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Abstract

Can economic theory help explain the persistence of a cultural enclave among the Cherokee Indians living in North Carolina during the nineteenth century? To date, Fogelson and Kutsche (1961) and Finger (1984) identify the continuation of a communal, labor-sharing agricultural institution called the *gadugi* as simply an example of Cherokee agency during a period of substantial upheaval. I contribute to the historiography on ancestral labor traditions by adopting Kimball's (1988) framework on the function of farming cooperatives to test whether this arrangement sprung up as a form of insurance against the idiosyncratic risk inherent in southern agriculture. Data collected from the 1850-1880 manuscript census returns on North Carolina Cherokee farms are used to compute the variance of household self-sufficiency, which appears substantial enough to warrant a non-market mechanism to pool risk.

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1 Introduction

This paper tests whether an ancient labor-sharing arrangement among Cherokee Indians persisted into the nineteenth century to ensure individuals against the idiosyncratic risk inherent in agricultural-based societies. The institution in question, called the *gadugi*, was adopted by a group of North Carolina Cherokees during a period of substantial upheavel in the nineteenth century when the federal government pursued an aggressive program to "civilize" Indians (Sheehan, 1973). While no economist has studied this particular labor arrangement, historians like Finger (1984) and Fogelson and Kutsche (1961) have identified the importance of maintaining this pre-historic, communal farming cooperative during the "civilization" process. In particular, Finger (1984: 61) explains the persistence of the *gadugi* and its accompanied low yields as examples of both "the inefficiency of Cherokee agriculture" and "a stubborn peasant resistance to change." By adopting a model first developed by Kimball (1988), I find that communal farming and the subsequent crop sharing was in fact an optimal response to the high variation in self-sufficiency levels during the nineteenth century. Given this interpretation, the low yields on North Carolina farms can thus be considered insurance premiums rather than productive inefficiencies.

Considerable effort has been recently undertaken to better understand the economic history of indigenous people (see Anderson, 1992; Anderson and Hill, 2002; and Barrington, 1988). Whether finding examples of private property (Demsetz, 1967), elastic supply elasticities

(Carlos and Lewis, 2001), or active market participation (Gregg, 2005), these studies often debunk myths regarding American Indian economic behavior. However, within the humanities literature, histories on post-contact Native people still commonly emphasize the role of non-economic factors such as cultural persistence in the face of colonial repression (Gleach, 1997; O'Brien, 1997; Perdue, 1998). While adding agency to Indian-white historical episodes is unquestioningly warranted, the post-revisionist historiography of American Indians can be further augmented by adopting simple economic theories regarding risk behavior and contract choice.[1]

One of the first historical accounts of risk sharing behavior among pre-industrial farming communities was McCloskey's (1976) study on plot scattering in Medieval England. Though challenged by Fenoaltea (1976), McCloskey's claim that farmers decreased their risk of crop failure by farming on spatially differentiated plots provided the impetus to finding alternative, Pareto-optimal non-market insurance schemes in low-income communities. For example, Kimball (1988) suggested that farming cooperatives in Medieval England would have been a viable risk sharing alternative to plot scattering; however, he could not muster any empirical evidence of such informal arrangements.[2] Using the same farming data, Bekar and Reed (2003) later used a simulation to find that holding small parcels was a more efficient form of self-insurance than either cooperation or storage. With respect to the North Carolina Cherokees, if there was enough intra-village variation in self-sufficiency, choosing crop and labor sharing provides some *prima facie* evidence that this particular arrangement was optimal over other feasible

[1]Milgrom and Roberts (1992: 207) maintains that efficient contracts "balance the costs of risk bearing against the incentive gains that result." In this case, treating the *gadugi* as a contract among risk-averse households suggests that the marginal cost of risk bearing (i.e., the potential higher crop output) was lower than the marginal gain from sharing (i.e., the lower probability of failing below subsistence).

[2]Richardson (2005) identified fraternities and customary poor laws as evidence of risk pooling among Medieval English peasants.

alternatives like borrowing and storage.

While there is an abundance of studies on risk avoidance behavior in peasant communities (see, for example, Scott's (1976) seminal work on reciprocity), few have studied the risk behavior of American Indians. This paper fills a hole in this existing literature on American Indian economic history by determining whether data from manuscript census on North Carolina Cherokee agriculture throughout the nineteenth century support an risk avoidance explanation for the continuation of their form of collective agriculture. Unlike the literature on Medieval risk sharing, there was documented evidence of a non-market labor-sharing institution developed and continued among the Cherokees during the nineteenth century. Census data on Cherokee agriculture are detailed enough to estimate inter-household variation in self-sufficiency, which arguably is a better measure of agricultural risk than individual crop yields. If the data support this institution as a form of self-insurance, then contemporary observations regarding the inefficiency of North Carolina agriculture need to be reassessed.

2 A Brief History of the *Gadugi*

The North Carolina Cherokee community evolved through the permission of the federal government when roughly 1,100 Cherokees remained on their North Carolina homesteads nestled in the valleys of the Smoky Mountains after the mass Cherokee removal of 1838 (Finger, 1984). The majority of these Cherokees lived in Qualla Town, located in one of the western-most counties of North Carolina (Mooney, 1995; Finger, 1984; Hudson, 1976). Their settlement was initially established in 1819 when 51 Cherokee families decided to remain on ceded land, thereby removing themselves from the Cherokee Nation (Finger, 1995). Interestingly, despite being located outside the boundary of the Nation, these people were considered culturally conservative. This description is held in part because they maintained onto economic institutions which were discarded in the larger Cherokee settlement just west of their North Carolina locale.

The most unique feature of this community was their communal form of farm production called the *gadugi*. Fogelson and Kutsche (1961) describe the gadugi as "a group of men who join together to form a company, with rules and officers, for continued economic and social reciprocity." Women sometimes joined the gadugi and served as food preparers for the team's evening meal. The precise manner which assigned individuals to the gadugi is unknown; however, matrilineal kinship must have played an important role. According to Gilbert, Jr. (1943), the gadugi contained roughly 12 members which included an elected chief, sheriff, secretary, and warner, whose purpose was to "command the operations of the company, tell them how long to work, and regulate the labor in general." These companies were brought together either at an individual's request or upon the general agreement of its members. They worked full days in succession on each member's farm. The functions of the gadugi included all typical agricultural tasks (e.g., hoeing and topping corn, and clearing land for cultivation) and other jobs such as constructing public buildings. Although the crops were harvested communally and the titles were not individually held, each Cherokee household owned the bounty from their family plot.[3] Thus, Cherokees held usufructary rights to all land improvements such as erected structures and cultivated crops and to all personal property such as livestock and farm implements.

Enrollment into the *gadugi* was not compulsory. Gilbert, Jr. (1932) determined that 25%

[3]The small number of Cherokees who applied for a 640-acre reservation in 1819 received a title; however, the majority of North Carolina Cherokees, in particular those located in the Qualla Boundary, did not receive a title (Williams, 1987).

of the adult population in Big Cove, a township in the Qualla Boundary, held memberships to the gadugi. Given the decline in its memberships due to the imposition of state taxes, the 1930s membership rate was certainly lower than the nineteenth century rate. Since Gilbert claimed that the gadugi had "mostly disappeared" after the imposition of the tax, the gadugi must have been a prominent aspect of Cherokee society during the antebellum and postbellum periods. For simplicity, this study will assume that each household located in the census manuscript returns were members of the gadugi.

Besides supplying farm services, this organization also provided an important avenue to generate nourishment and aid to its members. Mooney (1995) emphasized that the gadugi held many functions of an aboriginal town settlement such as famine relief. An alternative English translation provides further evidence of the relationship between the gadugi and food consumption: the word *gadu* can be translated as "where all the group meets and eats bread together" (Mooney, 1995; Fogelson and Kutsche, 1961). Historically, individual towns held communal structures to store grain for redistribution. The gadugi replaced public granaries with work- and crop-sharing agreements based on an individual's productivity. For example, in a rare account in 1859 of the terms of a work-sharing agreement, for cutting wheat, each member was later due exactly the same amount of bushels that member harvested (Kilpatrick and Kilpatrick, 1966). Thus, a needy Cherokee benefited from the help of the gadugi through the harvesting of his and her crops and the gadugi member benefited through the promise of future foodstuffs. Along with the guarantee of future bushels, the workers were required to receive an evening meal "in proper fashion" from the recipient of the work (Fogelson and Kutsche, 1961).

Given this background information, the goal of the next section is to model the decision of Cherokee farmers to trade off the risks from individualized farming and the return of collectively working in the *gadugi*. As mentioned earlier, the government attempted to "civilize" Indians mainly through programs designed to encourage Euro-American, market-oriented agriculture. While the unwillingness to simply adopt this program is considered an example of Indian agency during the acculturation process, this farming collective may be an optimal response to the relative costs of riskier, individualized farming. The general model of risk pooling incorporates information on three factors: risk preferences, variation in inter-household output, and shirking levels. All but the shirking parameter can be estimated from available data. Fortunately, shirking within the *gadugi* appears to have been trivial. Fogelson and Kutsche (1961) noticed that work was finished early, older men were given smaller jobs, and children were given complementary tasks like carrying water to the workers. Moral hazard problems are also generally modest when monitoring and enforcement become high-valued activities (Offer, 1997). By institutionalizing specific positions within the *gadugi*, the Cherokees The Cherokees most likely systematically mitigated moral hazard incentives.

3 The Model

This basic model of farming cooperatives was initially studied by Kimball (1988) and later augmented by Coate and Ravallion (1993). In general, if formal lending markets do not exist, it is feasible that a system of lending among families can prop up. These informal arrangements, labeled farming collectives, are modeled as a repeated game among risk averse households. This general framework suits the Cherokee community since current generosity appears to have been given with the expectation of future reciprocity. Cooperation among the Cherokees included, among other things, teamwork in harvesting and planting, communal meals at the end of a workday, and community-wide council meetings. Thus, modeling the *gadugi* as a cooperative risk-pooling mechanism seems sensible.

In Kimball's (1988) model, identically, risk-averse households engage in a repeated game where pre-sharing output on one farm is assumed to be independent of another. In each period, each farmer decides how much output to share where only symmetric sharing rules are considered. Thus, if farmer A helps farmer B during B's poor crop season, then the sharing is returned if the situation reversed. This reciprocity occurs either under infinitely-repeated interactions or under uncertainty of the termination date (Basu, 1987). Since Cherokees lived in close proximity to each other for the majority of their lives, assuming an infinitely-repeated game is appropriate.

The community's decision problem can be expressed as follows:

$$\max_{c} \sum_{t=0}^{\infty} \sum_{i=1}^{n} E \frac{U(c_t^i)}{(1+\delta)^t} \tag{1}$$

subject to two constraints

$$\sum_{i=1}^{n} c_t^i \leq \sum_{i=1}^{n} y_t^i \ \forall t \tag{2}$$

$$P_t^i \geq u(y_t^i) - u(c_t^i) \ \forall i \tag{3}$$

where E is the expectation operator, $U(c_t^i)$ is the household's i's utility at period t, δ is the utility discount rate, c_t^i is consumption of household i at time t, y_t^i is household i's output (or self-sufficiency) at time t, and P_t^i is the value of the *gadugi* at time t for the ith household.

The solution of this problem occurs when P_t^i, which is the present value of the difference between the per year utility inside and outside the cooperative, is greater than or equal to the punishment from cheating. Expulsion from the collective leads to individualized farming for the remainder of the game. If this inequality holds, then pooling is sustained as a self-enforcing insurance mechanism. In order to derive a closed-form solution, households are assumed to have identical, additively time-separable, constant relative-risk averse Von Neumann-Morgenstern utility functions, and per-period self-sufficiency levels are assumed to be distributed by the form $y^{m-1}e^{-y/\beta}/\beta^m\Gamma(m)$, where the mean is βm and the variance is $(\frac{\beta}{m})^2$. Therefore, the coefficient of variation, measured as $\frac{\sigma_y}{\mu_y}$, is equal to $m^{-1/2}$ (Kimball, 1988).[4]

As shown in Kimball (1988: 226-227), the value of the cooperative in a two-household game will be greater than the benefit of cheating, which is the future value of the cooperative, when

$$\frac{\int_0^{1/2} y^{(m-\rho)-1}(1-y)^{(m+\rho)-1}dy}{\int_0^1 y^{m-1}(1-y)^{m-1}} - \frac{1}{2} \geq \delta \tag{4}$$

where the entire left hand side is equal to the maximum utility discount rate which sustains a two-person farming collective. This result is calculated by determining when the difference between the benefit of being helped, which is the first term on the left-hand side, and the cost of sharing, which is the second term of the left-hand side, for any transfer is greater than the penalty of defecton.[5]

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[4]The utility function takes the form $\sum_{t=0}^{\infty} E\frac{1}{(1+\delta)^t}[\frac{c_t^{1-\rho}-1}{1-\rho}]$ where ρ is the Pratt-Arrow measure of relative risk aversion.

[5]I will briefy describe the derivation of this inequality. The value of the cooperative, say $W(\epsilon)$, needs to be greater than or equal to the punishment, ϵ. The discounted cost of pooling is equal to $\frac{\epsilon}{2\delta}$ since the richer household, say household B, will provide up to half its output. Dividing both sides of $\frac{\delta}{\epsilon}$ yields $-\frac{1}{2}$ on the left-hand side and δ on the right-hand side. The benefit from being helped to the poorer household (say, household A) then becomes the integral over $0 < y_A < y_B$ of the product of density functions of y_A and y_B, times the size of the transfer $\frac{\epsilon}{\delta}$, times the marginal utilities of y_A and y_B. With some further manipulation,

This utility discount rates that sustain cooperation can be computed by (1.) estimating the coefficient of variation per census year and the corresponding m values, and (2.) determining an appropriate range of values for ρ, the Arrow-Pratt relative risk aversion parameter, from existing studies on low-income communities. The availability of pre-sharing household agricultural data on the Cherokee community allows for the estimation of individual self-sufficiency.

4 Data and Empirical Procedure

In order to find pre-sharing variations in self-sufficiency throughout the nineteenth century, data are drawn from the 1850-1880 manuscript agricultural and population schedules from Haywood and Jackson Counties, North Carolina. Through error on the part of the U.S. Census Bureau, the Cherokees, who were not U.S. citizens, were enumerated alongside of their white neighbors. These data comprise the complete set of household-level data on nineteenth century Cherokee farming since pre-1850 agricultural schedules did not contain household-level data, and the 1890 manuscript censuses have not survived. Gallman (1970), Hutchinson and Williamson (1971), Ford (1985), and Weiman (1987), among others, have used census data to compute self-sufficiency rates in foodstuffs. The benefits of using census data include adopting household-level data on a variety of crops (over 30 in each census) and a variety of information on livestock counts. The lone shortcoming of nineteenth century agricultural data for this study is the missing information on "wild" foods, which may have helped offset individual food deficits (Witthofl, 1977). While the data on these supplements are missing, the degree to which the "wild" food consumption varied across households is most germane in this study. If the reliance on game and other foods was uniform across households, then

the numerator and denominator on the left hand equals the benefit from being helped.

the missing data will not influence these results.

The main variable of interest is the self-sufficiency in foodstuffs across households over this period. This variable is estimated by determining the residual household foodstuffs after deducting feed, seed, and human diet requirements. Seed requirements are the amount of a particular crop which is set aside for the following year's crop and feed requirements are the amount of food annually fed to each type of livestock. The seed requirements, represented as a percentage of total output, are as follows: corn, 5%; wheat, 12%; oats, 7%; rye, 11%; peas and beans, 9%; potatoes, 10%, barley 9%, buckwheat, 8% (Weiman, 1987; Atack and Bateman, 1987) The feed requirements for horses and oxen are 35 corn-equivalent bushels; mules, 30 bushels; cows, 5 bushels; and sheep, 0.25 bushels (Weiman, 1987; Ransom and Sutch, 1977). The critical assumption contained in these feed requirements is that cattle and particularly hogs were only penned and fattened with corn just prior to slaughter. These requirements are deducted from the total amount of food crops cultivated on a farm to determine the amount of food available for the family. Household diet requirements are assumed to equal 20 corn-equivalent bushels per household member, which is typically considered a lower bound for southern self-sufficiency (Ibid.). The remaining food, if available, is typically considered a marketable surplus.

5 Results

Household self-sufficiency estimates, represented in corn-equivalent bushels, and the percentage of households above subsistence in basic foodstuffs are located in Table 1. These estimates collaborate with anecdotal evidence on Cherokee self-sufficiency. For example, Finger (1995) mentioned that farm output peaked prior to the Civil War while the War's destruction depressed economic growth until the turn of the 20th century. Similarly, these self-sufficiency estimates imply that surplus production peaked in 1860 with a mean surplus of 107 corn-equivalents and subsequently fell until reaching its nadir in 1880 when the average Cherokee household held a food deficit of 41 bushels of corn.

Even though the Cherokees farmed on similar, small-scaled plots and grew similar crops, the variation in self-sufficiency suggests that land fertility may have varied substantially within this community. For instance, Finger (1984: 61) described the nineteenth-century lands in the Qualla Boundary as "fertile, broken, well watered. . . well adapted to agriculture" yet these fertile lands were limited only to the creek and river valleys. These self-sufficiency estimates also suggest that land fertility has substantial. For example, except for the 1860 census year, the standard deviation of self-sufficiency was greater than its sample mean.

These self-sufficiency estimates appear sensitive to slight modifications in the estimation procedure. For example, some families likely offset these food deficits by adjusting their feed requirements. By assuming that hogs and cattle were fed heavily by grazing and fattened with corn fodder or other crops, the standard deviations of these adjusted self-sufficiency estimates are still larger than the sample averages for the census years 1850, 1870, and 1880. Furthermore, these adjusted food surpluses can be decomposed into grain surpluses and pork surpluses, which are determined by dividing the value of animals slaughtered by the average price per pound of undressed pork, multiplying by the dressed carcass to live weight ratio, and subtracting the household meat requirements.[6] Assuming that all meat deficits were completely supplemented through hunting, mean self-sufficiency estimates become positive

[6]The average price per pound of undressed pork was 2.5 cents and the dressed carcass to live weight ratio was 0.76. This slaughter ratio is used in a number of studies (see, for example, Atack and Bateman (1987); Hutchinson and Williamson (1971); Gallman (1970)).

for each census year, yet the standard deviation is roughly equivalent to the sample mean. In sum, the high degree of variation in household self-sufficiency relative to its sample mean is robust to these modifications.

These self-sufficiency estimates are used to determine which utility discount rates are consistent with Eq. (4), and those minimum utility discount rates that would have sustained the *gadugi* as an equilibrium are located in Table 2. The range of values for m is determined by the self-sufficiency estimates. For example, the coefficient of variation in household self-sufficiency for each census year were as follows: 5.57 in 1850; 0.73 in 1860; 3.58 in 1870; and 2.04 in 1880. The mean coefficient of variation across these years is 2.98, which suggests the standard deviation in self-sufficiency was almost 300% larger than the sample mean. A coefficient of variation of 5.57 and 2.58 corresponds to a value of 0.01 for m. The lowest coefficient of variation, which occurred in 1860, corresponds to a value of 1.0 for m. To be safe, the values of m in Table 2 range from .01 to as high as 25. Obviously, the values of m that are most germane to the Cherokee data are between 0 and 1.

The ranges of the values for the relative risk aversion coefficient, ρ, are taken from a variety of papers on low-income communities. For example, Kurosaki and Fafchamps (2002) estimated the ρ for farmers in the Pakistan Punjab equal to 3.6, while Fafchamps and Pender (1997) earlier found Indian risk coefficients lying between 1.8 and 3.1. These Indian risk aversion parameters are similar to ones found in Binswanger's (1980) experiment on risk attitudes of rural Indian farmers. Shively (1999) used a range from 3 to 5 for low-income farmers in the Philippines, and Kimball (1988) used a range from 1/2 to 6 for Medieval English farmers. Given these past studies, a range of values from 1 to 5 are adopted, with the aversion to risk increases as ρ increases.

Given these ranges of m and ρ, almost every utility discount rates is high enough to warrant a collective. For example, since the range of m that most corresponds with the census data lies between 0 and 1, any utility discount rate will warrant cooperation even if the Cherokees were highly impatient. Only when the variation of coefficient in self-sufficiency shrinks to levels between .20 and .25 could the sharing hypothesis possibly be rejected. However, as the estimates suggest, this limited degree of variation in self-sufficiency does not remotely mirror the Cherokee society during the nineteenth century. In sum, cooperation could only be prevented if the Cherokees were highly impatient and actual variation in self-sufficiency was much less than variation estimated with census data. For example, only one utility discount rate in Table 2 is less than 15% per year, suggesting that if Cherokee utility discount rates were above 15%, cooperation would break down.

Is it possible to ascertain how impatient Cherokee farmers were? While the utility discount rate does not have to equal the interest rate when markets are imperfect, summarizing data on regional and national interest rates can provide a rough idea of the level of impatience during this period in U.S. history. While North Carolina financial data are scarce over this period, antebellum interest rates in South Carolina ranged between 5% and 9% from 1850-1860 (Bodenhorn and Rockoff, 1992). Bodenhorn and Rockoff (1992) also estimated the postbellum interest rate in the south from 1870-1891 at roughly 9.90%. At the national level, the cost of borrowing, in particular the interest on commercial paper, averaged 7.27% from 1850-1860 (James and Sylla, 2006). These interest rates, which ranged from 5% to just under 10% over this period, suggest that if the Cherokees were even slightly more impatient than their white neighbors, then each minimum utility discount rate listed in Table 2 would still be greater than any rate that would have prevented cooperation. In sum, the risk-pooling explanation for maintaining the *gadugi* cannot be rejected given the existing agricultural and financial data during this period in Cherokee history.

6 Concluding Remarks

As characteristic of many low-income communities, individual households "choose to create an institution that normally insures the weakest against ruin by making certain demands on better-off villagers" (Scott, 1976: 41). The demand for such an institution appears high on Cherokee farms given their high variation in obtaining a minimum consumption requirement. By establishing the *gadugi*, the Cherokees were responding to a greater risk of falling below subsistence rather than simply embracing a cultural relic in the face of cultural upheaval. In fact, the *gadugi* after 1890 began to make loans to its members from the profits generated from working on neighboring white farms. Thus, the evolution of the farming collective is further evidence that the *gadugi* was a form of insurance against the agricultural risks facing these farmers.

Given this explanation, if Cherokees were willing to lower crop yields to ensure against crop failure, then these lower yields on Cherokee farms should be not taken as evidence of productive inefficiency. For example, derisive comments about the North Carolina Cherokee society began during the early inception of the "civilization" program when government officials claimed they were "at least 20 years behind" other Cherokees in the acculturation progress (McLoughlin and Conser, Jr., 1977). During the enumeration of the 1835 Cherokee census, Nathaniel Smith (qtd. in Cherokee Census, 1835), the census taker for North Carolina, reemphasized the lack of in-state Cherokee progress: "I found in. . . Haywood counties the balance of those families. . . who have left their country and settled among the whites. . . [They] do not appear to be progressing in the art of civilization as much as those in the hart [sic] of the Nation." As shown earlier, lower yields may have simply been a cost of sharing, whereas lowering the variance of these yields through sharing was the benefit. Therefore, the degree to which Cherokee farmers were willing to trade off lower yields for lower risk is critical when analyzing the efficiency of Cherokee agriculture.

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Table 1: Farm Self-Sufficiency Rates in Cherokee North Carolina, 1850-1880

(Standard Deviation in Parenthesis)

		Percent of Households with Surpluses				
Year	Mean Surplus (bu.)	0-50 bu.	50-100 bu.	100-200 bu.	200+ bu.	% with Deficits
1850	12.14	33.3	17.5	9.2	0.8	39.2
	(67.62)					
1860	107.33	12.6	20.7	50.6	8.0	8.0
	(78.88)					
1870	38.07	21.7	11.9	16.8	5.6	44.1
	(136.64)					
1880	-41.38	17.2	4.7	4.7	0.0	73.4
	(84.77)					

Notes: The sufficiency levels are determined by subtracting the total yield, measured in corn equivalents, minus the standardized feed, seed, and diet requirements. The N in each year, starting with 1850, are as follows: 120; 87; 143; 64.
Source: 1850-1880 Manuscript Census Returns, Agriculture and Population Schedules, Haywood and Jackson Counties, North Carolina.

Table 2: Minimum Discount Rates that Sustain a Collective

(Percent per Year)

m	Coef. of Variation (CV)	ρ = 1	2	3	4	5
0.1	3.16	∞	∞	∞	∞	∞
0.2	2.24	∞	∞	∞	∞	∞
1	1.00	∞	∞	∞	∞	∞
2	0.70	125.00	∞	∞	∞	∞
5	0.45	43.26	177.54	807.91	6936.33	∞
10	0.32	25.13	75.33	190.03	499.42	1523.63
15	0.26	19.05	51.65	112.07	234.90	512.98
20	0.22	15.83	40.73	82.16	155.66	295.77
25	0.20	13.78	34.30	66.22	118.33	208.11

Notes: The numerator and denominator were derived using Mathematica.