Why do Europeans steal more than Americans?

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Abstract

Property crime is today more widespread in Europe than in the United States, while the opposite was true during the 1970s and 1980s. In this paper we study the determinants of crime in a dynamic general equilibrium labor and crime search model. We focus on United States and United Kingdom, and compute the contribution of various factors to the total change. We find that changes in the probability of apprehension and prison duration increased crime rates for both countries. At the same time, changes in the job finding and job separation rates decreased the crime rate in the United States, but increased it in the United Kingdom. Changes in the unemployment insurance rates and age distribution also contributed to the reversal.

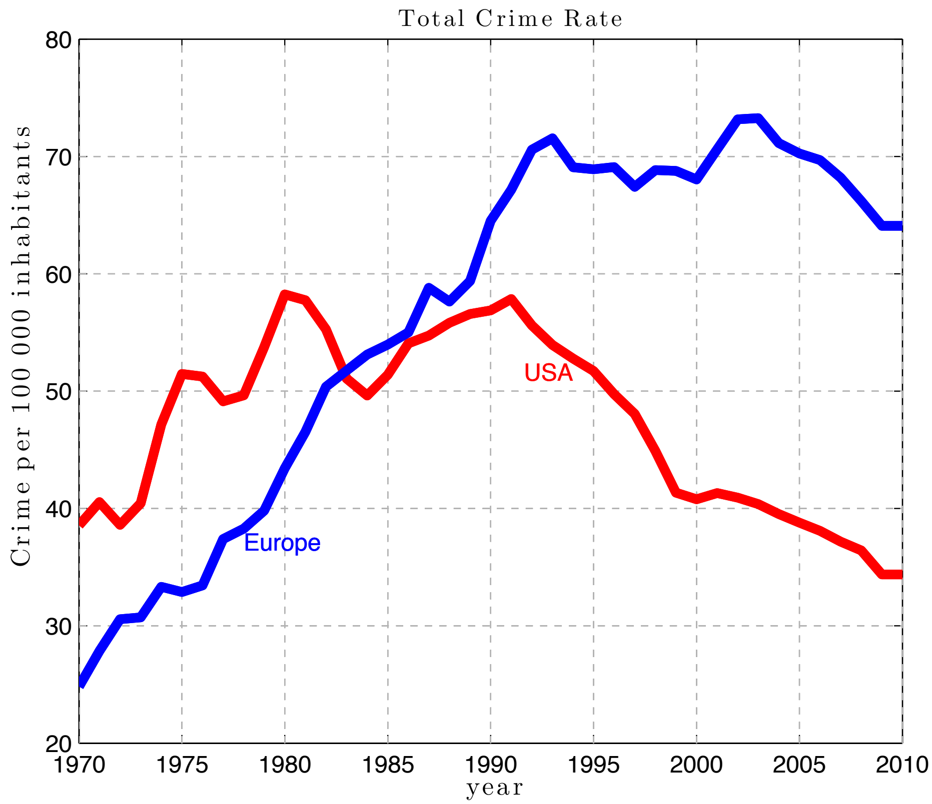
1 Introduction

The total crime rate is now higher in the five largest European countries (France, Germany, Italy, Spain, and the United Kingdom, henceforth "Europe") than in the United States, while the opposite was true during the 1970s and the early 1980s. This pattern holds, in particular, for property crimes (robbery, larceny and theft, and burglary). These facts were first documented by Buonanno, Drago, Galbiati, and Zanella (2011), who label the pattern "the reversal of misfortunes". Figures 1–4 illustrate such a pattern.

Figures 1 and 2 report the aggregate total and property crime rates in Europe (cases known to the police per 1000 inhabitants) and in the US.[1] In terms of the total crime rate, Europe took over the United States at the beginning of the 1980s, following a slowdown of crime trends in America. However, it is not until the beginning of the 1990s that a substantial gap opens up. At that time the European total crime rate was still growing (before leveling off at mid-1990s) while the US began experiencing a well-known, prolonged fall in crime rates. The behavior of the property crime rate is very similar, except that Europe got ahead after the beginning of the 1990s. During the 2000s Europe experienced a decline in property crimes slightly faster than the US, but this was not enough to undo the previous reversal: the Europe to United States ratio of property crime rates is still about 1.2, while it was 0.3 back in 1970.

Figures 3 and 4 report these same data after disaggregating Europe. The single European countries represented in this picture have experienced similar changes in the total crime rate, despite the marked differences in levels. In particular, the level and dynamics of crime rates in France, Germany and the UK were comparable to the corresponding levels and dynamics in the United States during the 1970s. But no slowdown during the 1980s and no turnabout during the 1990s took place in these European countries, although we do see a leveling-off during the 1990s. In the meanwhile, Italy and Spain (whose crime rate was less than 1/4 of the American level during the early 1970s) also took over the United States total crime

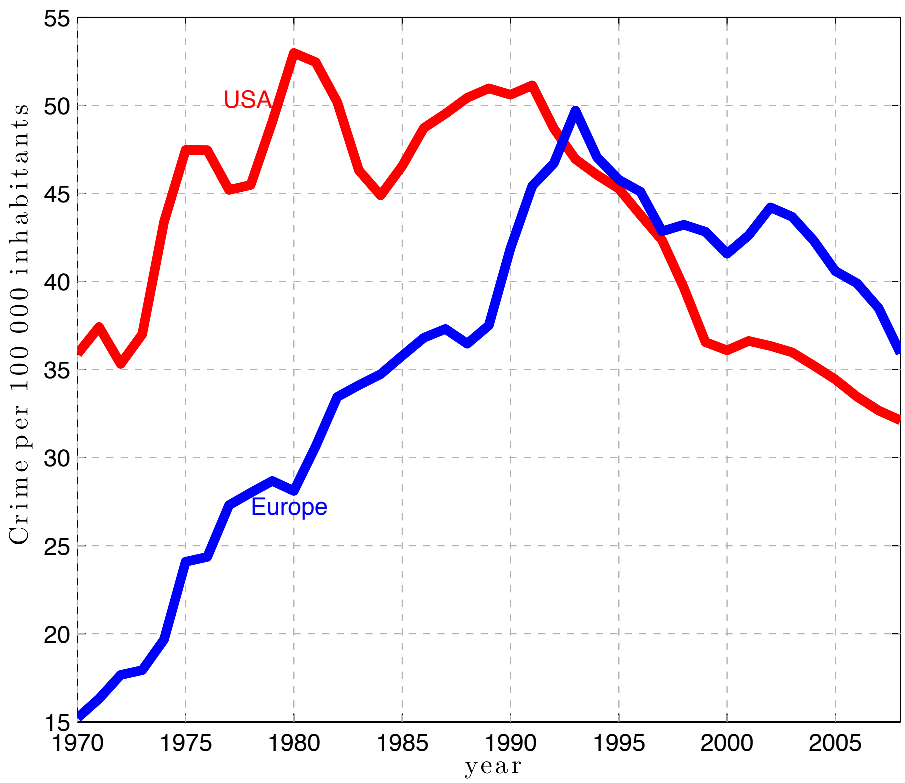
[1] The European crime rate is weighted by the population of each country. Buonanno, Drago, Galbiati, and Zanella (2011) show that the pattern is robust to correcting for cross-country differences in underreporting based on surveys of victims.



Europe includes France, Germany, Italy, Spain and United Kingdom.

Figure 1: Total Crime Rate

rate between the late 1990s and the early 2000s. In terms of growth rates, the one exception is the UK, which experienced a rapid decrease of the total crime rate after the early 2000s. This decline, however, follows a rapid increase which set in during the 1980s. As for the disaggregated property crime rates, France, Germany and the UK experienced an increase similar to the United States during the 1970s, although the level was below the American one. Property crime in Spain and Italy were a fraction of the United States level during the 1970s, but increased much faster during the 1980s. The UK overtook the United States during the early 1980s, in the course a process which lead to the doubling of the incidence of property crimes in Britain in just 10 years. Germany followed suit during the early 1990s, and France and Spain around 2000. However, the total crime rate in France is now again below the American one. Italy is the only country among those represented where the property



Europe includes France, Germany, Italy, Spain and United Kingdom.

Figure 2: Property Crime Rate

crime rate never jumped above the United States, although the two are now quite close.

These trends and the remarkable Europe–US reversal beg the question why the dynamics of crime diverged so much across the Atlantic. What made the European countries we are considering so similar to each other as so different from the US, in terms of crime trends, during the 1990s? In their empirical investigation, Buonanno, Drago, Galbiati, and Zanella (2011) consider a number of factors but can only conclude that the different incarceration policies in Europe and in the US account for 17% of the reversal of total crime and 33% of the reversal of property crime. Clearly, there is a lot to be explained. The limitation of purely empirical analyses is that they require exogenous sources of variation which are typically hard to find. Furthermore, they leave little room for policy experiments in the presence of general equilibrium effects.

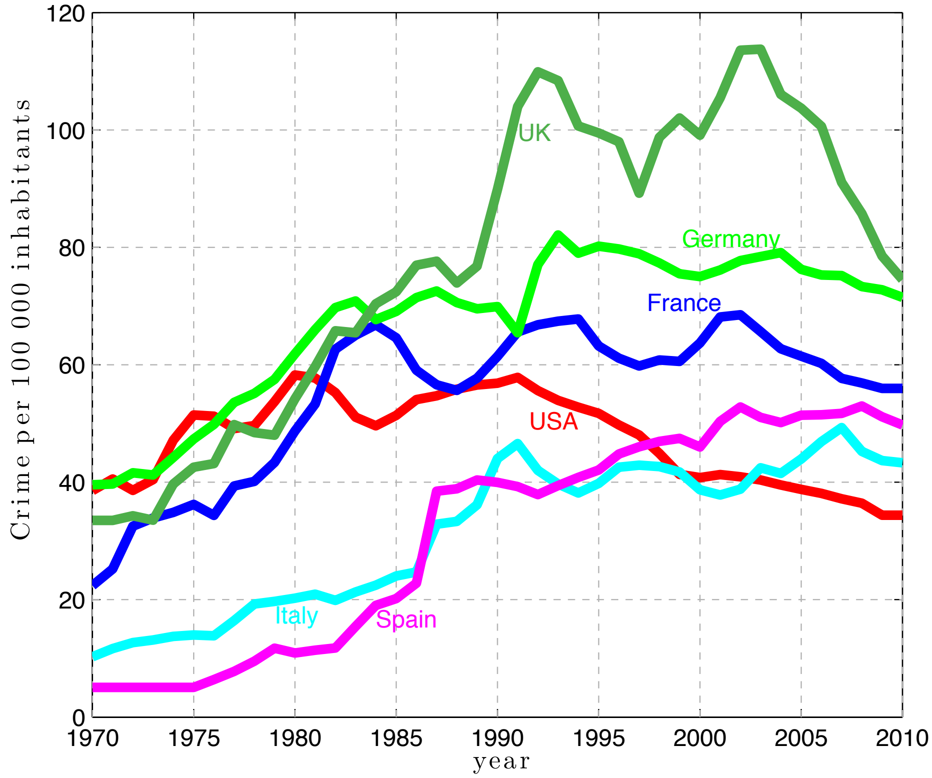


Figure 3: Total Crime Rate

In this paper we answer the question "what accounts for the 'reversal of misfortunes' between Europe and the US?" in an aggregate, dynamic general equilibrium model of crime, in the tradition of Becker (1968). By so doing, we provide a theoretical counterpart to empirical investigations of this question. We extend the labor and crime search model in Burdett, Lagos, and Wright (2003) and Engelhardt, Rocheteau, and Rupert (2008) to incorporate life-cycle elements.[2] The agents in the model search for a job when unemployed, can receive job offers on the job, and are randomly separated from their current job, in which case they become unemployed again. Both the unemployed and employed agents have random crime opportunities, in which case they weigh the costs and benefits of committing a crime. The benefit is that they get to consume what they steal. The cost is that they may get caught, in which case they go to prison, and consumption is lower when in prison.

[2]İmrohoroğlu, Merlo, and Rupert (2004) perform a similar exercise for the United States only. Their model, however, is a life-cycle Bewley economy with crime choice, rather than a labor search economy.

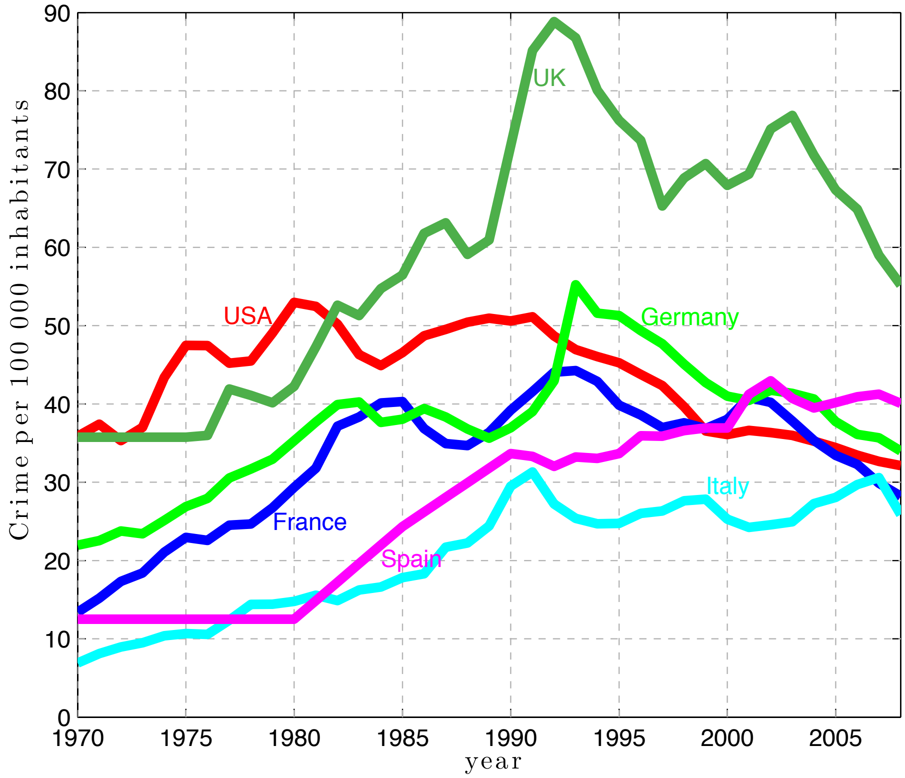


Figure 4: Property Crime Rate

Also, after being released from prison they start as unemployed regardless of their previous status, and receive relatively small benefits. In general equilibrium, the crime rate equals the probability of being victimized, and the amount stolen is determined by the average income in the economy.

For the moment, this exercise includes and compares the United States and United Kingdom.[3] We calibrate the model for both the United States and the United Kingdom to match the probabilities of being apprehended, the expected prison durations, job finding and job separation rates, unemployment insurance benefits, demographics, and other parameters. We choose prison consumption to reproduce the observed crime rates in 1970. We then evaluate the changes in 2000. As can be seen from figure 4, there was virtually no change in the crime rate in the United States between 1970 and 2000. For the United Kingdom,

[3] Data collection that will enable us to include all of the remaining largest European countries is ongoing.

the property crime rate more than doubled between those two years. The British crime rate was somewhat lower in 1970, but is significantly higher in 2000. The comparison between the United States and the United Kingdom in 1970 and 2000, is thus a prime example of the reversal mentioned before. We show that a properly calibrated model is able to explain both the increase in the property crime rate for the United Kingdom, and a stability of the property crime rate for the United States. Furthermore, we show that for the United States the property crime rate did not increase because several forces tended to offset each other. Specifically, changes in the probability of apprehension and prison duration contributed to an increase in the crime rate, changes in the labor market parameters, unemployment benefits and demographics decreased the crime rate, and the net effect was about zero. For the United Kingdom changes in the probability of apprehension and prison duration contributed to an increase in the crime rate as well. However, unlike in the United States, changes in the labor market parameters and unemployment benefits contributed to the increase in the crime rate as well, and changes in demographics had almost no effect. As a result, the crime rate increased significantly. Overall, the model is thus able to explain the reversal between the United States and United Kingdom.

2 Model

Time is continuous. Workers are risk neutral, have a life span J, and maximize the expected present discounted value of income,

$$\mathbb{E}_0 \int_0^J e^{-rj} x(j),$$

where r is the interest rate and $x(j)$ is income at age (time) j.

Jobs are characterized by their wage w. The distribution of job offers is $F : W \to [0, W]$, where $W = [0, \bar{w}]$, and $w \leq \infty$. We take the distribution of job offers as exogenous. At each point in time, individuals are in one of three states: employed, unemployed, or in prison. If they are employed, they receive a wage w. They also receive new job offers that arrive with intensity rate λ_E. Upon receiving an offer they decide whether to take the new job or stay at the old one. Employed people may also lose their job with intensity rate δ, in which case they become unemployed. Unemployed people receive unemployment benefits $b+\theta w$, where w is the last wage that the unemployed worker had, $\theta \in [0,1)$ is the replacement rate, and b is a constant component, representing such things as minimum living standards, but also the value of nonmarket time for the unemployed. Job offers arrive to the unemployed with intensity rate $\lambda_U \geq \lambda_E$ and, if they receive one, they decide whether to accept.

At any age, both the employed and unemployed can become victims of crime with probability γ. If they are victimized, they lose a fraction, α, of their current income. Employed and unemployed people also encounter crime opportunities at rate μ_E and μ_U, respectively. If they have the opportunity, they choose whether to commit a crime. If they choose to be criminals, they steal an amount g, but can be caught with probability π. If caught, they go to prison. While in prison they consume prison consumption z. Prisoners are stochastically released from prison at rate ρ. When the prisoners are released, their unemployment benefits are based on some minimum wage w_C, independent of their past wage history (w_C could possibly be zero, in which case they only receive b). We assume that both the employed and unemployed can commit crime.

2.1 Agent's problem

Let $V_E(w,j)$, $V_E(w,j)$ and $P(j)$ be the value functions of an employed person, unemployed person, and a person in prison. The expected payoff of an employed and unemployed criminal, $K_E(w,j)$ and $K_U(w,j)$, is

$$K_E(w,j) = g + \pi P(j) + (1-\pi)V_E(w,j) \tag{1}$$

$$K_U(w,j) = g + \pi P(j) + (1-\pi)V_U(w,j). \tag{2}$$

An employed person will commit a crime if $K_E(w,j) > V_E(w,j)$. Similarly, an unemployed person will commit a crime if $K_U(w,j) > V_U(w,j)$.

The value of being unemployed is

$$
\begin{aligned}
rV_U(w,j) = (1-\gamma\alpha)(b+\theta w) + \mu_U \max\left[K_U(w,j) - V_U(w,j), 0\right] \\
+ \lambda_U \int_0^{\overline{w}} \max[V_E(x,j) - V_U(w,j), 0] dF(x) + \frac{\partial V_U(w,j)}{\partial j}.
\end{aligned} \tag{3}
$$

The value of being employed is

$$
\begin{aligned}
rV_E(w,j) = (1-\gamma\alpha)w + \mu_E \max\left[K_E(w,j) - V_E(w,j), 0\right] + +\delta\left[V_U(w,j) - V_E(w,j)\right] \\
+ \lambda_E \int_0^{\overline{w}} \max[V_E(x,j) - V_E(w,j), 0] dF(x) + \frac{\partial V_E(w,j)}{\partial j}.
\end{aligned} \tag{4}
$$

If a criminal is caught, he goes to prison. After being released from prison, he starts as unemployed. The value of being in prison, $P(j)$, satisfies

$$
rP(j) = z + \rho\left[V_U(w_C,j) - P(j)\right] + \frac{\partial P(j)}{\partial j}. \tag{5}
$$

where w_C is the past wage value assigned to a newly released criminal. It follows from the Bellman equations that the derivatives at $j = J$ are given by $\frac{\partial V_E(w,J)}{\partial j} = -(1-\gamma\alpha)w$, $\frac{\partial V_U(w,J)}{\partial j} = -(1-\gamma\alpha)(b+\theta w)$, and that $\frac{\partial P(J)}{\partial j} = -z$.

The optimum is characterized by the labor market reservation wage function $R(w,j)$, and two crime reservation wages $C_E(j)$ and $C_U(j)$. They are defined by the following indifference conditions:

$$
V_E\left(R(w,j)\right) = V_U(w,j), \tag{6a}
$$

$$
V_E\left(C_E(j),j\right) = K_E\left(C_E(j),j\right), \tag{6b}
$$

$$
V_U\left(C_U(j),j\right) = K_U\left(C_U(j),j\right). \tag{6c}
$$

An individual of age j with a past wage w rejects a job offer x if $x < R(w,j)$ and accepts otherwise. An employed individual of age j commits a crime if his wage is below $C_E(j)$ and does not commit a crime otherwise. An unemployed individual of age j commits a crime if his last wage is below $C_U(j)$ and does not commit a crime otherwise. The reservation wage function R converges to $R(w, J) = b + \theta w$. This is intuitive, since in the limit there is no option value of staying unemployed. At the same time, both C_U and C_E converge to infinity, since the punishment for stealing goes to zero, while the benefit is bounded away from zero by g.[4]

We define a reservation wage w^* to be the reservation wage such that

$$w^* = R(w^*).$$

The reservation wage w^* represents a "fixed point" wage rate: an individual with past wage w^* will accept any wage offer that is better than his past wage, and reject any wage offer that is below his past wage. Moreover, the reservation wage function is above w if $w \leq w^*$, and is below w otherwise. Thus, if an individual starts with a past wage strictly higher than w^*, he is willing to accept some lower wage offers now.

One can use the definitions of the reservation wages and the value functions K_U and K_E to obtain the following:

Proposition 1

$$R\left(C_U(j), j\right) = C_E(j).$$

Proof. It follows from (1) and (2) that $V_U\left(C_U(j), j\right) = V_E\left(C_E(j), j\right) = P(j) + \frac{g}{\pi}$. Thus,

$$V_E\left(R(C_U(j), j)\right) = V_U\left(C_U(j), j\right) = V_E\left(C_E(j), j\right),$$

implying $R(C_U(j) = C_E(j)$. ■

According to the Proposition 1, if an unemployed agent is indifferent between committing and not committing a crime and accepts a wage equal to his reservation wage, he will continue to be indifferent between committing and not committing a crime. The relationship among

[4]To compute the limits note that the derivatives of the value function imply that at $j = J - \epsilon$ for some small ϵ, $V_U(w) = (1 - \gamma\alpha)(b + \theta w)\epsilon$ and $V_E(w) = (1 - \gamma\alpha)w\epsilon$. Using the definition of R delivers the limiting result. The limit on C_E and C_U is obtained similarly.

the reservation wages for an arbitrary age j is shown in Figure 5. Note that since $R(w, j) < w$ for $w > w^*(j)$, we have $C_U(j) > C_E(j)$: the unemployed have a higher crime reservation wage.

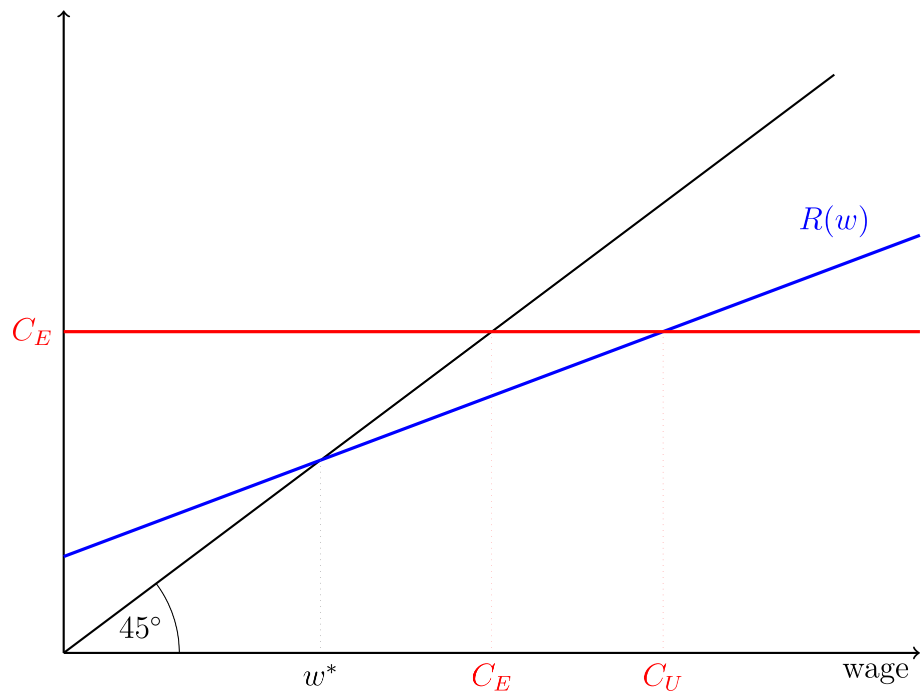


Figure 5: Reservation wages $R(w)$, C_U and C_E

2.2 Aggregates

In equilibrium there are five types of agents in the economy: unemployed criminals whose last wage is below $C_U(j)$, unemployed non-criminals with last wage higher than $C_U(j)$, employed criminals with wage below $C_E(j)$, employed non-criminals with wage above $C_E(j)$, and people in prison. Let $u_L(j)$, $u_H(j)$, $e_L(j)$, $e_H(j)$ and $n(j)$ be fractions of the population representing each type at age j. The fractions satisfy

$$u_L(j) + u_H(j) + e_L(j) + e_H(j) + n(j) = 1. \tag{7}$$

The distribution of states over the life-cycle is further going to be characterized by a distribution of wages conditional on the status of the agent $G_L(w,j)$, $G_H(w,j)$, $H_L(w,j)$ and $H_H(w,j)$. $G_L(w)$ represents the fraction of employed criminals with wage no greater than w, while $G_H(w)$ is the fraction of employed non-criminals with wage no greater than w. The interpretation of $H_L(w)$ and $H_H(w)$ is analogous. Note that by the definition of the reservation wages, the distributions will be such that

$$G_H(C_E(j),j) = H_H(C_U(j),j) = 0$$
$$G_L(C_E(j),j) = H_L(C_U(j),j) = 1.$$

At the beginning of the life-cycle, fractions e_{L0} and e_{H0} of the population start as employed criminals and non-criminals, while u_{L0} and u_{H0} start as unemployed criminals and non-criminals. For each category the initial conditional distributions are G_{L0}, G_{H0}, H_{L0} and H_{H0}. For simplicity, no individual is born as having committed a crime.

We will now describe the laws of motion for the five types in the population. Let

$$\phi_R(w,H) = \int_{R(x)\leq w} \left[F(w) - F(R(x))\right] \, dH(x),$$

be the fraction of people with distribution H that will accept offers paying at most w, given that their reservation wage function is R. Suppressing the dependence on j, the laws of motion for the employed people are:

$$\frac{\mathrm{d}e_L}{\mathrm{d}j} = \lambda_U \phi_R(C_E, H_L) u_L - \left[\delta + \mu_E \pi + \lambda_E(1 - F_{C_E})\right] e_L \tag{8a}$$
$$\frac{\mathrm{d}e_H}{\mathrm{d}j} = \lambda_U(1 - F_{C_E}) u_L + \lambda_U \phi_R(\bar{w}, H_H) u_H + \lambda_E \left(1 - F_{C_E}\right) e_L - \delta e_H, \tag{8b}$$

where $F_{C_E} = F(C_E)$. The first term of the first equation is the number of unemployed individuals that accept a wage low enough such that they will choose to be criminals if the opportunity arises. It follows from Proposition 1 that only unemployed criminals accept such a job offer. The second term of the first equation is the outflow of people from the pool of employed criminals. A fraction δ becomes unemployed, a fraction $\mu_E \pi$ is caught committing a crime and sent to prison, and a fraction $\lambda_E (1 - F_{C_E})$ move to higher paying jobs and will not commit crime. The second equation describes the flow in and out of the pool of employed non-criminals. Both unemployed criminals and non-criminals can get a wage offer paying enough to induce them to be non-criminals. In addition, some of the employed criminals transition to higher wages and become non-criminals. Because employed people with high wages do not commit crime, only a fraction, δ, of them lose their job.

The laws of motion for the unemployed are

$$\frac{\mathrm{d}u_L}{\mathrm{d}j} = \delta e_L + \delta G_H(C_U) e_H + \rho n - \lambda_U \left[1 - F_{C_E} + \phi_R(C_E, H_L)\right] u_L - \mu_U \pi u_L \tag{9a}$$

$$\frac{\mathrm{d}u_H}{\mathrm{d}j} = \delta[1 - G_H(C_U)] e_H - \lambda_U \left[1 - F(R(\bar{w})) + \phi_R(R(\bar{w}), H_H)\right] u_H. \tag{9b}$$

The first equation above describes the flows of unemployed criminals. First, they were employed criminals, and lost their job. Second, they were employed non-criminals with wage greater than C_E, but lower than C_U and lost their job. In this case, once becoming unemployed, they become criminals. Third, some people were in prison, and were released.[5] Some of the unemployed criminals will, on the other hand, find a job and become employed, either as noncriminals (fraction $\lambda_U (1 - F_{C_E})$), or as criminals (fraction $\lambda_U \phi_R(C_E, H_L)$). Some of the people are also caught committing a crime and sent to prison (fraction $\mu_U \pi$). The second equation describes the flows of unemployed non-criminals. They can become unemployed non-criminals in only one way: they had a job with a wage high enough (above C_U) and were separated from the job. Proposition 1 implies that when they leave, they will become employed non-criminals. People leave the pool of unemployed non-criminals when they receive an offer better than their reservation wage, in which case they become employed non-criminals.[6]

[5] Here we assume that w_C is equal to the lowest possible wage.

[6] The last expression on the right-hand side of the second equation is the number of people finding a job better than the reservation wage since $\int_{x \leq \bar{w}} \left[1 - F\left(R(x)\right)\right] dH(x) = 1 - F\left(R(\bar{w})\right) + \phi_R\left(R(\bar{w}), H\right)$.

Finally, the fraction of criminals evolves according to

$$\frac{\mathrm{d}n}{\mathrm{d}j} = \mu_E \pi e_L + \mu_U \pi u_L - \rho n. \tag{10}$$

The first two are the inflows from employed and unemployed criminals, and the last term is the number of people released from prison.

Unlike in a model where the unemployment benefits are independent of past wages ($\theta = 0$), one cannot solve for the fractions of types independently of their distribution functions. The laws of motion for the types must thus be complemented by the laws of motion for the distributions. The inflows and outflows are similar in principle, but a little bit more involved; Appendix describes the laws of motion in detail.

2.3 General Equilibrium

The model crime rate is computed as:

$$C = \frac{\int_{j=0}^{J} [\mu_U u_L(j) + \mu_E e_L(j)] q(j) dj}{1 - \int_{j=0}^{J} n(j) q(j) dj},$$

where $q(j)$ is the density of people of age j. The crime rate is computed as a fraction of the noninstitutionalized population, $1 - \int_{j=0}^{J} n(j)q(j)dj$. We also define the average earnings of both employed and unemployed by

$$\bar{e} = \int_{j=0}^{J} \left[e_L \int_{\underline{w}}^{C_E(j)} x \, dG_L + e_H \int_{C_E(j)}^{\overline{w}} x \, dG_H + u_L \int_{\underline{w}}^{C_U(j)} (b + \theta x) \, dH_L + u_H \int_{C_U(j)}^{\overline{w}} (b + \theta x) \, dH_H \right].$$

In equilibrium we require that the probability of being victimized equals the crime rate, and that the amount stolen by criminals is equal to the fraction of income stolen from victims. The equilibrium is defined as follows:

Definition 2 *The equilibrium is given by the value functions K_E, K_U, V_E, V_U and P, the reservation wage policies R, C_E and C_U, type fractions e_L, e_H, u_L, and u_H, and the* *distribution functions G_L, G_H, H_L and H_H such that, taking the initial values G_{L0}, G_{H0}, H_{L0} and H_{H0}, e_{L0} and e_{H0}, u_{L0} and u_{H0} as given,*

1. *The value functions satisfy equations (1), (2), (4), (3) and (5), and the reservation wage policies satisfy (6),*

2. *The distribution functions and type fractions satisfy (8), (9) and (11),*

3. *Victimization probabilities and the amount stolen are consistent with the aggregates:*

$$\gamma = C$$

$$g = \alpha \bar{e}.$$

Note: it might be better to introduce lump-sum taxes to balance the government budget, with only after tax income being subject to theft. Then one would simply have average earnings as the earnings of the employed only.

$$\bar{e} = \int_{j=0}^{J} \left[e_L \int_{\underline{w}}^{C_E(j)} x \, dG_L + e_H \int_{C_E(j)}^{\overline{w}} x \, dG_H \right]$$

3 Parameters and Calibration

When examining the determinants of crime, we focus on selected years 1970 and 2000. We also restrict attention to the United States and United Kingdom. For both years and for both countries we compute the stationary steady state for the economy. The benchmark year 1970 is special, because we calibrate the consumption level z, for which very little data is available, to be such that the model crime rate in 1970 matches the one observed in the data. For 2000 we keep z fixed at its 1970 value for both countries.

Life-cycle parameters

People are assumed to love from age 15 to age 64. Model period is set to one year, and so we set $J = 50$. The discount rate ρ is set to be 0.048 annually. The age distribution q is taken from the Bureau of the Census for the United States. For the United Kingdom, we use data from Eurostat.

Wages

The wage distribution F is assumed to be lognormal. The mean of wage offers is chosen so that the average accepted wages match the average detrended labor earnings in the data. Unfortunately, it is not possible to choose the standard deviation of log wage offers in a similar way, because the frictional wage dispersion is too small (Hornstein, Krusell, and Violante (2011)). Instead, we choose the variance of log wage offers to be such that for the United States in 1970 90 percent of wage offers is accepted by the workers. For 2000 and United Kingdom in 1970 we match the relative change in the standard deviation of log earnings. For both average earnings and standard deviations, we use the data reported in Heathcote, Perri, and Violante (2010) and Blundell and Etheridge (2010).

As shown in Table 1, a standard deviation of log earnings in 1970 is 0.105, which is only about 18 percent of the overall standard deviation of log earnings (citeNHeathcote/etal:2010). In 2000, the dispersion of wages increases by about 10 percent. United Kingdom starts with earnings inequality about 20 percent below US inequality in 1970, but catches up substantially by 2000.

Labor Market Parameters

The job separation parameter δ is equated with the job separation rate in the data. The parameter λ_U is not equal to the job finding rate, since the latter also depends on the probability of accepting a job offer. It is, however, set so that the job finding rate in the model matches the job finding rate in the data. For the United States we use the data from Shimer (2012), while for the United Kingdom we use the data from Smith (2011).

Model Parameters, Wages		
	1970	2000
Mean Earnings		
USA	1.000	1.062
UK	1.000	1.002
S.D. of Log Earnings		
USA	0.105	0.116
UK	0.083	0.107

Table 1: Model Parameters, United States and United Kingdom

The parameter λ_E is chosen to match a 3 percent job-to-job transition rate in the United States (Hornstein, Krusell, and Violante (2011)). For the United Kingdom, the job-to-job transition rate data are unavailable, and so we target the same ratio of job-to-job transition rate and the job finding rate as in the United States.

As shown in Table 2, the main difference between both countries is that all the three rates are about an order lower in the United Kingdom in 1970. In 2000, all the rates increase in the United Kingdom significantly, but a huge gap still remains: for example, the job-finding rate is still about five times higher in the United States. In contrast, the job finding rate in the United States is relatively constant over time, and the job reparation rate decreases a little.

We set the fixed component of the unemployment benefits b equal to zero. The replacement rate θ is computed as the gross replacement rates of the average production worker (APW), as computed by OECD. The resulting values of the average replacement rates are reported in the last row of Table 2. The replacement rates are higher in the United Kingdom, although they have converged to a relatively similar magnitudes by 2000. In the United States they increased from 0.110 to 0.140, while in the United Kingdom they declined from 0.250 to 0.170.

Model Parameters, Labor Market		
	1970	2000
Job Finding Rate		
USA	0.496	0.523
UK	0.041	0.107
Job Separation Rate		
USA	0.039	0.030
UK	0.002	0.004
Job-to-job Transition Rate		
USA	0.030	0.031
UK	0.002	0.006
UI Replacement Rate		
USA	0.110	0.140
UK	0.250	0.170

Table 2: Model Parameters, United States and United Kingdom

Crime Parameters

The inputs into the model are the probability of being apprehended π, the rate of release from prison ρ, and the crime opportunity rate μ_E and μ_U. In collecting data we focus on the property crime, which includes robbery, burglary, theft, motor vehicle theft, and larceny. The probability of being apprehended π is equated with the clearance rate. The clearance rate is defined in the United States as

$$\text{clearance rate} = \frac{\#\text{ of offenses cleared by arrest or exceptional means}}{\#\text{ of offenses}}.$$

Here "cleared" means that at least one person has been arrested, charged with an offense, and turned over to the court for prosecution.[7] Being cleared does not mean that the person is sentenced for the offense. The rate of release from prison ρ is calibrated so as to match the expected prison duration. We factor the probability of being sentenced into the expected prison duration. The expected prison duration is thus computed as the average length of

[7]Exceptional means include nonstandard cases, for example when the offender has died by suicide.

prison sentences multiplied by the fraction of offenders sentenced to prison. We normalize both μ_E and μ_U to one (more thought needs to go into this).

The data for the clearance rate and the expected prison duration are in Table 3. For the United States the data on clearance rate are taken from the "Uniform Crime Reports" publication, and the data on expected prison duration are from Bureau of Justice's "Sourcebook of Criminal Justice Statistics". For the United Kingdom the data are taken from the "Criminal Statistics England and Wales" annual publication.

Table 3 reveals several important findings. First, the clearance rates were higher in the United Kingdom in 1970, but by 2000 they decreased by more than half, and were lower than in the United States. The expected prison duration is significantly higher in the United States. On average, a sentenced British offender expects to serve only around 3.5 months in 2000, while in the United States he expects to serve around 12.6 months. This can be either due to a higher probability of sentencing, or due to the average length of prison sentences. The difference is due to both: United States are more likely to sentence an offender, and, conditional on sentencing, the offenders serve more time (verify this!). Over time, the expected prison duration has increased in both countries.

The parameter α that characterizes criminal earnings from property crimes, as well as the costs of property crime to victims is set to be 0.150 for the United States (see İmrohoroğlu, Merlo, and Rupert (2000)), and to 0.045 for United Kingdom (source?). While in prison the criminal receives a per-period consumption level z. Given that there is little data on consumption and utility while in prison, z is used to calibrate the model to match the crime rate in the benchmark year 1970.

To compute the model, we also need to set the initial conditions. We assume that 80 percent of the population starts as unemployed non-criminals, and 20 percent starts as unemployed criminals (this should be calibrated and not ad-hoc!). Within each category the distribution of wages is uniform.

Model Parameters, Crime		
	1970	2000
Clearance Rate		
USA	0.190	0.171
UK	0.391	0.155
Expected Prison Duration		
USA	11.6	12.6
UK	1.4	3.5

Table 3: Model Parameters, United States and United Kingdom

4 Results

In Table 4 we compare the crime rates produced by the model to the crime rate in the data. For 1970, the model has been calibrated in such a way so that the crime rate in the model matches the crime rate in the data. For 2000, the crime rate in the United States was essentially the same as in 1970 (37.9 in 1970 and 37.6 in 2000). The data align with the model extremely well: the model predicts no change in the crime rate between 1970 and 2000. As we shall see later, this does not mean that there were no changes in the underlying parameters between 1970 and 2000, but rather that the various changes worked in both directions, leading to almost no change in the crime rate.

For the United Kingdom the crime rate between 1970 and 2000 more than doubled: it increased from 31.5 to 67.9. The model is consistent with a significant increase in the crime rate, although it predicts a larger increase in the crime rate in 2000 (89.1, 21.2 points higher than in the data).

Figure 6 looks at the predicted distribution of the crime rate over the life-cycle in 1970. Two results stand out. First, consistently with data (what data?), crime is mostly committed by the young. With small exceptions, the crime rate is decreasing with age. Second, crime decreases much faster with age in the United States, where virtually all the crime is committed by people below the age of thirty. In contrast, the decline in crime in the United Kingdom is much smaller, and a significant fraction of crime is committed by people above

Benchmark Results				
	1970		**2000**	
	Data	Model	Data	Model
USA	37.9	37.9*	37.6	37.9
UK	31.5	31.5*	67.9	89.1

* values are calibrated to match the data

Table 4: Benchmark results, United States and United Kingdom

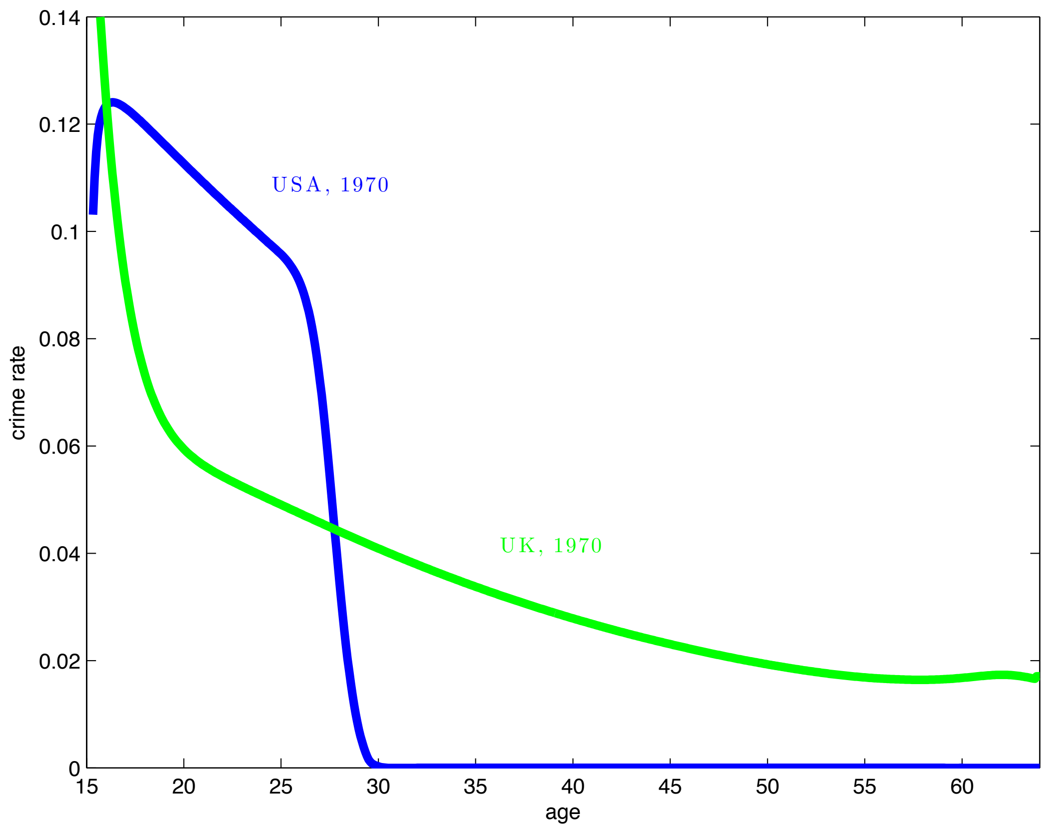


Figure 6: Crime Rate over the Life-Cycle

the age of 30 as well. The reason for this comes from differences in labor market parameters. As discussed before, both the job finding and job separation rates are much lower in the United Kingdom. Thus, it takes much longer for the young people to find well paying jobs and quit committing crime. Given that the average crime rate has been calibrated to match the crime rate in the data, this results in a different distribution of the crime rate over the

2000 Crime rate, Decomposition		
	USA	UK
2000 Crime rate, model	100.0	100.0
Relative to 2000 crime rate, percentage		
1970 clearance rate and prison duration	38.6	55.6
1970 job finding and separation rates	163.1	77.5
1970 replacement ratio	125.38	91.9
1970 age distribution	111.51	99.4

Table 5: Experiments, United States and United Kingdom

life-cycle, rather than a level increase in the crime rate.

Disaggregating the Changes

In what follows, we will disaggregate the overall changes to determine the contribution of the key parameters of the model. In the first experiment we keep the values of the probability of apprehension and prison length at the 1970 level. In the second one, we keep the job finding rates and the job separation rates at their 1970 level. In the third one, we keep the replacement rate at its 1970 level, and in the fourth one the age distribution is fixed at its 1970 level. All the other parameters are at its 2000 levels. We compute the counterfactual crime rate in 2000 for each of the experiment. We report the counterfactual crime rate as a percentage of the benchmark crime rate in Table 5.[8]

Changes in the clearance rates and prison duration contributed to the increase in the crime rate in both countries. If they were kept at its 1970 level, the crime rate would be 61.4 percent lower in the United states and 44.4 percent lower in the United Kingdom in 2000. The main cause of this is the decrease in the clearance rate in both countries, which is especially large in the United Kingdom (see Table 3). The increase in the prison duration works in the opposite direction, but is not strong enough to dominate the changes in the clearance rates.

Changes in the job finding and job separation rates tended to decrease the crime rate

[8]Numbers smaller than 100 indicate that a given factor contributed to the increase in the crime rate.

in the United States. If they were at their 1970 level, the crime rate would be 63.1 percent higher. In contrast, changes in the job finding and job separation rates have contributed to an increase in the crime rate in the United Kingdom. If their values did not change since 1970, the crime rate would be 22.5 percent lower. The main reason behind those differences is that the job separation rate has decreased in the United States, but about doubled in the United Kingdom (see table 2). The job finding rate in the United Kingdom has increased as well, but the increase was not strong enough to dominate the increase in the job separation rate.

The unemployment insurance replacement rate has increased in the United States and decreased in the United Kingdom (see table 2). More generous unemployment insurance tends to decrease the crime rate in the model because it increases the opportunity costs of committing a crime. Thus, changes in unemployment insurance decreased the crime rate in the United States (by 25.4 percent) but increased it in the United Kingdom (by 8.1 percent).

Finally, the population has aged between 1970 and 2000 in the United States, with the average age in the 15-64 population increasing by about a year. In the United Kingdom, somewhat surprisingly, there was almost no change in the population distribution between those years. The average age in the 15-64 population has been around 38.5 in both years. Older population tends to decrease the crime rate since the crime is mostly committed by the young. As a result, changes in the population distribution in the United States decreased the crime rate in 2000 by about 11.5 percent, but did not contribute to the changes in the crime rate in the United Kingdom almost at all.

United Kingdom with US Crime Policies

To be completed.

5 Conclusions

We study the determinants of the "the reversal of misfortunes" between United Kingdom and United States. In 1980 the property crime rate was lower in the United Kingdom, while in 2010 it was more than twice as big. We construct a dynamic general equilibrium model with crime and labor search, and show that it can explain the reversal.

We decompose the results into the contribution of various factors, and find that in the United States changes in the probability of apprehension and prison duration were offset by changes in the labor markets, unemployment benefits and aging of the population while in the United Kingdom they tended to reinforce each other.

Appendix A : Computational Details

Write $\phi_L(w,j)$ to stand for $\phi_{R(:,j)}(w, H_L(.,j))$ and $\phi_H(w,j)$ to stand for $\phi_{R(:,j)}(w, H_H(.,j))$. The laws of motion for the distributions of the employed $G_L(.,j)$ and $G_H(.,j)$, $H_L(.,j)$ and $H_H(.,j)$ evolve according to

$$\begin{aligned}
\frac{\mathrm{d}}{\mathrm{d}j}[G_L(w)e_L] &= \lambda_U \phi_L(w,j) u_L \\
&\quad - \left[\delta + \mu_E \pi + \lambda_E (1 - F_{C_E})\right] G_L(w) e_L - \lambda_E [F_{C_E} - F(w)] G_L(w) e_L \\
\frac{\mathrm{d}}{\mathrm{d}j}[G_H(w)e_H] &= \lambda_U [F(w) - F_{C_E}] u_L + \lambda_U \phi_H(w) u_H \\
&\quad + \lambda_E \left[F(w) - F_{C_E}\right] e_L - \left[\delta + \lambda_E (1 - F(w))\right] G_H(w) e_H.
\end{aligned}$$

The first terms on the right-hand side represent the number of people that will switch from being unemployed (either as criminals or as non-criminals) to being employed. To understand the equations, note that: Note that

1. To become an employed criminal, the agent must have been an unemployed criminal before. That's because an unemployed noncriminal will only accepts job offers high enough that will make him an employed criminal. Hence H_H or u_H does not show up

in the first equation.

2. Unemployed criminals can become employed noncriminals, if they receive high enough wage offer. Since for unemployed criminals $R(w) < C_E$, the number of people that receive such wage offer is $[F(w) - F_{C_E}]u_L$.

3. For an unemployed non-criminal the reservation wage is always greater than C_E because unemployed non-criminals have wages greater than C_U.

4. The second term on the right-hand side of the first equation are people lost from the pool of low wage employed people: either they will become unemployed, or they are caught stealing, or they receive a new job offer that is higher than C_E and they will become high wage employed individuals.

5. The last term on the right-hand side stands for people that receive a job offer that is better than w, but still low enough (lower than C_E), so they stay criminals.

6. The second term on the right-hand side of the second equation represent people who transit from low wage employment to high wage employment.

7. The last term of the second equation represents people lost from the pool of high wage employed people. Since none of those people is committing crime, no one is lost to the pool of convicted criminals.

The laws of motion for the unemployed $H_L(.,j)$ and $H_H(.,j)$ evolve according to

$$\begin{aligned}
\frac{\mathrm{d}}{\mathrm{d}j}[H_L(w)u_L] &= \delta\left[G_L(w)e_L + G_H(w)e_H\right] \\
&\quad - \lambda_U\left[H_L(w)\left(1 - F(R(w,j))\right) + \phi_L(R(w,j),j)\right]u_L - \mu_U \pi H_L(w)u_L + \rho n \\
\frac{\mathrm{d}}{\mathrm{d}j}[H_H(w)u_H] &= \delta[G_H(w) - G_H(C_U)]e_H \\
&\quad - \lambda_U\left[H_H(w)\left(1 - F(R(w,j))\right) + \phi_H(R(w,j),j)\right]u_H
\end{aligned}$$

The equations are explained as follows:

1. People can transit to unemployed criminals either from employed criminals ($G_L(w)e_L$ of them), or from employed noncriminals ($G_H(w)e_H$ of them). The second case happens when the past wage satisfies $C_E \leq w \leq C_U$. This can be seen from the fact that $G_H(C_E) = 0$. Thus, if $w < C_E$ then only employed criminals join.

2. People can leave the pool of unemployed criminals in two ways. Either the get caught and become convicted criminals, or get a job offer that's better than their reservation wage. Note that since $H_H(C_U) = 0$, the integration in the second equation is effectively for x between C_U and w.

3. A fraction ρn of people is released from jail, and becomes unemployed. Here we assume that they will get the initial wage w^*, the smallest sustainable wage in the long run. Th equation needs to be modified if the unemployed start with something higher, or something smaller (if they get $w_0 < w^*$ then the domain needs to be extended to include w_0).

4. People can transit to unemployed noncriminals only from employed noncriminals. There will be $\delta[G_H(w) - G_H(C_U)]e_H$ of them.

Differentiation the expressions on the left-hand side, the laws of motion can be rewritten as

$$
\begin{aligned}
u_L \frac{\mathrm{d}H_L(w)}{\mathrm{d}j} &= \delta \left[G_L(w)e_L + G_H(w)e_H\right] - H_L(w)\frac{\mathrm{d}u_L}{\mathrm{d}j} \\
&\quad - \lambda_U \left[H_L(w)\left(1 - F(R(w,j))\right) + \phi_L(R(w,j),j)\right] u_L - \mu_U \pi H_L(w) u_L + \rho n \qquad \text{(11a)} \\
u_H \frac{\mathrm{d}H_H(w)}{\mathrm{d}j} &= \delta[G_H(w) - G_H(C_U)]e_H - H_H(w)\frac{\mathrm{d}u_H}{\mathrm{d}j} \\
&\quad - \lambda_U \left[H_H(w)\left(1 - F(R(w,j))\right) + \phi_H(R(w,j),j)\right] u_H \qquad \text{(11b)} \\
e_L \frac{\mathrm{d}G_L(w)}{\mathrm{d}j} &= \lambda_U \phi_L(w,j) u_L - G_L(w)\frac{\mathrm{d}e_L}{\mathrm{d}j} \\
&\quad - \left[\delta + \mu_E \pi + \lambda_E(1 - F_{C_E})\right] G_L(w)e_L - \lambda_E[F_{C_E} - F(w)]G_L(w)e_L \qquad \text{(11c)} \\
e_H \frac{\mathrm{d}G_H(w)}{\mathrm{d}j} &= \lambda_U[F(w) - F_{C_E}]u_L + \lambda_U \phi_H(w) u_H - G_H(w)\frac{\mathrm{d}e_H}{\mathrm{d}j} \\
&\quad + \lambda_E \left[F(w) - F_{C_E}\right] e_L - \left[\delta + \lambda_E(1 - F(w))\right] G_H(w) e_H. \qquad \text{(11d)}
\end{aligned}
$$

Those equation completely characterize the dynamics of the distribution over the life-cycle. Note that the laws of motion for the fractions e_L, e_H, u_L, u_H and n are a special case of those equations, evaluated at C_U, $\bar{w}$, C_E and $\bar{w}$, respectively.

References

Becker, G. (1968). Crime and punishment: An economic approach. *Journal of Political Economy 78*, 169–217. 5

Blundell, R. and B. Etheridge (2010). Consumption, income and earnings inequality in britain. *Review of Economic Dynamics 13*(1), 76–102. 16

Buonanno, P., F. Drago, R. Galbiati, and G. Zanella (2011). Crime in Europe and the United States: dissecting the reversal of misfortunes. *Economic Policy 26*(67), 347–385. 2, 4

Burdett, K., R. Lagos, and R. Wright (2003). Crime, inequality, and unemployment.

American Economic Review 93(5), 1764–1777. 5

Engelhardt, B., G. Rocheteau, and P. Rupert (2008). Crime and the labor market: A search model with optimal contracts. *Journal of Public Economics 92*(10), 1876–1891. 5

Heathcote, J., F. Perri, and G. Violante (2010). Unequal we stand: An empirical analysis of economic inequality in the United States, 19672006. *Review of Economic Dynamics 13*, 15–51. 16

Hornstein, A., P. Krusell, and G. L. Violante (2011). Frictional wage dispersion in search models: A quantitative assessment. *American Economic Review 101*(7), 2873–98. 16, 17

İmrohoroğlu, A., A. Merlo, and P. Rupert (2000). On the political of income redistribution. *International Economic Review 41*, 1–25. 19

İmrohoroğlu, A., A. Merlo, and P. Rupert (2004). What accounts for the decline in crime? *International Economic Review 45*(3), 707–729. 5

Shimer, R. (2012). Reassessing the ins and outs of unemployment. *Review of Economic Dynamics 15*(2), 127–148. 16

Smith, J. C. (2011). The ins and outs of uk unemployment*. *The Economic Journal 121*(552), 402–444. 16