime.

Although they do not use the method themselves, Cloninger and Marchesini seem to advocate using the estimated betas as dependent variables in a regression model that puts community characteristics on the right-hand side. This would allow researchers to identify successful crime fighting techniques. Rather than use this two-step procedure, one could simply begin by specifying the arbitrage pricing model (Roll and Ross, 1980). There would be a gain in precision and efficiency of the estimators.

Conclusion

In the decades-old debates about scientific method and positivism, it has been repeatedly stated that the acid test of a model is its ability to fit the facts. The validity and usefulness of the model should not rest on the realism of its assumptions. Cloninger and Marchesini should not be held to a different standard than the rest of us. Instead, in spite of any reservations expressed here, they should be encouraged to pursue the application of the capital asset pricing model, and its cousins, to the study of the incidence and control of crime.

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Crime and the Beta Coefficient: A Reply*

Buck (1995) offers an instructive analysis of our paper (Cloninger and Marchesini, 1995). His comments enhance our attempt to explain the philosophical and theoretical bases of crime betas. For that we are in his debt.

A few issues Buck raises, however, deserve some further elaboration and clarification. First, whereas a riskless asset that allows individuals to take refuge from all criminal activity does not exist, individuals may purchase a portfolio of assets that yield a zero beta for any particular crime. That is, the choice of productive, residential, protective, and other assets could yield a portfolio with a zero crime beta with respect to a specific crime. Because crimes are heterogeneous, a zero risk of one, e.g., burglary, does not imply a zero risk of any other crime, e.g., robbery. Risk-averse individuals would take little comfort in a portfolio whose *average* beta is zero particularly if the betas of homicide or rape were large.

Second, Buck correctly points out that differential tax effects exist between the licit and illicit sectors. High marginal tax rates may bias individuals to engage in the illicit sector. However, to the extent that illicit income is laundered through legitimate enterprises, transaction costs and tax liabilities arise on the illicit gains.

Third, Buck's comment that "[t]hose who seek illegal income are at best risk neutral" (Buck, 1995:913) appears to contradict his own referenced work (Buck et al., 1989) and is, at best, perplexing. We assume the seekers of illegal income to which Buck refers are criminals or potential criminals. Contrary to Buck's present statement, Buck et al. (1989) concluded, "*[A]ll the intercepts are negative and significant, implying that, on the average, criminals are risk averse*" (p. 368; emphasis added). In the conclusions, they stated, "*[T]he study reveals that criminals are indeed risk averse*" (p. 370; emphasis added).

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