8 Online Appendix

8.0.1 Proof of Lemma 1

We need some additional notation. Let $z = n, y$ denote the community of choice, namely the clan (n) or the city (y). As before, let $p = \lambda, \gamma$ denote the preference type, namely clannish (λ) or citizen (γ). Expected equilibrium welfare of type p in community z is a known function of the composition of the population settling in community z, namely: $W^{pz}(x^{\lambda z}, x^{\gamma z})$, where $x^{\lambda z}$ denotes the fraction of λ type in each dynasty who have chosen community z, and $x^{\gamma z}$ denotes the fraction of γ type in each dynasty who have chosen that same community - see Table 1.

Exploiting the results and the notation in the text, we have:

$$\begin{aligned} W^{\lambda n}(x^{\lambda n}, x^{\gamma n}) &= 1 + \lambda - \tau + H(g^n) \\ W^{\gamma n}(x^{\lambda n}, x^{\gamma n}) &= 1 + H(g^n) \\ W^{\lambda y}(x^{\lambda y}, x^{\gamma y}) &= \delta + 1 - q + H(g^y) \text{ if } x^{\gamma y} \geq \hat{e} \\ W^{\gamma y}(x^{\lambda y}, x^{\gamma y}) &= \delta + 1 + \gamma - \tau + H(g^y) \text{ if } x^{\gamma y} \geq \hat{e} \\ W^{\lambda y}(x^{\lambda y}, x^{\gamma y}) &= W^{\gamma y}(x^{\lambda y}, x^{\gamma y}) = \delta + 1 \text{ if } x^{\gamma y} < \hat{e}, \end{aligned} \tag{8}$$

where g^n and g^y are known functions of x^{pz} through (1)-(2).

By definition, δ^p is obtained from (8) setting $W^{pn} = W^{py}$. Exploiting (8), some simple algebra completes the proof.

Note that, given the assumed distribution of δ, we have:

$$\begin{aligned} x^{pn} &= d\delta^p x^p \text{ if } \delta^p \in [0, 1/d], \\ x^{pn} &= 0 \qquad \text{if } \delta^p \leq 0, \\ x^{pn} &= x^p \qquad \text{if } \delta^p \geq 1/d \end{aligned} \tag{9}$$

and correspondingly for x^{py}.

8.0.2 Proof of Propositions 1 and 2

We consider each equilibrium separately

Equilibrium with Full Sorting By (8), the value of δ that leaves type γ indifferent between the clan and the city is:

$$\begin{aligned} \delta^\gamma &= \tau - \gamma + H(g^n) - H(g^y) \\ &= \tau - \gamma + H(\tau x^\lambda) - H[M\tau(1 - x^\lambda) - e] \end{aligned} \tag{10}$$

for $x^\gamma = 1 - x^\lambda \geq \hat{e} \equiv e/M\tau$ where the second equation follows from (1), (2), (9). Clearly, equation (10) defines an implicit function $\delta^\gamma = D^s(x^\lambda)$, where the s superscript is a reminder that this is the full sorting equilibrium. By (10):

$$\frac{\partial \delta^{\gamma}}{\partial x^{\lambda}} \equiv D_x^s = \tau[H_g(g^n) + MH_g(g^y)] > 0 \tag{11}$$

The equilibrium conditions discussed above require:

$$0 \geq D^s(x^{\lambda}) \geq 1/d - a \tag{12}$$

which by (11) is satisfied only for some values of x^{λ}. Specifically, implicitly define $\bar{x}$ and $\underline{x}$ by:

$$\begin{aligned} D^s(\bar{x}) &= 0 = \tau - \gamma + H(\tau\bar{x}) - H[M\tau(1-\bar{x}) - e] \\ D^s(\underline{x}) &= 1/d - a = \tau - \gamma + H(\tau\underline{x}) - H[M\tau(1-\underline{x}) - e] \end{aligned} \tag{13}$$

By (11), $\bar{x} > \underline{x}$. Then an equilibrium with full sorting exists if $x^{\lambda} \in [\underline{x}, \bar{x}]$. Furthermore, (10) implies that:

$$1 - \hat{e} > \bar{x} > 1/2 > \underline{x} > 0$$

if the following conditions are satisfied (each condition corresponds to one of the above inequalities in the same order):

$$\tau - \gamma + H(\tau(1-\hat{e})) > 0 \tag{A1}$$
$$\tau - \gamma + H(\tau/2) - H(M\tau/2 - e) < 0 \tag{A2}$$
$$\lambda + q - \tau + H(\tau/2) - H(M\tau/2 - e) > 1/d \tag{A3}$$
$$\lambda + q - \tau - H(M\tau - e) < 1/d \tag{A4}$$

Finally, note that in this equilibrium with full sorting, the fraction of each dynasty living in the city is:

$$x^y = x^{\gamma} = (1 - x^{\lambda}) \equiv G^s(x^{\lambda}) \tag{14}$$

hence it moves one for one in the opposite direction with changes in the fraction of clannish types in the population. Summarizing the above discussion:

Suppose that (A1)-(A4) hold. Then an equilibrium with full sorting exists if and only if $x^{\lambda} \in [\underline{x}, \bar{x}]$, where $1 - \hat{e} > \bar{x} > 1/2 > \underline{x} > 0$. In this equilibrium the fraction of each dynasty living in the city is $x^y = G^s(x^{\lambda})$ given by (14), and it varies inversely with x^{λ} over the range $x^y \in [(1-\bar{x}), (1-\underline{x})]$

Equilibrium with segregation in the clan Next, consider the equilibrium where the clannish types are segregated in the clan, while the citizens are present in both communities. Repeating the previous steps, the value of δ that leaves type γ indifferent between the clan and the city is:

$$\begin{aligned} \delta^{\gamma} &= \tau - \gamma + H(g^n) - H(g^y) \\ &= \tau - \gamma + H(\tau x^{\lambda}) - H[M\tau(1 - d\delta^{\gamma})(1 - x^{\lambda}) - e] \end{aligned} \tag{15}$$

where the second equation follows from (1), (2), (9), having used:

$$x^{\gamma y} = x^{\gamma} - x^{\gamma n} = (1 - d\delta^{\gamma})(1 - x^{\lambda})) \tag{16}$$

by (9). Again, equation (15) defines a known function $\delta^{\gamma} = D^{c}(x^{\lambda})$. By the implicit function theorem applied to (15):

$$\frac{\partial \delta^{\gamma}}{\partial x^{\lambda}} \equiv D^{c}_{x} = \frac{\tau[H_g(g^n) + M(1 - d\delta^{\gamma})H_g(g^y)]}{1 - d(1 - x^{\lambda})M\tau H_g(g^y)} > 0 \tag{17}$$

where the last inequality follows from (C1) and from the fact that in this equilibrium $\delta^{\gamma} \leq 1/d$. The equilibrium conditions discussed above require that the γ types are present in both the clan and the city. This requires:

$$1/d > D^{c}(x^{\lambda}) > 0$$

In fact, the equilibrium conditions are more stringent than that, because, city size cannot be smaller than $e/M\tau \equiv \hat{e}$ in order to sustain the enforcement technology. Imposing this additional constraint, we have that equilibrium requires that $x^{\lambda} < 1 - \hat{e}$ and, by (16), that:

$$(1 - \frac{\hat{e}}{1 - x^{\lambda}})/d > D^{c}(x^{\lambda}) > 0 \tag{18}$$

Since $a > 1/d$, (18) then also implies that the clannish types are in all in the clan ($\delta^{\lambda} > 1/d$).

Note that, by (15) and (13), at the point $x^{\lambda} = \bar{x}$ we have $D^{c}(\bar{x}) = D^{s}(\bar{x}) = 0$. By (17), then, it follows that condition (18) is satisfied for at least some $x^{\lambda} \geq \bar{x}$. Since under (A1) we have that $1 - \hat{e} > \bar{x}$, we know that an equilibrium with segregation in the clan exists for at least some $1 - \hat{e} > x^{\lambda} > \bar{x}$. Let $x^{\max}$ be the upper bound for x^{λ} where (18) is satisfied. By (15) and by the definition of $\hat{e}$, this upper bound is implicitly defined by the condition:

$$(1 - \frac{\hat{e}}{1 - x^{\max}})/d = \tau - \gamma + H(\tau x^{\max}) \tag{19}$$

Clearly, $x^{\max} < 1 - \hat{e}$. Moreover, since at the point $x^{\lambda} = \bar{x}$ we have $D^{c}(\bar{x}) = D^{s}(\bar{x}) = 0$, since $D^{c}_{x} > 0$, and since by (19) $D^{c}(x^{\max}) > 0$, we must also have $x^{\max} > \bar{x}$. Hence if $x^{\lambda} \in (\bar{x}, x^{\max})$ this equilibrium with segregation in the clan exists.

Finally, note that in this equilibrium, the fraction of each dynasty living in the city size is:

$$x^{\gamma y} = (1 - dD^{c}(x^{\lambda}))(1 - x^{\lambda})) \equiv G^{c}(x^{\lambda}) \tag{20}$$

Differentiating with respect to x^{λ} we immediately have that, by (17):

$$G^{c}_{x} = -(1 - dD^{c}(x^{\lambda}) - (1 - x^{\lambda})dD^{c}_{x} < 0 \tag{21}$$

Hence here too city size shrinks as the proportion of clannish types in the population increases. Intuitively, as x^{λ} rises, the clan becomes more attractive because all the clannish population is segregated in the clan and they all contribute to the public good. This draws more citizens in the clan, which makes the city even less attractive compared to the clan (because public good provision in the city shrinks). Equilibrium is restored when the idiosyncratic value of the preference parameter δ has risen enough for pivotal individual (i.e. when δ^γ is high enough) - by assumption (C1) and by (17) we know that this will eventually happen. Summarizing the above discussion:

Suppose that (A1)-(A4) hold. Then an equilibrium with segregation in the clan exists if and only if $x^\lambda \in (\bar{x}, x^{\max})$, where $1 - \hat{e} > x^{\max} > \bar{x} > 1/2$. In this equilibrium the fraction of each dynasty living in the city is $x^y = G^c(x^\lambda)$ given by (20), and it varies inversely with x^λ over the range $x^y \in (\hat{e},\, (1-\bar{x}))$.

Equilibrium with segregation in the city Finally, consider the equilibrium where the citizen types are segregated in the clan, while the clannish are present in both communities. Repeating the previous steps, the value of δ that leaves type λ indifferent between the clan and the city is:

$$\begin{aligned}\delta^\lambda &= q + \lambda - \tau + H(g^n) - H(g^y) \\ &= q + \lambda - \tau + H(\tau d\delta^\lambda x^\lambda) - H[M\tau(1-x^\lambda) - e]\end{aligned} \tag{22}$$

where the second equation follows from (1), (2), (9), having used:

$$x^{\lambda n} = d\delta^\lambda x^\lambda \tag{23}$$

by (9). Again, equation (22) defines a known function $\delta^\lambda = D^e(x^\lambda)$. By the implicit function theorem applied to (22):

$$\frac{\partial \delta^\lambda}{\partial x^\lambda} \equiv D^e_x = \frac{\tau[d\delta^\lambda H_g(g^n) + MH_g(g^y)]}{1 - dx^\lambda \tau H_g(g^y)} > 0 \tag{24}$$

where the last inequality follows from (C1). The equilibrium conditions discussed above require that the λ types are present in both the clan and the city. This requires:

$$1/d > D^e(x^\lambda) > 0 \tag{25}$$

Since $a > /1/d$, (25) then also implies that the citizen types are in all in the city ($\delta^\gamma < 0$).

Note that, by (22) and (13), at the point $x^\lambda = \underline{x}$ we have $D^e(x) = D^s(x) + a = 1/d$ (i.e. all clannish types are in the clan) By (24), then, it follows dition (25) is satisfied for at least some $x^\lambda \leq \underline{x}$. Since under (A4) we have that $\underline{x} > 0$, we know that an equilibrium with segregation in the clan exists for at least some $x^\lambda < \underline{x}$. Let $x^{\min}$ denote the minimum value of x^λ below which all clannish types are attracted to the city. By (25), $x^{\min}$ is defined implicitly by:

$$0 = q + \lambda - \tau + H(\tau d\delta^\lambda x^{\min}) - H[M\tau(1-x^{\min}) - e]$$

By (13) we know that $x^{\min} < \underline{x}$, but we cannot tell whether $x^{\min} > 0$ or $x^{\min} = 0$.

Finally, note that in this equilibrium, the fraction of each dynasty living in the city is:

$$x^y = (x^\gamma + x^{\lambda y}) = 1 - dD^e(x^\lambda)x^\lambda \equiv G^e(x^\lambda) \tag{26}$$

Differentiating with respect to x^λ we immediately have that, by (24):

$$G_x^e(x^\lambda) = -dD^e(x^\lambda) - x^\lambda dD_x^e < 0 \tag{27}$$

Hence here too city size shrinks as the proportion of clannish types in the population increases. Intuitively, as x^λ rises, the clan becomes more attractive because more of the clannish are present in the clan and they contribute to the public good. This draws more clannish types from the city into the clan. Equilibrium is restored when the idiosyncratic value of the preference parameter δ has risen enough for pivotal individual (i.e. when δ^λ is high enough) - by assumption (C1) and by (24) we know that this will eventually happen. Summarizing the above discussion:

Suppose that (A1)-(A4) hold. Then an equilibrium with segregation in the city exists if and only if $x^\lambda \in (x^{\min}, x)$, where $\underline{x} > x^{\min} \geq 0$. In this equilibrium the fraction of each dynasty living in the city is $x^y = G^e(x^\lambda)$ given by (26), and it varies inversely with x^λ over the range $x^y \in ((1-)\underline{x}1)$.

8.0.3 Proof of Proposition 3

Consider the equilibrium with segregation in the clan. Here equilibrium clan size is $x_t^n = 1 - x_t^{\gamma y} = 1 - G^c(x_t^\lambda)$. Hence (7) can be re-written as:

$$\begin{aligned} x_{t+1}^\lambda &= (1-\bar{p}) + (\bar{p} + \underline{p} \; - 1) \; x_t^\lambda + (\bar{p} - \underline{p})(1 - G^c(x_t^\lambda)) \\ &= (1-\bar{p}) + [2\bar{p} \; - 1 - (\bar{p} - \underline{p}) D^c(x_t^\lambda)] \; x_t^\lambda + (\bar{p} - \underline{p}) D^c(x_t^\lambda) \end{aligned} \tag{28}$$

where the last equality follows from (20). Denoting by $\delta_s^c \equiv D^c(x_s^\lambda)$ the steady state value of δ^γ in this equilibrium, we can express the steady state fraction of the clannish types by:

$$x_s^\lambda = \frac{1 - \bar{p} + (\bar{p} - \; \underline{p})\delta_s^c}{2(1-\bar{p}) + (\bar{p} - \; \underline{p})\delta_s^c} \equiv x^{\lambda c} > 1/2 \tag{29}$$

where the last inequality follows by noting that in this equilibrium $\delta_s^c > 0$. Thus, in this steady state more than half the population ends up being clannish. The reason is that even some citizens are attracted to the clan, which in turn influences the preferences of their offspring towards the clannish type. Since the steady state is jointly determined by (29) and (15), that implicitly defines $\delta_s^c = D^c(x^\lambda)$, in this equilibrium the steady state is affected by changes in parameters of the static model, since the distribution of types across communities is endogenous, and in turn it influences the evolution of preferences.

Is this steady state stable? Differentiating (28) with respect to x_t^λ, we obtain:

$$\begin{aligned} \frac{\partial x_{t+1}^\lambda}{\partial x_t^\lambda} &= (\bar{p} + \underline{p} \; - 1) - (\bar{p} - \underline{p}) \; G_x^c = \\ &= (\bar{p} + \underline{p} \; - 1) + (\bar{p} - \underline{p})[(1 - dD^c(x_t^\lambda)) + (1 - x_t^\lambda) dD_x^c] \end{aligned} \tag{30}$$

where the second equality follows from (21). Since both terms on the right hand side of (30) are positive, the dynamics is monotonic. If the right-most term is not too large in the neighborhood of the steady state (or if $\bar{p}-\underline{p}$ is sufficiently small), then the right hand side of (30) is also smaller than unity, so that the steady state is locally stable. Thus, if $x^{\lambda c} \in (\bar{x}, x^{\max})$ defined in the previous subsection, then for any initial condition in this same interval $(\bar{x}, x^{\max})$, the economy remains in the equilibrium with segregation in the clan and eventually reaches the steady state. Recalling that $(1 - \frac{\hat{e}}{1-x^{\max}})/d > D^c(x^\lambda) > 0$, and using (29), a sufficient condition for $x^{\lambda c} < x^{\max}$ is:

$$x^{\max} > \frac{1 - \underline{p} - (\bar{p} - \underline{p})\hat{e}}{2 - \bar{p} - \underline{p}}$$

QED.

8.0.4 Proof of Proposition 4

Finally, consider the equilibrium with segregation in the city. Here equilibrium clan size is $x_t^n = 1 - x_t^y = 1 - G^e(x_t^\lambda)$. Hence (7) can be rewritten as:

$$\begin{aligned} x_{t+1}^\lambda &= (1-\bar{p}) + (\bar{p} + \underline{p} \ -1)\ x_t^\lambda + (\bar{p} - \underline{p})(1 - G^e(x_t^\lambda)) \\ &= (1-\bar{p}) + (\bar{p} + \underline{p} \ -1 + (\bar{p} - \underline{p})dD^e(x_t^\lambda))\ x_t^\lambda \end{aligned} \tag{31}$$

where the last equality follows from (26). We can thus express the steady state fraction of clannish types in this equilibrium as:

$$x_s^\lambda = \frac{1-\bar{p}}{2-\bar{p}- \ \underline{p} - (\bar{p} - \ \underline{p})d\delta_s^e} \equiv x^{\lambda e} < 1/2 \tag{32}$$

where $\delta_s^e \equiv D^e(x_s^\lambda)$ and where the last inequality follows by noting that in this equilibrium $\delta_s^e < 1/d$. Thus, in this steady state less than half the population ends up being clannish.that con The reason is that some clannish types are attracted to the city, which in turn influences the preferences of their offspring towards the citizen type. Since the steady state is jointly determined by (32) and (22), that implicitly defines $\delta_s^e = D^e(x_s^\lambda)$, in this equilibrium too the steady state is affected by changes in parameters of the static model, since the distribution of types across communities is endogenous, and in turn it influences the evolution of preferences.

To assess stability, again differentiate (31) with respect to x_t^λ, to obtain:

$$\begin{aligned} \frac{\partial x_{t+1}^\lambda}{\partial x_t^\lambda} &= (\bar{p} + \underline{p} \ -1) - (\bar{p} - \underline{p})\ G_x^e = \\ &= (\bar{p} + \underline{p} \ -1) - (\bar{p} - \underline{p})d[D^e(x_t^\lambda)) + x_t^\lambda D_x^e] \end{aligned} \tag{33}$$

where the second equality follows from (27). If the right-most term is not too large in absolute value in the neighborhood of the steady state (or if $\bar{p}-\underline{p}$ is sufficiently small), then the right hand side of (33) is also smaller than unity, so that the steady state is locally stable. Moreover, if $\bar{p}-\underline{p}$ is sufficiently small, then the right hand side of (33) is also positive, so that the dynamics is also monotonic. Thus, if $x^{\lambda e} \in (x^{\min}, \underline{x})$ defined in the previous subsection, then for any initial condition in this same interval $(x^{\min}, \underline{x})$, the economy remains in the equilibrium with segregation in the city and eventually reaches the steady state. QED.