Supplement to "Pirates of the Mediterranean: An empirical investigation of bargaining with asymmetric information": Appendix

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A.1. Characterization of sequential equilibria for the general model

Since $p=\beta^{T-1}\underline{b}$ in the final bargaining period, we can compute the upper bound on the remaining types such that selling to any possible type (by setting $p=\beta^{T-2}\underline{b}$) is optimal according to the optimization problem

$$\max_p p\cdot\frac{F(X)-F\left(\frac{p/\beta^{T-2}-\beta\delta\underline{b}}{1-\beta\delta}\right)}{F(X)}+\frac{F\left(\frac{p/\beta^{T-2}-\beta\delta\underline{b}}{1-\beta\delta}\right)}{F(X)}\left(\beta^{T-2}v+\beta^{T-1}\delta\underline{b}\right).$$

Therefore, optimal p in the final period satisfies

$$\frac{v+\beta\delta\underline{b}-p/\beta^{T-2}}{(1-\beta\delta)}f\left(\frac{p/\beta^{T-2}-\beta\delta\underline{b}}{1-\beta\delta}\right)-F\left(\frac{p/\beta^{T-2}-\beta\delta\underline{b}}{1-\beta\delta}\right)+F(X)\le 0. \tag{A.1}$$

Setting $p=\beta^{T-2}\underline{b}$ (and using $F(\underline{b})=0$) allows us to determine the upper bound on remaining types:

$$X=F^{-1}\left[\left(\underline{b}-\frac{v}{1-\beta\delta}\right)f(\underline{b})\right].$$

From the way we solved for X, this upper bound on remaining types in the final period can also be interpreted as the minimum type such that if types were hypothetically distributed over $[X,\overline{b}]$, the game would end one period earlier than with types distributed over $[\underline{b},\overline{b}]$.

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Letting b_t^* denote the threshold valuation such that the buyer is indifferent between accepting and rejecting in period t, for any $b_{T-1}^* \in (\underline{b}, X)$, the price in the next-to-last period, p_{T-1}, such that b_{T-1}^* is the cutoff can be determined from the fact that this type is indifferent between accepting in $T-1$ and waiting until T to accept. That is,

$$\beta^{T-2} b_{T-1}^* - p_{T-1} = \delta \beta^{T-1} (b_{T-1}^* - \underline{b}),$$

which gives $p_{T-1} = (1-\delta\beta)\beta^{T-2} b_{T-1}^* + \delta\beta^{T-1}\underline{b}$.

Given p_T and p_{T-1}, b_{T-2}^* can be calculated as the upper bound of types that make it to $T-1$ from (A.1) since this characterizes the $T-1$ optimization problem when the following period has $p_T = \beta^{T-1}\underline{b}$. Generating the first couple such cutoff values gives

$$\begin{aligned} b_T^* &= \underline{b}, \\ b_{T-1}^* &\in \left(\underline{b}, F^{-1}\left[\left(\underline{b} - \frac{v}{1-\beta\delta}\right) f(\underline{b})\right]\right), \\ b_{T-2}^* &= F^{-1}\left[\left(b_{T-1}^* - \frac{v}{1-\beta\delta}\right) f(b_{T-1}^*) + F(b_{T-1}^*)\right]. \end{aligned}$$

The prices are given by

$$\begin{aligned} p_T &= \beta^{T-1}\underline{b}, \\ p_t &= (1-\beta\delta)\beta^{t-1} b_t^* + \delta p_{t+1}, \quad t = 1, \dots, T-1. \end{aligned}$$

We can solve for the $T-3$ cutoff from the objective function:

$$\begin{aligned} \max_{b_{T-2}^*} \{ & (F(b_{T-3}^*) - F(b_{T-2}^*)) p_{T-2} \\ & + (F(b_{T-2}^*) - F(b_{T-1}^*))(\beta^{T-3} v + \delta p_{T-1}) \\ & + F(b_{T-1}^*)(\beta^{T-3} v(1+\beta\delta) + \delta^2 \beta^{T-1}\underline{b})\}. \end{aligned}$$

The first-order condition is

$$\begin{aligned} 0 = & (F(b_{T-3}^*) - F(b_{T-2}^*)) \frac{\partial p_{T-2}}{\partial b_{T-2}^*} - f(b_{T-2}^*) p_{T-2} \\ & + (F(b_{T-2}^*) - F(b_{T-1}^*)) \delta \frac{\partial p_{T-1}}{\partial b_{T-2}^*} + \left(f(b_{T-2}^*) - f(b_{T-1}^*) \frac{\partial b_{T-1}^*}{\partial b_{T-2}^*} \right) (\beta^{T-3} v \\ & + \delta p_{T-1}) + f(b_{T-1}^*) \frac{\partial b_{T-1}^*}{\partial b_{T-2}^*} (\beta^{T-3} v(1+\beta\delta) + \beta^{T-1}\delta^2 \underline{b}) \\ = & (F(b_{T-3}^*) - F(b_{T-2}^*)) \left((1-\beta\delta) + \delta \frac{\partial p_{T-1}}{\partial b_{T-2}^*} \right) - f(b_{T-2}^*)[(1-\beta\delta) b_{T-2}^* \\ & + \delta p_{T-1}] + (F(b_{T-2}^*) - F(b_{T-1}^*)) \delta \left[\frac{\partial p_{T-1}}{\partial b_{T-2}^*} \right] \\ & + \left(f(b_{T-2}^*) - f(b_{T-1}^*) \left[\frac{\partial b_{T-1}^*}{\partial b_{T-2}^*} \right] \right) (\beta^{T-3} v + \delta p_{T-1}) \end{aligned}$$

$$
\begin{aligned}
&+ f\big(b^*_{T-1}\big)\left[\frac{\partial b^*_{T-1}}{\partial b^*_{T-2}}\right]\big(\beta^{T-3}v(1+\beta\delta) + \beta^{T-1}\delta^2\underline{b}\big) \\
&= F\big(b^*_{T-3}\big)\left((1-\beta\delta) + \delta\frac{\partial p_{T-1}}{\partial b^*_{T-2}}\right) - (1-\beta\delta)F\big(b^*_{T-2}\big) - \delta F\big(b^*_{T-1}\big)\left[\frac{\partial p_{T-1}}{\partial b^*_{T-2}}\right] \\
&+ f\big(b^*_{T-2}\big)\big(-(1-\beta\delta)b^*_{T-2} + \beta^{T-3}v\big) \\
&+ \delta f\big(b^*_{T-1}\big)\left[\frac{\partial p^*_{T-1}}{\partial b^*_{T-2}}\right]\left(-b^*_{T-1} + \frac{\beta^{T-2}v}{1-\beta\delta}\right),
\end{aligned}
$$

where the last expression used $\frac{\partial p^*_{T-1}}{\partial b^*_{T-2}} = \beta^{T-2}(1-\beta\delta)\frac{\partial b^*_{T-1}}{\partial b^*_{T-2}} = 0$. Using the first-order condition for the $T-1$ problem, which reduces to $F(b^*_{T-2}) - F(b^*_{T-1}) + f(b^*_{T-1})[-b^*_{T-1} + \frac{v}{1-\beta\delta}] = 0$, the implicit function theorem gives

$$
\frac{\partial p^*_{T-1}}{\partial b^*_{T-2}} = \frac{(1-\beta\delta)f\big(b^*_{T-2}\big)}{2f\big(b^*_{T-1}\big) + f'(b^*_{T-1})\left(b^*_{T-1} - \frac{v}{1-\beta\delta}\right)}.
$$

Substituting this in, the first-order condition becomes

$$
\begin{aligned}
0 = &F\big(b^*_{T-3}\big)\left[2f\big(b^*_{T-1}\big) + f'\big(b^*_{T-1}\big)\left(b^*_{T-1} - \frac{v}{1-\beta\delta}\right) + \delta f\big(b^*_{T-2}\big)\right] \\
&- F\big(b^*_{T-2}\big)\left[2f\big(b^*_{T-1}\big) + f'\big(b^*_{T-1}\big)\left(b^*_{T-1} - \frac{v}{1-\beta\delta}\right)\right] - \delta F\big(b^*_{T-1}\big)f\big(b^*_{T-2}\big) \\
&+ f\big(b^*_{T-2}\big)\left(-b^*_{T-2} + \frac{\beta^{T-3}v}{1-\beta\delta}\right)\left[2f\big(b^*_{T-1}\big) + f'\big(b^*_{T-1}\big)\left(b^*_{T-1} - \frac{v}{1-\beta\delta}\right)\right] \\
&+ \delta f\big(b^*_{T-1}\big)f\big(b^*_{T-2}\big)\left(-b^*_{T-1} + \frac{\beta^{T-2}v}{1-\beta\delta}\right).
\end{aligned}
$$

And now we can solve for the $T-3$ cutoff,

$$
b^*_{T-3} = F^{-1}\big[F\big(b^*_{T-2}\big) + f\big(b^*_{T-2}\big)C\big],
$$

where

$$
C = \frac{\left(b^*_{T-2} - \frac{\beta^{T-3}v}{1-\beta\delta}\right)\left\{2f\big(b^*_{T-1}\big) + f'\big(b^*_{T-1}\big)\left[b^*_{T-1} - \frac{v}{1-\beta\delta}\right]\right\} + \delta f\big(b^*_{T-1}\big)\frac{v(1-\beta^{T-2})}{1-\beta\delta}}{2f\big(b^*_{T-1}\big) + f'\big(b^*_{T-1}\big)\left[b^*_{T-1} - \frac{v}{1-\beta\delta}\right] + \delta f\big(b^*_{T-2}\big)}.
$$

We can then solve for $b^*_{T-4}, \dots, b^*_2$ and $\tilde{b}_1$, and

$$
b^*_1 = F^{-1}\left[\frac{F(\tilde{b}_1) - \pi}{1-\pi}\right]
$$

as functions of b^*_{T-1}. If $b^*_1(b^*_{T-1})$ has an inverse, we can then express $b^*_2, \dots, b^*_{T-1}$ and $p_1, \dots, p_{T-1}$ as functions of b^*_1.

Given the parameters of the associated bargaining problem, let $\breve{b}_t^*$ and $\breve{p}_t$ denote the solution for the acceptance threshold and the price, respectively, in the model without a probabilistic liquidity constraint. For $t = 2, \dots, T$, define $\hat{b}_t(b_1) = \breve{b}_t^* : \breve{b}_1^* = b_1$ and $\hat{p}_t(b_1) = \breve{p}_t : \breve{b}_1^* = b_1$ as the respective threshold and price as a function of the period-1 cutoff, b_1^*.

The probability that the bargaining game will end in t (unconditionally) is

$$
\begin{aligned}
&(1-\pi)\big(1-F(b_1^*)\big), \quad t=1,\\
&F(\tilde{b}_1)-F\big(\hat{b}_2(\tilde{b}_1)\big), \quad t=2,\\
&F\big(\hat{b}_{t-1}(\tilde{b}_1)\big)-F\big(\hat{b}_t(\tilde{b}_1)\big), \quad t=3,\dots,T.
\end{aligned}
$$

The seller's payoff if the game ends in t is $(1-(\beta\delta)^{t-1})\frac{v}{1-\beta\delta}+\delta^{t-1}p_t$, so the objective function can be given as

$$
\begin{aligned}
&\max_{b_1^*}(1-\pi)\big(1-F(b_1^*)\big)p_1+\big(F(\tilde{b}_1)-F\big(\hat{b}_2(\tilde{b}_1)\big)\big)\big(v+\delta\hat{p}_2(\tilde{b}_1)\big)\\
&\quad+\sum_{t=3}^{T}\big(F\big(\hat{b}_{t-1}(\tilde{b}_1)\big)-F\big(\hat{b}_t(\tilde{b}_1)\big)\big)\left[\big(1-(\beta\delta)^{t-1}\big)\frac{v}{1-\beta\delta}+\delta^{t-1}\hat{p}_t(\tilde{b}_1)\right],
\end{aligned}
$$

which is equivalent to

$$
\begin{aligned}
&\max_{b_1^*}(1-\pi)\big(1-F(b_1^*)\big)p_1+F(\tilde{b}_1)\big(v+\delta\hat{p}_2(\tilde{b}_1)\big)\\
&\quad+\sum_{t=2}^{T-1}\delta^{t-1}F\big(\hat{b}_t(\tilde{b}_1)\big)\big[v-\hat{p}_t(\tilde{b}_1)+\delta\hat{p}_{t+1}(\tilde{b}_1)\big].
\end{aligned}
$$

Hence, the first-order condition becomes

$$
\begin{aligned}
0&=(1-\pi)\big(1-F(b_1^*)\big)\frac{\partial p_1}{\partial b_1^*}-(1-\pi)p_1 f(b_1^*)\\
&\quad+\frac{\partial\tilde{b}_1}{\partial b_1^*}\big\{F(\tilde{b}_1)\delta\hat{p}_2'+f(\tilde{b}_1)(v+\delta\hat{p}_2)+D\big\},
\end{aligned}
$$

where

$$
D=\sum_{t=2}^{T-1}\delta^{t-1}\big[F(\hat{b}_t)\big(-\hat{p}_t'+\delta\hat{p}_{t+1}'\big)+(v-\hat{p}_t+\delta\hat{p}_{t+1})f(\hat{b}_t)\hat{b}_t'\big],
$$

and the argument $\tilde{b}_1$ is suppressed in the hatted functions, $\hat{b}$ and $\hat{p}$ (and also their derivatives $\hat{b}'$and $\hat{p}'$). Using

$$
\frac{\partial\tilde{b}_1}{\partial b_1^*}=\frac{(1-\pi)f(b_1^*)}{f\big(\pi+(1-\pi)F(b_1^*)\big)} \quad\text{and}\quad \frac{\partial p_1}{\partial b_1^*}=(1-\beta\delta)+\frac{\delta\hat{p}_2'(1-\pi)f(b_1^*)}{f\big(\pi+(1-\pi)F(b_1^*)\big)},
$$

while factoring out $(1-\pi)$, the first-order condition becomes

$$\begin{aligned} 0 &= (1-\beta\delta)\big(1-F\big(b_1^*\big)\big) - p_1 f\big(b_1^*\big) \\ &\quad + \frac{f\big(b_1^*\big)}{f\big(\pi+(1-\pi)F\big(b_1^*\big)\big)}\Bigg\{\delta(1-\pi)\big(1-F\big(b_1^*\big)\hat{p}_2'\big) + F(\tilde{b}_1)\delta\hat{p}_2' \\ &\quad + f(\tilde{b}_1)(v+\delta\hat{p}_2) + \sum_{t=2}^{T-1}\delta^{t-1}\big[F(\hat{b}_t)\big(-\hat{p}_t' + \delta\hat{p}_{t+1}'\big) \\ &\quad + (v-\hat{p}_t+\delta\hat{p}_{t+1})f(\hat{b}_t)\hat{b}_t'\big]\Bigg\}, \end{aligned}$$

which can be used to solve for the optimal acceptance threshold in the first period.

A.2. Data construction and summary statistics

From the reign of Philip II (reigned 1556–1598) onward, royal authorities appointed a notary to accompany the ransoming missions. This notary was required to record all financial transactions and often provided anecdotes relevant to the bargaining procedures. The data are drawn from these notary records, which contain information on a wide variety of ransomed captives, ranging from the Spanish nobility and clergy to fisherman.

Table A.1 provides the number of captives ransomed in each of the 22 ransoming expeditions we use in this paper. The first column provides the year(s) spanned by the ransoming trip and the second column gives the archival reference for the notarial record. The third column provides the number of captives for whom a full ransom was paid, whereas the fourth column provides the number of those for whom only the exit tax was paid or the ransom price was zero or missing.[1]

In Table A.2, we provide summary statistics for all individuals with full ransoms, which is our baseline sample. The missed trip variable is calculated using an individual's time in captivity, the year he was ransomed, the ransoming trips performed by the Mercedarian redemption order (Garí y Siumell (1873)), and the trips in the sample. We used these data to compute how many known trips had gone to Algiers since a captive was captured (we assume that if the individual was captured in the year in which a ransoming expedition came, he missed that trip) until they were ransomed.[2]

Children are defined as all individuals who are less than 12 years old. Females are those who have the first names Ageda, Agueda, Agustina, Alberta, Aldonza, Ana, Angela, Antona, Antonia, Beatriz, Bernarda, Catalina, Caterina, Cathalina, Clara, Constanza, Cornelia, Cristina, Damiana, Dominga, Elena, Elvira, Esperanza, Feliciaña, Felipa, Francisca, Gerónima, Ginesa, Gregoria, Guida, Inés, Isabel, Jacinta, Joana, Josepha, Juana,

[1]The exit tax was a fixed sum that had to be paid before a captive was allowed to leave Algiers. Thus, captives who had paid their own ransoms or who had been set free had to pay this tax before they could leave Algiers.

[2]To construct the year of capture we subtract the time in captivity (which is always greater than zero) from the year of ransom.

TABLE A.1. Data sources.

Year	Archive	Full Ransom	Exit Tax or Missing	All
1575	mss2963	140	5	145
1580/1581	l118, l120	151	0	151
1582	l119	106	1	107
1587/1588	l122	96	6	102
1591/1592	l121	116	4	120
1618	l125	144	1	145
1627	mss3872	141	2	143
1642	l133	139	3	142
1649	l132	91	15	106
1651	mss3597	230	9	239
1660	mss4359	365	3	368
1662	l139	261	24	285
1664	mss4394	230	32	262
1667	mss3586	200	11	211
1669	mss3593	180	9	189
1670	l135	168	24	192
1675	mss2974	497	22	519
1678	mss7752	421	28	449
1679	l146	127	38	165
1686	mss4363	308	12	320
1690	l145	127	37	164
1692	l147	140	16	156
Total		4378	302	4680

Note: Archive entries prefaced with l are from the Archivo Histórico Nacional, còdices. The number after l details the *legajo*. Archive entries prefaced with mss are from the Biblioteca Nacional de Madrid. The number after mss gives the manuscript number. The column Full Ransom provides the number of captives for whom a full ransom was paid; the column Exit Tax or Missing provides the number of captives for whom only the exit tax was paid (or similar) as well as the number of captives who were missing information on their price or this price was zero. See the text for details.

Jusepa, Leonarda, Lucia, Lucrecia, Luisa, Madalena, Magdalena, Manuela, Margarita, María, Mariana, Marina, Marta, Nicolasa, Paula, Pereta, Petronila, Teresa, Theodora, Thomasa, Thomasina, Vitoria, and Yasimina or are otherwise specified as female.

Although the professions are drawn from the ransom entries and are likely generally accurate when the relevant information is provided, these professional categories are surely measured with error. In addition to the fact that we could not identify a profession for roughly half of the sample, in some cases a captive could be classified as belonging to two separate categories. Although such conflicts do not arise frequently, in such cases we have picked one category and when doing this have sought to choose the category that best corresponds to the captive.[3] All classifications have been documented and are

[3]To be precise, fisherman are those who were caught while fishing and for whom no other information was available. Clerics are those whose first name begin with “Fray” or who are otherwise defined as clerics irrespective of other information. For the remaining entries, we proceeded sequentially. For the remaining individuals, we assign an individual to the carrera if there was information that he was taken on the *carrera de indias*. From those remaining, we identify soldiers or those in the service of the king. From those remain-

Table A.2. Summary statistics (full ransoms).

Variable	*N* (1)	Mean (2)	Std. (3)	Min (4)	Max (5)
General					
Year of ransom	4378	1654.63	33.22	1575	1692
ln(*ransom*)	4378	7.40	0.59	3.67	11.71
ln(*earmarked*)	908	6.90	1.09	3.69	11.70
Age at ransom	4322	34.73	14.16	0.08	88.00
Time captive	4296	5.62	6.38	0.02	60.00
Age at captivity	4265	29.11	13.14	0	85.92
Female	4378	0.07	0.26	0	1
Child	4322	0.03	0.17	0	1
Mainland	4323	0.59	0.49	0	1
*L*dis	4323	5.07	2.07	0	9.13
*L*disalg	4323	6.68	0.72	0	9.20
*L*discap	2090	4.21	2.77	0	9.38
Missed trips	4296	1.93	2.73	0	25
Profession					
Fisherman	4378	0.13	0.34	0	1
Carrera	4378	0.05	0.22	0	1
Soldier	4378	0.26	0.44	0	1
Cleric	4378	0.03	0.16	0	1
Noble	4378	0.003	0.05	0	1
Other	4378	0.03	0.16	0	1
Missing	4378	0.50	0.50	0	1

Note: Earmarked funds are those sent from Spain for the ransom of a specific captive. *L*dis is the logarithm of 1 plus the minimum distance of a captive's home to the bargaining bases. *L*disalg is the logarithm of 1 plus the distance from a captive's home to Algiers. *L*discap is the logarithm of 1 plus the distance from a captive's home to his place of capture. Carrera denotes captives caught on their way to or returning from the Americas. See the text for details.

available (along with the archival reference for each ransom entry) in the replication files for this paper.[4]

To identify the latitude and longitude of a captive's home as well as the exact place of his capture, we used the website http://www.latlong.net.[5] A map of the location of capture for captives ransomed from the baseline sample is provided in Figure A.1, where larger circles denote more ransomed captives who were captured in a given area. Algiers is denoted by the black circle labeled Algiers. The remaining black circles denote the bargaining bases. The Kingdom of Castile is shaded grey.[6]

ing, we assign an individual to the nobility if there is evidence he was a member of the nobility. From those remaining, we assign an individual to the other category if he is identified as a barbero, carpintero, cirujano, comerciante, comerciante de esclavos, contra maestre, criado, grumete, guardia, herrero, labrador, labradora, mercader, or pastor. For the remainder of the individuals, we could not identify a profession.

[4]For a complementary discussion of the data construction, see Chaney (2015).

[5]To calculate distances, we used the vincenty module in STATA to obtain the Haversine-based calculations.

[6]Excel files documenting the original data transcription as well as the matching of hometowns and places of capture to latitudes and longitudes are available upon request.

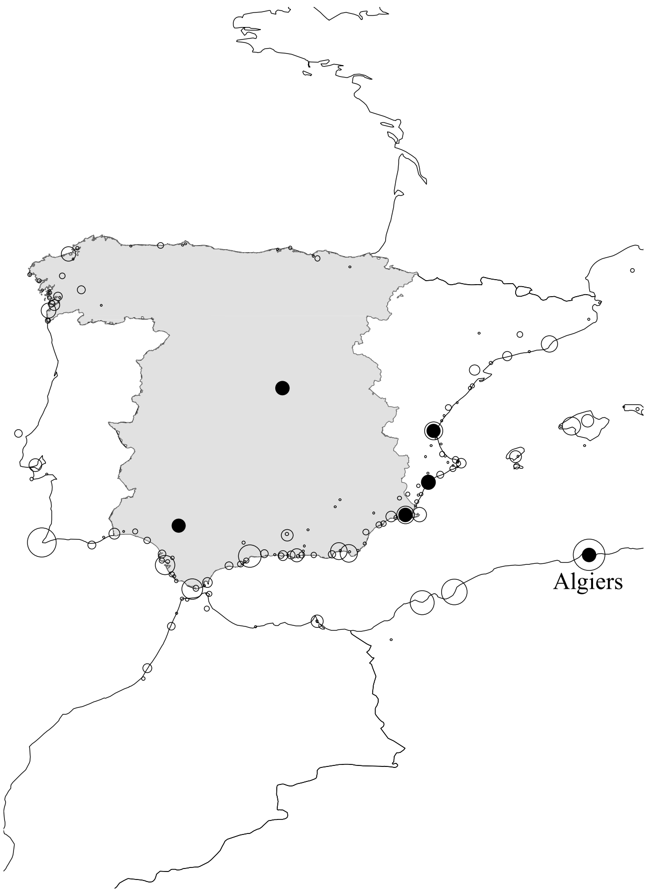

FIGURE A.1. Number of captives ransomed by place of capture. Larger circles denote a larger number of ransomed captives. Algiers is denoted by the black circle labeled Algiers. The remaining black circles denote the bargaining bases. The Kingdom of Castile is shaded grey.

Of the 915 earmarked captives in the full sample (there are 908 in the baseline sample), we obtained the funds sent for 634 from the main ransom record. For the remaining 281 captives, we found this information elsewhere in the ransoming records. When there was information both in the main record and elsewhere (for 257 captives), the amount of earmarked money was exactly the same in roughly 60% of the cases. When there was divergence, this seems to have often been because either only the amount used to ransom a captive was recorded in the main record or the captive had multiple sources of earmarked money that were not all recorded elsewhere in the ransom records. When there were conflicts, we used the amount of earmarked funds as given in the main ransom record.

Although the majority of ransom prices were given in silver reales or pesos, more rarely ducados, Algerian doblas, escudos, maravedies, and billon prices appear. We have converted all ransom prices to reales; to do this, we have used the implied conversion in the ransom records when available.[7] When these conversions were not available, we have used the following conventions: 1 ducado = 375 maravedis, 1 real = 34 maravedis, 1 gold coin = 8 silver coins, 1 billon real = 0.5 silver reales.[8] It should be stressed that for most captives, no conversions were necessary, and even when they were necessary, most conversions were drawn from the ransom books. Thus, measurement error due to these conversions is probably not a major concern.

In Table A.3, we present the correlates of ransom prices. In column 1, we omit trip dummies and only include the profession dummies where the omitted group is captives

TABLE A.3. Correlates of ransom prices.

	(1)	(2)	(3)	(4)	(5)
Time captive				−1.09	−1.05
				(0.13)	(0.13)
Age at capture				−0.56	−0.59
				(0.08)	(0.07)
Fisherman	−13.04	−13.61	−11.90	−8.46	−8.86
	(1.85)	(2.28)	(2.32)	(2.19)	(2.15)
Carrera	22.58	22.22	20.51	21.19	21.45
	(4.88)	(6.43)	(6.02)	(5.54)	(5.49)
Cleric	66.38	64.68	67.55	69.64	69.53
	(7.55)	(8.64)	(8.07)	(7.99)	(8.15)
Soldier	4.59	4.09	6.27	8.66	6.90
	(2.12)	(2.33)	(2.66)	(2.74)	(2.49)
Noble	205.98	190.88	178.48	159.48	133.69
	(45.36)	(41.59)	(37.14)	(36.07)	(32.72)
Other	−9.69	−14.14	−6.29	−4.49	−4.76
	(6.45)	(5.84)	(5.16)	(4.80)	(4.76)
Child				5.12	4.44
				(4.46)	(4.49)
Female				10.38	11.48
				(6.01)	(5.72)
Constant	737.63	738.10			
	(1.18)	(2.20)			
Trip dummies?	No	No	Yes	Yes	Yes
N	4378	4296	4296	4265	4220
SE	Robust	Cluster	Cluster	Cluster	Cluster
Sample	All	All	All	All	Dist.

Note: The row SE denotes how the standard errors are calculated in each regression; clustered standard errors are clustered by year of capture. The row Sample denotes the subsample used and All denotes the entire possible sample, whereas Dist. denotes that the sample is limited to observations with non-missing values for distance to the bargaining bases. All coefficients are multiplied by 100 for ease of exposition.

[7]For example, the ransom record of Fernando Corzo (l122, f. 132r) notes "his ransom cost 100 escudos which make 420 doblas of Algiers at the rate of 4.2 doblas per escudo [...the 420 doblas] are worth 40,000 maravedies." This implies that 420 doblas are worth approximately 1176 reales or each dobla is worth 2.8 reales.

[8]See Cayón, Cayón, and Cayón (2005, pp. 401–402) and Lea (1906, pp. 560–561).

whose profession is not identified. The results show the mean ransom (more precisely, the exponential of the mean of log ransoms) of the omitted group was 1598 reales for captives whose profession we could not identify. These prices were over 13 log points lower for fisherman, 23 log points higher for those captured on their way to and from the Americas, 66 log points higher for clerics, 5 log points higher for soldiers, and over 200 log points higher for members of the nobility. In column 2, we cluster standard errors by the integer value of a captive's exact date of capture. The number of observations drops when we do this, because this date of capture is calculated by using the TimeCaptive variable, which has 4296 nonmissing values. In column 3, we add trip dummies. In column 4, we include the full vector of controls, and in column 5, we limit the sample to those who have non-missing homes. The specification in column 5 is the same as in column 2 of panel A of Table 1 in the main text.

In general, the results are stable across these specifications and are consistent with the historical literature stressing that captives such as those coming to and from the Americas and soldiers were in higher demand than other captives (e.g., Friedman (1983, p. 146)).

In Table A.4, we reproduce Table 1 from the main text and include the distance from his home that a captive was taken as a control. Here, we simply note that the inclusion of this control does not qualitatively affect the results (aside from the natural decrease in statistical precision that comes from the reduced sample size).

In Table A.5, we show how the distribution of gains from trade, and total costs, depend on the offer arrival frequency and on the depreciation rate during captivity.

A.3. Derivation of the likelihood function

For each negotiation, we observe three outcome quantities: transaction price, $P(i, n_i, t_i)$, number of rejected offers plus 1, n_i, and time in captivity, t_i. Exogenous quantities are personal characteristics of the captives $\boldsymbol{X}_i$. Thus, for each observation, the general form of the likelihood function is

$$L_i = \text{Prob}\big[P(i, n_i, t_i)|n_i, t_i\big]\,\text{Prob}[t_i|n_i]\,\text{Prob}[n_i]. \tag{A.2}$$

Given that arrival of the possibility to negotiate is a random variable that depends only on λ, which we estimate separately, term $\text{Prob}[t_i|n_i]$ does not depend on the unknown parameters and will be omitted in subsequent equations. Note also that estimating λ in a separate step is equivalent to a joint estimation because λ enters only $\text{Prob}[t_i|n_i]$, which does not have any other parameters in it.

For our specification of the error term,

$$\text{Prob}\big[P(i, n_i, t_i)|n_i, t_i\big] = \frac{1}{\sqrt{2\pi\theta^2}} e^{-\frac{(\log P(i,n_i,t_i)-\log p(i,n_i,t_i))^2}{2\theta^2}}. \tag{A.3}$$

Moreover, for the function forms of the buyer's and seller's valuations, the equilibrium price has the linear form

$$\log p(i, n_i, t_i) = \boldsymbol{\alpha}\boldsymbol{X}_i - x t_i + \log p_{n_i}. \tag{A.4}$$

TABLE A.4. Time in captivity, distance to bargaining bases, and ransom prices: robustness.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Panel A: OLS			
Years captive	−1.04	−0.96	−1.01	−0.88	−0.77	−0.59	−0.76
	(0.18)	(0.18)	(0.52)	(0.22)	(0.22)	(0.69)	(0.22)
Age at capture	−0.75	−0.70	−0.78	−0.97	−0.93	−1.00	−0.93
	(0.09)	(0.09)	(0.20)	(0.10)	(0.11)	(0.22)	(0.11)
Ldiscap	1.11	0.52	1.12	1.88	1.27	1.20	1.25
	(0.48)	(0.48)	(0.83)	(0.58)	(0.64)	(1.68)	(0.63)
ln(*earmarked*)			−131.69			−124.39	
			(20.63)			(30.07)	
$\ln^2$(*earmarked*)			12.34			11.85	
			(1.46)			(2.22)	
p-value	[0.12]	[0.17]	[0.66]	[0.70]	[0.47]	[0.56]	[0.45]
				Panel B: IV			
Years captive	−8.03	−6.73	−12.29	−11.16	−9.54	−13.35	−13.82
	(2.82)	(2.38)	(4.74)	(5.33)	(5.66)	(9.96)	(8.89)
	[−18.88, −3.89]	[−12.11, −1.53]	[−30.85, −4.98]	[−32.05, −2.93]	[−19.18, 2.78]	[−52.38, 25.68]	[−48.66, 21.01]
Age at capture	−1.14	−1.18	−1.23	−1.47	−1.55	−1.39	−1.85
	(0.20)	(0.23)	(0.30)	(0.30)	(0.42)	(0.38)	(0.60)
Ldiscap	1.55	−0.01	2.02	3.19	0.77	3.14	0.56
	(0.72)	(0.62)	(1.49)	(1.30)	(0.90)	(3.50)	(1.15)
ln(*earmarked*)			−139.39			−150.00	
		(24.51)			(40.87)		
$\ln^2$(*earmarked*)			12.54			13.16	
			(1.69)			(2.69)	
p-value	[0.01]	[0.01]	[0.02]	[0.06]	[0.13]	[0.22]	[0.15]
				Panel C: First Stage			
Ldis	0.29	0.34	0.28	0.22	0.22	0.22	0.31
	(0.09)	(0.09)	(0.10)	(0.10)	(0.10)	(0.14)	(0.20)
Ldiscap	0.05	−0.13	0.03	0.13	−0.06	0.12	−0.06
	(0.07)	(0.06)	(0.10)	(0.09)	(0.08)	(0.18)	(0.08)
N	2051	2051	409	1157	1157	248	1157
Clusters	121	121	83	113	113	61	113
Controls?	No	Yes	Yes	No	Yes	Yes	Yes, cities
Sample	All	All	All	Castile	Castile	Castile	Castile

Note: The dependent variable in panels A and B is the logarithm of captive's ransom, whereas that in panel C is years in captivity before ransom. The row p-value in panels A and B presents the p-value for the null hypothesis that the coefficient on years in captivity is the same as that on age at capture. Ldis is the logarithm of 1 plus the minimum distance from a captive's home to the bargaining bases. Ldiscap is the logarithm of 1 plus the distance from a captive's home to his place of capture. Standard errors are clustered by year of capture. Coefficients in panels A and B are multiplied by 100 for ease of exposition.

TABLE A.5. Comparative statics of gains from trade.

λ/x	−70%	−40%	Estimated	+40%	+70%
			Seller's Share		
−70%	39.6	39.6	39.4	39.2	39.1
−40%	34.8	33.9	34.4	33.9	34.5
Estimated	30.3	30.7	31.6	32.3	32.8
+40%	20.8	21.4	21.9	22.3	22.6
+70%	19.8	20.2	20.5	21.1	21.4
			Buyer's Share		
−70%	47.4	46.8	46.2	45.4	45.0
−40%	53.1	54.4	52.1	53.3	51.2
Estimated	58.5	56.9	54.3	51.8	49.9
+40%	70.8	68.8	67.3	67.0	66.1
+70%	70.9	69.8	69.2	67.1	66.0
			Total Costs		
−70%	12.9	13.6	14.5	15.4	15.9
−40%	12.0	11.7	13.5	12.8	14.3
Estimated	11.2	12.4	14.2	15.8	17.4
+40%	8.5	9.8	10.8	10.7	11.3
+70%	9.3	10.0	10.2	11.8	12.6

Note: This table shows shows how the distribution of gains from trade between the seller and the buyer, and the costs, depends on λ (offer arrival intensity) and on x (depreciation rate while captive). Total gain is normalized to 100%. Comparative statics with respect to λ is shown in rows; comparative statics with respect to x is shown in columns. For example, the central column shows the distribution of gains for x estimated earlier, the first column shows that distribution when x is lowered by 70%, the second column shows that distribution when x is lowered by 40%, and so forth.

Denoting

$$\hat{\varepsilon} = \log P(i, n_i, t_i) - \boldsymbol{\alpha} \boldsymbol{X}_i + x t_i - \log p_{n_i}, \tag{A.5}$$

we can write the log-likelihood function as

$$\log L = -\frac{N}{2} \log \theta^2 - \frac{1}{2\theta^2} \sum_i \hat{\varepsilon}_i^2 + \sum_i \log \mathrm{Prob}[n_i]. \tag{A.6}$$

Following the standard estimation procedure, we define our maximum likelihood estimates as the set of parameter values that maximize the function above. However, to make the computation more robust and less demanding, we break the optimization into several steps. In the first step, we solve for $\hat{\theta}$ and substitute it back into the likelihood function. The first-order condition for $\hat{\theta}^2$ is

$$-\frac{N}{2\hat{\theta}^2} + \frac{1}{2\hat{\theta}^4} \sum_i \hat{\varepsilon}_i^2 = 0, \tag{A.7}$$

which results in the following estimate of $\hat{\theta}$:

$$\hat{\theta}^2 = \frac{1}{N} \sum_i \hat{\varepsilon}_i^2. \tag{A.8}$$

Substituting $\hat{\theta}^2$ back into the likelihood function and dropping the constant yields our maximum likelihood function:

$$\log L = -\frac{N}{2} \log\left(\frac{1}{N} \sum_i \left(\log P(i, n_i, t_i) + x t_i - \boldsymbol{\alpha} \boldsymbol{X}_i - \log p_{n_i}\right)^2\right) + \sum_i \log \mathrm{Prob}[n_i]. \quad \text{(A.9)}$$

The convenience of this function form is that the vector parameter $\boldsymbol{\alpha}$ does not affect $\mathrm{Prob}[n_i]$. Hence, the estimate of $\boldsymbol{\alpha}$ minimizes the sum of squared errors in the first term. Hence, it is the standard OLS estimate of regressing $\log P(i, n_i, t_i)$ on $\boldsymbol{X}_i$ and $\log p_{n_i}$.

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