Appendices

A1 Symbiosis, habitat and change

The basic dynamics of symbiosis between populations in biology argue that the growth of a population depends on its own reproduction, symbiosis with the other population and habitat constraints (Murray 1993, pp. 83-84).

$$\frac{dN_1}{dt} = r_1 N_1 + \alpha_1 N_1 N_2 - l_1 N_1^2 \tag{A1.1}$$

$$\frac{dN_2}{dt} = r_2 N_2 + \alpha_2 N_1 N_2 - l_2 N_2^2 \tag{A1.2}$$

$r_x N_x$	Growth rate of population one and two (reproduction)
$\alpha_x N_1 N_2$	Symbiosis between populations one and two
$l_x N_x^2$	Growth constraint due to habitat conditions

With the adjustments described in Sect. 2.1, the development of the cluster's firm population (Eq. A1.3) is conditional on its own growth (reproduction) and the symbiotic effects between the population and itself (f), local conditions (c) and a supporting industry (s) all representing the effects of agglomeration economies.

$$\frac{df(t)}{dt} = a_{ff} \cdot f(t)^{\alpha_{ff}} + a_{ef} \cdot (\hat{f}(e) - f(t)) + a_{cf} \cdot c(t)^{\alpha_{cf}} + a_{sf} \cdot s(t)^{\alpha_{sf}} - \phi_f \cdot f(t)^{\rho f} \tag{A1.3}$$

$$\frac{dc(t)}{dt} = a_{fc} \cdot f(t)^{\alpha_{fc}} - \phi_c \cdot c(t)^{\rho_c} \tag{A1.4}$$

$$\frac{ds(t)}{dt} = a_{fs} \cdot f(t)^{\alpha_{fs}} - \phi_s \cdot s(t)^{\rho_s} \tag{A1.5}$$

The term $a_{ff} \cdot f(t)^{\alpha_{ff}}$ and its' equivalents in Eqs. A1.3 to A1.5 describe the symbiotic relationship between the different variables and the growth of the local firm population, while the habitat constraints are expressed as terms of the form $\phi_f \cdot f(t)^{\rho_f}$. In addition, $a_{ef} \cdot (\hat{f}(e) - f(t))$ accounts for the effect of external conditions on the local firm population by reflecting that its state is driven towards the area's carrying capacity. Parameters α_{ff} α_{cf} α_{sf} α_{fc} α_{fs} denounce the minimum levels of c, f and s for the emergence of symbiotic processes (agglomeration economies) whereas ρ_f ρ_c ρ_s indicate the maximum levels of the respective variables before growth constraints within the region begin to set in. If the symbiotic interactions are to be relevant, they need to become effective before growth constraints interfere, i.e. it is assumed that $\alpha_{ff}, \alpha_{cf}, \alpha_{sf}, \alpha_{fc}, \alpha_{fs} < \rho_f, \rho_c, \rho_s$.

Mathematically, the resulting system of equations yields two different states depending on exogenous conditions (e) and parameter values. The first state is characterised by one stable equilibrium value for the number of local firms. If there are n regions hosting clusters of the industry described in this fashion, they all converge towards this equilibrium, implying a uniform industry distribution. The second state knows two equilibria with low or high numbers of firms in each area and thus allows for the emergence of an agglomeration if some regions converge to the first and some to the second equilibrium. Mathematically, the second state only arises if one of the parameters for the symbiotic relationships has a value larger than one, i.e. the respective relationship is relatively weak if there are few local firms but becomes over proportionally strong as the size of the cluster increases. One example of such a relationship is policy support that will likely be stronger for large than for small local industries. It is in the context of this second state, that the development of clusters can be analysed.

A2 Clusters as core-periphery structures

A key aspect underlying the models of the New Economic Geography regards the consumer's utility function $U = C_M^{\mu} \cdot C_A^{1-\mu}$ where 1-μ is the share of manufacturing in consumer expenditure. In it, the utility from consumption of manufacturing products relates to the number of varieties c_i and the quantities of each variety consumed:

$$C_M = \left[\sum_{i=1}^{N} c_i^{(\sigma-1)/\sigma} \right]^{\sigma/(\sigma-1)} \qquad \text{(A2.1)}$$

$\sigma > 1$ Elasticity of substitution between varieties

Iceberg transport costs are included by expressing that of each unit shipped between regions only a fraction $\tau < 1$ arrives. The larger τ, the lower transport costs. Producers maximise profits by setting the price for the local and non-local products in region one or two as:

$$p_{1/2} = \left(\frac{\sigma}{\sigma - 1} \right) \cdot \beta w_{1/2} \qquad \text{(A2.2)}$$

$$p_{1(2)/2(1)} = \frac{p_{1/2}}{\tau} \qquad \text{(A2.3)}$$

$w_{1/2}$ Wages in region one and two

Due to free entry in the sector, profits are driven to zero. This means that output per firm in each region is identical, regardless of wage rates, relative demand and the likes. Therefore, industry output in each region hinges only on the latter's endowment with labour and the distribution of the industry between both regions is conditional on the distribution of manufacturing labour $L=L_1+L_2$ over space. A given distribution of labour (without factor mobility) then yields the short-term equilibrium values for wages, income and so on. Workers are then argued to move to the region offering them higher real wages, which leads to an agglomeration or dispersion of the industry.

To investigate the role of different model parameters, Krugman assumes that all workers (and firms) are concentrated in region one. The question is then, when it pays for one defecting firm to start producing in the other region, thus enabling a dispersion of the industry over space. Transportation costs work to the firm's disadvantage when selling to region one but constitute an advantage for sales in region two. In addition, wages for manufacturing workers are higher in region two as workers have to be attracted there by higher salaries. The breaking point of where relocation becomes profitable is defined as the quotient of the value of sales in region two and that of sales in region one.

$$\frac{V_2}{V_1} = v = \frac{1}{2}\tau^{\mu\sigma}\left[(1+\mu)\tau^{\sigma-1} + (1-\mu)\tau^{-(\sigma-1)}\right] \qquad \text{(A2.4)}$$

Put differently, if v>1, relocation becomes profitable and the fully concentrated equilibrium is unstable. The value of v is then related to different parameter values for manufacturing expenditure, transport costs and scale economies in order to determine the "breaking points" of the fully concentrated equilibrium.

$$\frac{\partial v}{\partial \mu} = v\sigma(\ln\tau) + \frac{1}{2}\tau^{\sigma\mu}\left[\tau^{\sigma-1} - \tau^{-(\sigma-1)}\right] < 0 \qquad \text{(A2.5)}$$

The larger the share of income spent on manufacturing products, the stronger the attractiveness of the large market in region one and workers demand a larger wage premium to move to the other area. In consequence, sales of a defective firm are lower. "*A larger share of manufactures in consumer expenditures also favours agglomeration, because it augments the impact of immigration on the size of the local market for manufactures. In addition, it increases the weight of the prices of manufactures in real wages, thus enabling firms located in regions with more industry to attract workers without having to pay high nominal wages*" (Ottaviano and Puga 1997, p. 10).

$$\frac{\partial v}{\partial \tau}=\frac{\mu\sigma v}{\tau}+\frac{\tau^{\mu\sigma}(\sigma-1)\left[(1+\mu)\tau^{\sigma-1}-(1-\mu)\tau^{-(\sigma-1)}\right]}{2\tau} \tag{A2.6}$$

For high transport costs (low levels of τ), defection is profitable. As transport costs decrease, the value of defection becomes smaller than 1 for intermediate transport costs. Further decreases in transport cost then see the value of defection approach 1 from below as location becomes increasingly irrelevant.

$$\frac{\partial v}{\partial \sigma}=\ln(\tau)\left\{\mu v+\frac{1}{2}\tau^{\mu\sigma}\left[(1+\mu)\tau^{\sigma-1}-(1-\mu)\tau^{-(1-\sigma)}\right]\right\}=\ln(\tau)\left(\frac{\tau}{\sigma}\right)\left(\frac{\partial v}{\partial \tau}\right) \tag{A2.7}$$

The higher scale economies (the lower elasticity of substitution; Krugman 1991b, p. 490), the lower the profits from defection since it pays very strongly to concentrate production in one site and the attractiveness of region one bears out very strongly in this context (sales of local products are higher due to their lower cost implying that firms near a large market make greater use of these scale economies). In addition, "*[...] a lower elasticity of substitution across varieties in consumers' preferences increases the importance of having a large variety of products available locally. By reinforcing the monopoly power of firms over their own varieties, this weakens local competition and favours agglomeration*" (Ottaviano and Puga 1997, p. 10).

A3 Location choice, path dependence and clusters

The location benefits of an area (B_{fq}) are argued to depend on an area's intrinsic features and firm's preferences (G_{fq}) on the one, as well as agglomeration benefits (A_{fq}) on the other hand.[126]

$$B_{\mathrm{fq}}=G_{fq}+A_{fq}(n_q) \tag{A3.1}$$

Depending on the benefits obtained (B_{fq}), each firm has a certain preference for each location. At a given point in time, it will locate in region q if its benefits in q (geographic and agglomeration returns) exceed those of all other areas (i), i.e. $B_{fq}>B_{fi}$. The distribution of firms' locational preferences (influencing G_{fq}) is random in order to introduce 'historical accident'. Therefore, the probability that a firm preferring location q over all others entering in the next time period yields:

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[126] If $A_{fq}(n_q)$ is increasing in n_q, agglomeration economies exists, if it decreases, there are diseconomies from agglomeration (also termed 'congestion cost').The notation employed here differs from that used by Arthur himself. It has been adapted to that of the model introduced by Maggioni 2002 to ensure better comparability.

$$p_{\mathrm{q}} = \Pr ob\left\{\left\lfloor G_{fq} + A_{fq}(n_q)\right\rfloor > \left\lfloor G_{fi} + A_{fi}(n_i)\right\rfloor all \rightarrow i \neq q\right\} \tag{A3.2}$$

This probability also depends on the distribution of firms having entered the regions before as they determine each area's agglomeration benefits ($A_{fx}(n_x)$).

The number of firms in each location ($n_q=n_q/n$) or the share of each location of the (total number of firms in the) industry (x_q) then mirrors its spatial distribution.

$$n_q = (n_1(n),\ldots,\ n_Q(n)) \text{ and } x_q = (x_1(n),\ldots,\ x_Q(n)) \tag{A3.3}$$

Since the industry's spatial distribution evolves with one firm being added at a time, the number of firms in any location at a point in time equals the number of firms already located there plus the chance of a firm with a preference for this area being the next to chose its site.

$$q_{n+1} = n_q + b(n;x_q) \tag{A3.4}$$

Where b in Eq. A3.4 is a unit vector assigning the next entering firm to one of the possible locations. The probability of the next firm choosing location q (i.e. b being 1 in location q) equals pq(n;xq) and depends on q's share of the industry (xq) as well as the total number of firms in the sector (n).

Accordingly, the share of each region in the total number of firms evolves as:

$$\begin{gathered} x_{n+1} = x_q + \frac{1}{n+1}\left[b(n;x_q) - x_q\right], \text{ or} \\ x_{n+1} = x_q + \frac{1}{n+1}\left[p(n;x_q) - x_q\right] + \frac{1}{n+1}\mu(n;x_q)\text{, with} \\ \mu(n;x_q) = b(n;x_q) - p(n;x_q) \end{gathered} \tag{A.3.5}$$

The locational shares of all areas are therefore dependent on the attractiveness of the region, which drives the expected motion of the firms in the industry. At the same time, such a stabilisation is perturbed by the randomness of firm entry ($\mu(n;x_q)$). As both motion and perturbation effects become smaller with growing firm numbers in the industry, locational shares can be expected to settle at a given level if the industry becomes large. Uhus nder certain conditions,[127] there are different combinations of industry allocations over all areas, which are stable, fixed points. These fixed points are shaped (regarding the industry share of each area) by the locational probability function (p); i.e. they depend on the differentials in

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[127] More detail on the mathematical foundations is provided in Arthur 1990, p. 240. It is argued that that their notion of equilibrium shares in a path dependent process is a generalisation of the strong law of large numbers where shares are stabilised if increments are added independently of the present state of the process.

firms' locational tastes as well as the impact of agglomeration effects on an area's profitability.

Gross locational benefits B_{fq} for firm f locating in area q are again a composite of geographic and agglomeration benefits.

$$B_{fq} = G_{fq}(k_q, l_q, s_q, u_q) + A_{fq}(n_q) \tag{A3.6}$$

- G_{fq} = geographical benefits: Depend on intrinsic features of the area, e.g. the quality of local production factors (capital k_q and labour l_q), the efficiency of the local network of specialised (service) suppliers s_q, urban and industrial infrastructure u_q.
- $A_{fq}(n_q)$ = agglomeration benefits: A concave, non-monotonic function of n_q implying that gross benefits initially increase with the number of firms due to agglomeration economies but decrease once an optimum cluster size in terms of firm numbers has been reached.

Locational cost c_{fq} are can correspondingly be expressed as the sum of geographic and agglomeration cost.

$$c_{fq} = g_{fq}(r_q, w_q, d_q, t_q) + a_{fq}(n_q) \tag{A3.7}$$

- g_{fq} = geographical cost: Reflect the cost structure of the area, i.e. local interest rates r_q, wages w_q, average service prices d_q, land rents and taxation t_q.
- $a_{fq}(n_q)$ = agglomeration cost/ congestion cost: A convex, non monotonic function of n_q, i.e. local costs initially decrease with firm numbers due to agglomeration economies but start to increase after an optimum level as the greater competition for a limited pool of inputs and infrastructure increases their price.

As a consequence, net locational benefits Net_{fq} can be expressed as the differences between total benefits and costs. As long as Net_{fq} is positive, firms will locate in the area, increasing the size of the agglomeration.

$$Net_{fq} = B_{fq} - c_{fq} = H_{fq}(r_q, w_q, d_q, t_q, k_q, l_q, s_q, u_q) + h_{fq}(n_q) = a_q - h_{fq}(n_q) \tag{A3.8}$$[128]

Since Net_{fq} constitutes the difference between a concave and a convex function, it is concave itself, implying that up to a threshold level, each new firm entering the agglomeration increases the average profitability of locating in the region. Beyond the threshold level, new entrants decrease the average net benefits available to both incumbents and new entrants.

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[128] If geographic benefits and costs do not change over time, H_{fq} can be summarised by a constant term α_q.

The development process is modelled stressing the relevance of firms' spatial interactions, i.e. "*the rate of growth of the industrial mass [of the cluster] equals the product of the individual firm's contribution to the regional population's growth [i.e. its contribution to local benefits and costs] and the number of firms already in the region*" (Maggioni 2002, pp. 100f). This is expressed by a logistic equation.

$$\frac{dn_q}{dt} = r_q\, n_q(t) \left(1 - \frac{n_q(t)}{K_q}\right) \qquad \text{(A3.9)}$$

The firm's contribution to regional growth (net locational benefits) decreases as a linear function of regional population size. This leads to the aforementioned S-shaped curve: as the area is small ($n_q(t)$ is near zero), the growth constraint of a firm's entry $\left(\frac{n_q(t)}{K_q}\right)$ is close to one, implying that the area develops as if only agglomeration economies existed (at a rate of $r_q n_q(t)$). As the number of firms approaches the maximum level K_q, the constraint on growth becomes more apparent, i.e. $\left(\frac{n_q(t)}{K_q}\right)$ approaches zero.

A4 Model parameter values and fitness landscapes

EvenK=4 K= 2.33 C= 0.67 *

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w1	-	x	x	x																				
w2	x	-	x	x																				
w3	x	x	-	x																				
w4	x	x	x	-																				
w5					-	x	***x***	***x***																
w6					x	-	***x***	***x***																
w7					***x***	***x***	-	x																
w8					***x***	***x***	x	-																
w9									-	x	x	x												
w10									x	-	x	x												
w11									x	x	-	x												
w12									x	x	x	-												
w13													-	x	x	x								
w14													x	-	x	x								
w15													x	x	-	x								
w16													x	x	x	-								
w17																	-	x	***x***	***x***				
w18																	x	-	***x***	***x***				
w19																	***x***	***x***	-	x				
w20																	***x***	***x***	x	-				
w21																					-	x	x	x
w22																					x	-	x	x
w23																					x	x	-	x
w24																					x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

* K and C values are calculated taking the total number of intra- (denoted by x) and inter-agent (denoted by ***x***) externalities divided by the number of elements (N=24). In the case of EvenK=4, this yields 56 intra-agent externalities (i.e. K=56/24=2.33) and 16 inter-agent externalities (i.e. C=16/25=0.67). The following K and C values are determined accordingly.

EvenK=5 K= 2.50 C= 1.33

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w1	-	x	x	x	x																			
w2	x	-	x	x	x																			
w3	x	x	-	x	x																			
w4	x	x	x	-	x																			
w5	x	x	x	x	-																			
w6						-	***x***	***x***	***x***	***x***														
w7						***x***	-	x	x	x														
w8						***x***	x	-	x	x														
w9						***x***	x	x	-	x														
w10						***x***	x	x	x	-														
w11											-	x	***x***	***x***	***x***									
w12											x	-	***x***	***x***	***x***									
w13											***x***	***x***	-	x	x									
w14											***x***	***x***	x	-	x									
w15											***x***	***x***	x	x	-									
w16																-	x	x	***x***	***x***				
w17																x	-	x	***x***	***x***				
w18																x	x	-	***x***	***x***				
w19																***x***	***x***	***x***	-	x				
w20																***x***	***x***	***x***	x	-				
w21																					-	x	x	x
w22																					x	-	x	x
w23																					x	x	-	x
w24																					x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=7 K= 3.17 C= 2.33

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_{1}	-	x	x	x	x	x	***x***																	
w_{2}	x	-	x	x	x	x	***x***																	
w_{3}	x	x	-	x	x	x	***x***																	
w_{4}	x	x	x	-	x	x	***x***																	
w_{5}	x	x	x	x	-	x	***x***																	
w_{6}	x	x	x	x	x	-	***x***																	
w_{7}	***x***	***x***	***x***	***x***	***x***	***x***	-																	
w_{8}								-	x	x	x	x	***x***	***x***										
w_{9}								x	-	x	x	x	***x***	***x***										
w_{10}								x	x	-	x	x	***x***	***x***										
w_{11}								x	x	x	-	x	***x***	***x***										
w_{12}								x	x	x	x	-	***x***	***x***										
w_{13}								***x***	***x***	***x***	***x***	***x***	-	x										
w_{14}								***x***	***x***	***x***	***x***	***x***	x	-										
w_{15}															-	x	x	x	***x***	***x***	***x***			
w_{16}															x	-	x	x	***x***	***x***	***x***			
w_{17}															x	x	-	x	***x***	***x***	***x***			
w_{18}															x	x	x	-	***x***	***x***	***x***			
w_{19}															***x***	***x***	***x***	***x***	-	x	x			
w_{20}															***x***	***x***	***x***	***x***	x	-	x			
w_{21}															***x***	***x***	***x***	***x***	x	x	-			
w_{22}																						-	x	x
w_{23}																						x	-	x
w_{24}																						x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=8 K= 3.67 C= 3.33

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_{1}	-	x	x	x	x	x	***x***	***x***																
w_{2}	x	-	x	x	x	x	***x***	***x***																
w_{3}	x	x	-	x	x	x	***x***	***x***																
w_{4}	x	x	x	-	x	x	***x***	***x***																
w_{5}	x	x	x	x	-	x	***x***	***x***																
w_{6}	x	x	x	x	x	-	***x***	***x***																
w_{7}	***x***	***x***	***x***	***x***	***x***	***x***	-	x																
w_{8}	***x***	***x***	***x***	***x***	***x***	***x***	x	-																
w_{9}									-	x	x	x	***x***	***x***	***x***	***x***								
w_{10}									x	-	x	x	***x***	***x***	***x***	***x***								
w_{11}									x	x	-	x	***x***	***x***	***x***	***x***								
w_{12}									x	x	x	-	***x***	***x***	***x***	***x***								
w_{13}									***x***	***x***	***x***	***x***	-	x	x	x								
w_{14}									***x***	***x***	***x***	***x***	x	-	x	x								
w_{15}									***x***	***x***	***x***	***x***	x	x	-	x								
w_{16}									***x***	***x***	***x***	***x***	x	x	x	-								
w_{17}																	-	x	***x***	***x***	***x***	***x***	***x***	***x***
w_{18}																	x	-	***x***	***x***	***x***	***x***	***x***	***x***
w_{19}																	***x***	***x***	-	x	x	x	x	x
w_{20}																	***x***	***x***	x	-	x	x	x	x
w_{21}																	***x***	***x***	x	x	-	x	x	x
w_{22}																	***x***	***x***	x	x	x	-	x	x
w_{23}																	***x***	***x***	x	x	x	x	-	x
w_{24}																	***x***	***x***	x	x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=9 K= 4.25 C= 3.00

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_{1}	-	x	x	x	x	x	***x***	***x***	***x***															
w_{2}	x	-	x	x	x	x	***x***	***x***	***x***															
w_{3}	x	x	-	x	x	x	***x***	***x***	***x***															
w_{4}	x	x	x	-	x	x	***x***	***x***	***x***															
w_{5}	x	x	x	x	-	x	***x***	***x***	***x***															
w_{6}	x	x	x	x	x	-	***x***	***x***	***x***															
w_{7}	***x***	***x***	***x***	***x***	***x***	***x***	-	x	x															
w_{8}	***x***	***x***	***x***	***x***	***x***	***x***	x	-	x															
w_{9}	***x***	***x***	***x***	***x***	***x***	***x***	x	x	-															
w_{10}										-	x	x	***x***	***x***	***x***	***x***	***x***	***x***						
w_{11}										x	-	x	***x***	***x***	***x***	***x***	***x***	***x***						
w_{12}										x	x	-	***x***	***x***	***x***	***x***	***x***	***x***						
w_{13}										***x***	***x***	***x***	-	x	x	x	x	x						
w_{14}										***x***	***x***	***x***	x	-	x	x	x	x						
w_{15}										***x***	***x***	***x***	x	x	-	x	x	x						
w_{16}										***x***	***x***	***x***	x	x	x	-	x	x						
w_{17}										***x***	***x***	***x***	x	x	x	x	-	x						
w_{18}										***x***	***x***	***x***	x	x	x	x	x	-						
w_{19}																			-	x	x	x	x	x
w_{20}																			x	-	x	x	x	x
w_{21}																			x	x	-	x	x	x
w_{22}																			x	x	x	-	x	x
w_{23}																			x	x	x	x	-	x
w_{24}																			x	x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=10 K= 3.67 C= 4.33

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_1	-	x	x	x	x	x	*x*	*x*	*x*	*x*														
w_2	x	-	x	x	x	x	*x*	*x*	*x*	*x*														
w_3	x	x	-	x	x	x	*x*	*x*	*x*	*x*														
w_4	x	x	x	-	x	x	*x*	*x*	*x*	*x*														
w_5	x	x	x	x	-	x	*x*	*x*	*x*	*x*														
w_6	x	x	x	x	x	-	*x*	*x*	*x*	*x*														
w_7	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x														
w_8	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x														
w_9	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x														
w_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-														
w_{11}											-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_{12}											x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_{13}											*x*	*x*	-	x	x	x	x	x	*x*	*x*				
w_{14}											*x*	*x*	x	-	x	x	x	x	*x*	*x*				
w_{15}											*x*	*x*	x	x	-	x	x	x	*x*	*x*				
w_{16}											*x*	*x*	x	x	x	-	x	x	*x*	*x*				
w_{17}											*x*	*x*	x	x	x	x	-	x	*x*	*x*				
w_{18}											*x*	*x*	x	x	x	x	x	-	*x*	*x*				
w_{19}											*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x				
w_{20}											*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-				
w_{21}																					-	x	x	x
w_{22}																					x	-	x	x
w_{23}																					x	x	-	x
w_{24}																					x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=11 K= 3.92 C= 5.33

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_1	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*													
w_2	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*													
w_3	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*													
w_4	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*													
w_5	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*													
w_6	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*													
w_7	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x													
w_8	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x													
w_9	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x													
w_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x													
w_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-													
w_{12}												-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
w_{13}												*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*		
w_{14}												*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*		
w_{15}												*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*		
w_{16}												*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*		
w_{17}												*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*		
w_{18}												*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*		
w_{19}												*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x		
w_{20}												*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x		
w_{21}												*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x		
w_{22}												*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-		
w_{23}																							-	x
w_{24}																							x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=12 K= 5.00 C= 6.00

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_1	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	x												
w_2	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	x												
w_3	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	x												
w_4	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	x												
w_5	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	x												
w_6	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	x												
w_7	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x												
w_8	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x												
w_9	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x												
w_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x												
w_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x												
w_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-												
w_{13}													-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*
w_{14}													x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*
w_{15}													x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*
w_{16}													x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*
w_{17}													x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*
w_{18}													x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*
w_{19}													*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x
w_{20}													*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x
w_{21}													*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x
w_{22}													*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x
w_{23}													*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x
w_{24}													*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=13 K= 4.58 C= 6.50

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
W_{1}	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*											
W_{2}	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*											
W_{3}	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*											
W_{4}	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*											
W_{5}	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*											
W_{6}	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*											
W_{7}	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*											
W_{8}	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*											
W_{9}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*											
W_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*											
W_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*											
W_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*											
W_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-											
W_{14}														-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{15}														x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{16}														x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{17}														x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{18}														x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*
W_{19}														*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x
W_{20}														*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x
W_{21}														*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x
W_{22}														*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x
W_{23}														*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x
W_{24}														*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=14 K= 4.33 C= 7.00

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
W_{1}	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*										
W_{2}	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*										
W_{3}	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*										
W_{4}	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*										
W_{5}	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*										
W_{6}	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*										
W_{7}	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*										
W_{8}	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*										
W_{9}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*										
W_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*										
W_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*										
W_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*										
W_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x										
W_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-										
W_{15}															-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{16}															x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{17}															x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{18}															x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*
W_{19}															*x*	*x*	*x*	*x*	-	x	x	x	x	x
W_{20}															*x*	*x*	*x*	*x*	x	-	x	x	x	x
W_{21}															*x*	*x*	*x*	*x*	x	x	-	x	x	x
W_{22}															*x*	*x*	*x*	*x*	x	x	x	-	x	x
W_{23}															*x*	*x*	*x*	*x*	x	x	x	x	-	x
W_{24}															*x*	*x*	*x*	*x*	x	x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=15 K= 4.25 C= 7.50

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
W_{1}	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*									
W_{2}	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*									
W_{3}	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*									
W_{4}	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*									
W_{5}	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*									
W_{6}	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*									
W_{7}	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*									
W_{8}	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*									
W_{9}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*									
W_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*									
W_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*									
W_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*									
W_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x									
W_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x									
W_{15}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-									
W_{16}																-	x	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{17}																x	-	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{18}																x	x	-	*x*	*x*	*x*	*x*	*x*	*x*
W_{19}																*x*	*x*	*x*	-	x	x	x	x	x
W_{20}																*x*	*x*	*x*	x	-	x	x	x	x
W_{21}																*x*	*x*	*x*	x	x	-	x	x	x
W_{22}																*x*	*x*	*x*	x	x	x	-	x	x
W_{23}																*x*	*x*	*x*	x	x	x	x	-	x
W_{24}																*x*	*x*	*x*	x	x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=16 K= 4.33 C= 8.00

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_{1}	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*								
w_{2}	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*								
w_{3}	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*								
w_{4}	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*								
w_{5}	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*								
w_{6}	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*								
w_{7}	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*								
w_{8}	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*								
w_{9}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*								
w_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*								
w_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*								
w_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*								
w_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x								
w_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x								
w_{15}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x								
w_{16}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-								
w_{17}																	-	x	*x*	*x*	*x*	*x*	*x*	*x*
w_{18}																	x	-	*x*	*x*	*x*	*x*	*x*	*x*
w_{19}																	*x*	*x*	-	x	x	x	x	x
w_{20}																	*x*	*x*	x	-	x	x	x	x
w_{21}																	*x*	*x*	x	x	-	x	x	x
w_{22}																	*x*	*x*	x	x	x	-	x	x
w_{23}																	*x*	*x*	x	x	x	x	-	x
w_{24}																	*x*	*x*	x	x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=17 K= 4.58 C= 8.50

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_{1}	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*							
w_{2}	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*							
w_{3}	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*							
w_{4}	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*							
w_{5}	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*							
w_{6}	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*							
w_{7}	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*							
w_{8}	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*							
w_{9}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*							
w_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*							
w_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*							
w_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*							
w_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x							
w_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x							
w_{15}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x							
w_{16}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x							
w_{17}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-							
w_{18}																		-	*x*	*x*	*x*	*x*	*x*	*x*
w_{19}																		*x*	-	x	x	x	x	x
w_{20}																		*x*	x	-	x	x	x	x
w_{21}																		*x*	x	x	-	x	x	x
w_{22}																		*x*	x	x	x	-	x	x
w_{23}																		*x*	x	x	x	x	-	x
w_{24}																		*x*	x	x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=18 K= 5.00 C= 9.00

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_{1}	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*						
w_{2}	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*						
w_{3}	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*						
w_{4}	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*						
w_{5}	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*						
w_{6}	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*						
w_{7}	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*						
w_{8}	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*						
w_{9}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*						
w_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*						
w_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*						
w_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*						
w_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x						
w_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x						
w_{15}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x						
w_{16}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x						
w_{17}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x						
w_{18}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-						
w_{19}																			-	x	x	x	x	x
w_{20}																			x	-	x	x	x	x
w_{21}																			x	x	-	x	x	x
w_{22}																			x	x	x	-	x	x
w_{23}																			x	x	x	x	-	x
w_{24}																			x	x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=19 K= 4.58 C= 10.5

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_1	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_2	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_3	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_4	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_5	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_6	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_7	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_8	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_9	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*					
w_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*					
w_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*					
w_{15}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*					
w_{16}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*					
w_{17}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*					
w_{18}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*					
w_{19}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-					
w_{20}																				-	x	x	x	x
w_{21}																				x	-	x	x	x
w_{22}																				x	x	-	x	x
w_{23}																				x	x	x	-	x
w_{24}																				x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=20 K= 4.33 C= 12.00

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_1	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_2	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_3	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_4	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_5	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_6	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_7	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_8	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_9	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				
w_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*				
w_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*				
w_{15}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*				
w_{16}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*				
w_{17}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*				
w_{18}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*				
w_{19}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x				
w_{20}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-				
w_{21}																					-	x	x	x
w_{22}																					x	-	x	x
w_{23}																					x	x	-	x
w_{24}																					x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=21 K= 4.25 C= 13.50

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
w_1	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_2	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_3	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_4	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_5	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_6	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_7	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_8	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_9	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
w_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*			
w_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*			
w_{15}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*			
w_{16}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*			
w_{17}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*			
w_{18}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*			
w_{19}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x			
w_{20}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x			
w_{21}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-			
w_{22}																						-	x	x
w_{23}																						x	-	x
w_{24}																						x	x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=22 K= 4.33 C= 15.00

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
W_1	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_2	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_3	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_4	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_5	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_6	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_7	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_8	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_9	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		
W_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*		
W_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*		
W_{15}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*		
W_{16}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*		
W_{17}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*		
W_{18}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*		
W_{19}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x		
W_{20}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x		
W_{21}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x		
W_{22}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-		
W_{23}																							-	x
W_{24}																							x	-
	Group 1						Group 2						Group 3						Group 4					

EvenK=23 K= 4.58 C= 16.50

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
W_1	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_2	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_3	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_4	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_5	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_6	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_7	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_8	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_9	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	
W_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	
W_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	
W_{15}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	
W_{16}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	
W_{17}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	
W_{18}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	
W_{19}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	
W_{20}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	
W_{21}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	
W_{22}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	
W_{23}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	
W_{24}																								-
	Group 1						Group 2						Group 3						Group 4					

EvenK=24 K= 5.00 C= 18.00

	N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12	N 13	N 14	N 15	N 16	N 17	N 18	N 19	N 20	N 21	N 22	N 23	N 24
W_1	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_2	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_3	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_4	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_5	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_6	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_7	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_8	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_9	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_{10}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_{11}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_{12}	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
W_{13}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{14}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{15}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{16}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{17}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x	*x*	*x*	*x*	*x*	*x*	*x*
W_{18}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-	*x*	*x*	*x*	*x*	*x*	*x*
W_{19}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	-	x	x	x	x	x
W_{20}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	-	x	x	x	x
W_{21}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	-	x	x	x
W_{22}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	-	x	x
W_{23}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	-	x
W_{24}	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	x	x	x	x	x	-
	Group 1						Group 2						Group 3						Group 4					

A5 The simulation model

As is depicted in table A5.1., the simulation model presented here consists of two separate units. One (FF) represents the entire fitness landscape whereas the other (Population) mirrors the different clusters. Put differently, the object “Population” accounts for the differently architectured clusters (with respect to their mode of co-ordination that is reflected in agents’ selection mechanisms, see also table A5.2.) while the object “FF” provides a measure of success of their adaptive measures within each simulation run. Changing the relevant parameters reflecting element interdependence in the object “FF” (*EvenK, ForeOverlap, AftOverlap*) furthermore allows for an indirect inclusion of the effects of a growing or decreasing division of labour on cluster performance (For additional detail on objects, *parameters* and variables, as well as simulation settings see tables A5.3.-A5.5.).

Table A5.1. Model object structure

Root		
FF “FF” contains all objects, variables and parameters making up the fitness landscape	Population “Population” contains all objects, variables and parameters making up the cluster and its agents. Populations differ according to their agents’ selection mechanisms representing different forms of co-ordination in the cluster.	
Bit “Bit” represents all the objects, variables and parameters working upon one of the N=24 elements in the fitness landscape.	Substring “Substring” denotes the number of decompositions of the entire string controlled by the agent groups in the cluster. Here Substring=4.	
Link “Link” represents all interdependencies between system elements N. Links can exist between elements within the control of one agent (K) as well as between agents (C).	SSBit “SSBit” identifies the n elements pertaining to a substring. SSBit=6	Agent “Agent” represents all actors conducting activities in the cluster. Agents are allocated into groups pertaining to a given substring.
		ABit “ABit” denotes all the activities n under the control of one agent. Here ABit=6.

At the start of each simulation run, the fitness landscape (FF) is initialised using the equation Init. Starting from their (randomly assigned) initial configurations, Agents are then allowed to explore their subset of the fitness landscape through mutation and selection. More precisely, agents change all six ABits under their control with a given probability (*ProbMut=0.5*) using the variable Mutation. They then evaluate the expected local fitness (*ExpLocFit*) given by the variable TestMe of their new configuration (*TValues*) in comparison to the previous one (*AValues*). The extent to which elements in the entire string enter the agents’ decisions by influencing the TestMe function and are expressed in the expected local fitness

(*FlagTest*) reflects the different modes of co-ordination in the cluster. In individualistic clusters, only the elements under each agent's control enter the evaluation of her strategy. In the collective case, all elements enter an agent's selection mechanism whereas in alliance scenarios, only the agent's and the alliance partner's fitness matter. In the dominant firm scenario, all agents aim at improving their own and the dominant actor's fitness (except for the latter who behaves egoistically). The expected local fitness is derived by holding the states of the elements outside an agent's control constant.

To get from individual agent to agent group dynamics (SubString), a bidding process is introduced where agents bid with their new configuration in Bidding. Agents are chosen to represent their group (their substring) based on a certain *Criterion*. Here, the *Criterion* applied for an agent to be *Chosen* as the representative of her substring is the highest *ExpGlobFit* derived by TestMe (again holding the rest of the string constant). If an agent is chosen to represent his substring, the current configuration of her bits (*ABit*) becomes the configuration of the substring bits (*SSBit*). Agent groups are then aggregated into cluster dynamics (Population) by taking the configurations of all substrings and computing the new fitness values for agent groups (*ActLF*) and the cluster (*Fitness*) through FitFun. Both values are saved for each simulation step. Having derived the actual fitness values for both, the process starts again with individual agents attempting a mutation of their current configuration.

Depending on whether a bifurcation event or an environmental perturbation is investigated, simulations are changed every 600 steps. In the case of bifurcations, the Populations are reinitialised with new fitness landscapes (FF) using the function Init. In the case of perturbations, the fitness landscape is changed for *NumShiftBit* elements every 600 steps using the Shift function.

Table A5.2. Agent orientations (reflecting different modes of co-ordination)

	Selection mechanism (FlagTest)
Individualistic	Each agent cares only for her own fitness, i.e. for the fitness of the elements under her control (FlagTest=FlagSString=6).
Collective	Each agent cares for the fitness of the entire cluster, i.e. all variables enter her evaluation of the strategy (FlagTest=N=24).
Alliance	Each agent cares for her own and ally fitness, i.e. FlagTest=12. The distribution of these elements then depends on the constellation of alliances in the cluster.[129]
Leader	The dominant firm cares only for its own fitness (FlagTest=FlagSString=6). The other agents in the cluster care for their own fitness and that of the dominant firm, i.e. their FlagTest=12.

Agent orientations matter as they determine what elements enter the TestMe function (FlagTest=1 or 0) evaluating a given strategy by returning the agents expected local fitness.

Table A5.3. Simulation settings

Label	Features
SString6, Agent 2(1)	Nine populations representing individualistic, collective as well as different alliance and hierarchy clusters containing two agents each, except for the case of the dominant firm where the agent group consists of one agent only. Used to test the effect of different numbers of agents on cluster performance.
SString6, Agent 5(1)	Nine populations representing individualistic, collective as well as different alliance and hierarchy clusters containing five agents each, except for the case of the dominant firm where the agent group consists of one agent only. Used to generate results regarding the relative performance of different cluster co-ordination mechanisms (see table A5.2.) for changing degrees of interdependence.
SString6, Agent 5(5)	Nine populations representing individualistic, collective as well as different alliance and hierarchy clusters containing five agents each (the dominant firm is replaced by a dominant group containing five agents). Used to test the effect of a dominant agent group.
SString6, Agent 10(1)	Nine populations representing individualistic, collective as well as different alliance and hierarchy clusters containing ten agents each, except for the case of the dominant firm where the agent group consists of one agent only. Used to test the effect of different numbers of agents on cluster performance.
SString6, Indiv_Coll	Ten populations representing different constellations of egoistic and collectively oriented agent groups. Populations 1-4 exhibit one egoistic group in each of the four substrings, populations 5-10 have different constellations with two egoistic and two collective agent groups. Used to test the stability of the collective regime against egoistic behaviour.
SString6, Inv_Ego	Four populations representing different numbers of egoistic agents (1-4) in the first agent group. Used to test when the “prisoner’s dilemma” begins to materialise.

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[129] See also table A6.1. in App. 6.

Table A5.4. Objects, parameters and variables

Root

Label	Comment
Init (0)	Equation setting the basic initialisations for the fitness landscape as well as the different populations. Computed only once, it transforms itself into a parameter and is not computed again.
CreateFitContrib (0)	Variable in the fitness landscape that creates the fitness values. Initialises the vectors used for computing and storing the landscape fitness values. Appears in equation for: Init
N (P)	Parameter measuring the number of landscape elements (N=24). Appears in equation for: FitFun, CreateFitContrib, Init, Shift, InitEvenFF, InitKauffFF
NumFF (P)	Parameter measuring the number of fitness functions used in the simulation. Here, NumFF=1. Appears in equation for: FitFun, Init, Shift
PeriodShift (P)	Parameter measuring the number of simulation steps to be executed before the next shift in the fitness landscape. In the perturbation model, PeriodShift=600 steps. Appears in equation for: Shift
Shift (1)	Equation altering the fitness contributions for a limited number of landscape elements (NumShiftBit). Appears in equation for: Shift
UseMem(P)	Parameter determining whether fitness landscape values are stored for system configurations or not. Here, UseMem=0, i.e. landscape values are only stored for current system configurations. If the same point is revisited later in the simulation, its fitness is determined again using the fitness contribution values. Allows to implement N/K fitness landscapes even if their total number of points is larger than the available memory. Appears in equation for: Init
NumShiftBit (P)	Parameter measuring the number of elements whose fitness contribution is altered in each shift. Here, NumShiftBit=6 (in the perturbation model) Appears in equation for: Shift

Object FF
Contained in Object: Root
Containing Objects: Bit
Appears in equation for: Init, Shift

IdFF (P)	Parameter identifying each fitness function (only one used here). Appears in equation for: FitFun
InitEvenFF	Initialises the object structure for a fitness function with evenly (block) distributed interdependencies Appears in equation for: InitFF
InitKauffFF (0)	Initialises the object structure for a fitness function with randomly distributed interdependencies Appears in equation for: InitFF

Table A5.4. (Cont.)

TypeFF (P)	Determines whether a fitness function with evenly or randomly distributed elements is used (here, InitEvenFF) Appears in equation for: InitFF
InitFF (0)	Initialises the fitness functions Appears in equation for: InitFF

FitFun (0)	Computes the fitness for each element state. This implementation makes use of dynamically allocated memory. It means that FitFun stores in memory the fitness of points already computed, including the fitness contribution of each bit of the string. If the point has never been computed before, then a new fitness value is randomly generated respecting the constraints defined in the landscape and stored in memory for future uses. The core idea of NK systems is that the fitness of a binary point is computed as the average of the fitness contributions (fc) of each element. The epistatic relations of NK systems define which bit influences other bits. Therefore, the system must store in memory $2^{(K+1)}$ fc's for each bit linked to other K bits. The current implementation, summarised below, allows for the creation of as complex landscapes as desired, even if the whole NK system would require and impossibly huge amount of memory. The system continues to allocate memory for new points until the operating system's memory limitations are reached. At that point the LSD programme crashes. Technically, the data on fitness values are stored in a memory structure defined as:
	struct bit
	{int id; //id of the bit (from 1 to N)
	struct dynlink l; //see below
	int *link; //vector of integers reporting the bit's linked to the bit
	int nlink; //number of bit's linked to the bit (i.e. length of *link)
	double fitcontr; //fitness contribution of the bit, computed by FitFun whenever requested};
	struct dynlink {dynlink *l0; dynlink *l1; double *f; };
	The dynlink is an element of the binary linked chain generated whenever the fitness of a point is computed. Starting from bit.l a unary linked chain is generated passing for l0 or l1 depending on the states of the related bits. Only the last dynlink contains an existing f field, for the fitness contributions.
	When FitFun is requested it stores the states of related bits for each bit in *link. Then, in l checks whether l0 exists or is NULL (if the related bit is 0) or checks l1, if the related bit is 1. This continues until either:
	a NULL l0 or l1 is encountered. Continue to generate a new linked chain until the end of related bits and generate a new fitness contribution stored in f.
	the related bits are finished. Return the f value as fitness contribution.
	At the end of each simulation running the "close_sim()" function cleans up all the memory.
	Appears in equation for: TestMe, Fitness, Shift

Table A5.4. (Cont.)

EvenK (P)	Parameter indicating the number of elements that are reciprocally linked, i.e. it determines the size of the blocks of interdependent elements Appears in equation for: InitEvenFF, InitKauffFF
ForeOverlap (P)	Parameter indicating how many of the EvenK interdependent elements are unilaterally linked with elements in the previous block (first block elements linked with those in the last block). Appears in equation for: InitEvenFF, InitKauffFF
AftOverlap (P)	Parameter indicating how many of the EvenK interdependent elements are unilaterally linked with elements in the next block (last block elements linked with those in the first block). Appears in equation for: InitEvenFF, InitKauffFF

Object Bit
Contained in Object: Root → FF
Containing Objects: Link
Appears in equation for: FitFun, Shift, InitEvenFF, InitKauffFF

IdBit (P)	Parameter identifying each of the N elements (Bits) of the fitness landscape. Appears in equation for: TestMe, Fitness, Shift, InitEvenFF, InitKauffFF
FitContr (P)	Parameter denoting the fitness contribution of each element state as a result of the state of that element (Bit) and those of interdependent ones. Appears in equation for: FitFun, TestMe, Fitness, Shift
appBit (P)	Parameter tagging the n=6 Bits affected by the shift function. Appears in equation for: Shift

Object Link
Contained in Object: Root → FF → Bit
Appears in equation for: FitFun, Shift, InitEvenFF, InitKauffFF

IdLink (P)	Parameter identifying which two elements are connected (existing link). Appears in equation for: InitEvenFF, InitKauffFF
Exist (P)	Parameter showing whether a link between two elements exists (1) or not (0). Appears in equation for: FitFun, InitEvenFF, InitKauffFF

Object Population
Contained in Object: Root
Containing Objects: SubString
Appears in equation for: Shift

ProbMut (P)	Parameter setting the probability for an element state modification by the agent. Appears in equation for: Mutation
Fitness (0)	Computes the fitness of the string, as obtained by the champions of all substrings. Appears in equation for: Shift
TestMe (0)	Provides the fitness of the string composed by the tentative bits of the agent and the current bits for the other sub-strings. Writes the global fitness in TestFit (P) and returns the expected local fitness of the agent Appears in equation for: Mutation, Shift

Table A5.4. (Cont.)

Object SubString
Contained in Object: Root → Population
Containing Objects: Agent, SSBit
Appears in equation for: Fitness, Shift

IdSS (P)	Parameter determining the identity of a specific substring. Appears in equation for: TestMe
Bidding (0)	The Substring scans all its agents finding the highest bid according to a specific criterion. It then returns the expected fitness for that bid. Appears in equation for: Fitness
ActLF (P)	Parameter measuring and saves the actual fitness for each substring in every simulation step. Appears in equation for: Fitness, Shift
Criterion (P)	Parameter determining how the substring selects the best-performing agent. If Criterion=1 (here), the agents are ranked according to the expected global fitness of their mutation. If Criterion=2, agents are evaluated based on the expected local fitness of their mutation. Appears in equation for: Bidding

Object Agent
Contained in Object: Root → Population → SubString
Containing Objects: ABit
Appears in equation for: Bidding, Shift

IdAgent (P)	Parameter allowing for an identification of all agents in the population. Appears in equation for: Bidding
Mutation (0)	Variable attempting a change of the current agent configuration (AValues). Appears in equation for: Bidding
Chosen (P)	The parameter chosen is set to 1 for the agent emerging as the champion of the bidding process in each simulation. That agent's configuration then enters as the new substring. Appears in equation for: Bidding, Fitness
ExpLocFit (P)	Parameter measuring the expected local fitness of a specific agent configuration in each simulation step, holding the remainder of the string constant. Appears in the equation for: Mutation, Bidding, Shift
ExpGlobFit (P)	ExpGlobFit measures the expected global (string) fitness of any agent's configuration in each simulation step, while holding the rest of the string constant. Appears in equation for: TestMe, Mutation, Bidding

Table A5.4. (Cont.)

Object ABit
Contained in Object: Root → Population → SubString → Agent
Appears in equation for: TestMe, Mutation, Fitness

IdAB (P)	Parameter identifying the bits under control of an agent. Appears in equation for: TestMe, Fitness
AValue (P)	Parameter corresponding to the fitness of the agent's current configuration (obtained in the last simulation step). Appears in equation for: Mutation, Fitness
TValue (P)	Parameter denoting the fitness of the configuration after mutation by the agent. The mutation (TValue) is only retained if its fitness is better than the previous one. Retention in turn depends on the selection mechanism underlying the TestMe function. Appears in equation for: TestMe, Mutation
FlagTest (P)	FlagTest decides whether an element is used in evaluating (testing) the fitness value of a mutation executed by an agent. If FlagTest=1, the respective element matters for the agent's evaluation of his strategy. If FlagTest=0, it does not. The expected local fitness (ExpLocFit) for an agent (determining his acceptance of a mutation) is calculated over the range of FlagTest. Appears in equation for: TestMe
FlagSString (P)	Parameter allocating each ABit to its corresponding SubString. Appears in equation for: TestMe, Mutation, Fitness

Object SSBit
Contained in Object: Root → Population → SubString
Appears in equation for: Fitness, Shift

IdSSB (P)	Parameter identifying the SSBits pertaining to a given SubString. Appears in equation for: TestMe, Fitness, Shift
Value (P)	Parameter representing the current element state [0;1]. Appears in equation for: TestMe, Fitness, Shift

Table A5.5. Variables and equations

Object Root

Variable Init; Used in: (never used)
Using: CreateFitContrib N NumFF UseMem InitFF

```
if(!strcmp(label,"Init"))
{ /* Equation setting the basic initializations.
Computed only once, it transforms itself into a pa-
rameter and is not computed again. Assigns the
Landscape object to a specific pointer to speed up
calls to the landscape */
p->cal("CreateFitContrib",0);
/ creates the memory location for the landscape
data
v[0]=V("N");
for(i=0; i<(int)v[0]; i++)
 RND>0.5?str[i]=0:str[i]=1;
v[2]=V("NumFF");
v[6]=V("UseMem");
if(v[6]==1)
{
try {
v[1]=pow(2,v[0]);
mydata=new double* [(long int)v[2]];
for(i=0; i<(int)v[2]; i++)
 {
  mydata[i]=NULL;
  mydata[i]=new double[(long int)v[1]];
  for(j=0; j<(long int)v[1]; j++)
   mydata[i][j]=-1;
 }
inmem=1;
 }
catch(...)
 {
for(i=0; i<(int)v[2]; i++)
 {
 if(mydata[i]!=NULL)
   delete[] mydata[i];
 }
 delete[] mydata;
 plog("No memory\n");
 inmem=0;
 }
}
else  inmem=0;
CYCLE(cur1, "FF")   VS(cur1,"InitFF");
param=1;
res=0;
goto end;
}
```

Variable CreateFitContrib; Used in: Init
Using: N

```
if(!strcmp(label,"CreateFitContrib"))
{ /* Variable in the landscape that creates the
landscape values. Initialises the vectors used
for computing and storing the landscape val-
ues. */
v[0]=p->cal("N",0);
str=new unsigned int[(int)v[0]];
//temporary strings, used to store the binary
point
str2=new unsigned int[(int)v[0]]; //numbers
str3=new unsigned int[(int)v[0]]; //numbers
str4=new unsigned int[(int)v[0]]; //numbers
fc=new bit[(int)v[0]];
//memory structure used to store landscape.
See FitFun comments
for(v[1]=0; v[1]<v[0] ; v[1]++ )
 {
  fc[(int)v[1]].l.l0=NULL;
  fc[(int)v[1]].l.l1=NULL;
 }
res=1;
param=1;
goto end;
}
```

Table A5.5. (Cont.)

Variable Shift; Used in: Shift
Using: N NumFF PeriodShift Shift NumShiftBit FitFun IdBit FitContr appBit Fitness TestMe ActLF ExpLocFit IdSSB Value

```
if(!strcmp(label,"Shift"))
{ /* Every PeriodShift steps the fitness contributions are shifted. That is, NumShiftBit of the fit-
ness contributions are changed and fitness of all agents, substrings, etc. has to be updated. */
v[0]=VL("Shift",1);
if(v[0]>1) END_EQUATION(v[0]-1);
v[0]=p->cal("N",0);
v[3]=VS(root,"NumFF");
v[7]=V("NumShiftBit");
CYCLE(cur, "FF")
 {
 CYCLES(cur,cur1, "Bit")
  WRITES(cur1,"appBit",1);
 for(v[8]=0; v[8]<v[7]; v[8]++)
 {
  cur1=RNDDRAWS(cur,"Bit","appBit");
  WRITES(cur1,"appBit",0);
  v[10]=VS(cur1,"IdBit")-1;
  shift(&fc[(int)v[10]].l, (int)v[3]);
  }
 }
CYCLE(cur, "Population")
 {
   v[11]=0;  v[13]=0;
   i=0;  CYCLES(cur, cur1, "SubString")
    {
   v[13]++; CYCLES(cur1, cur2, "Agent")
    {
     v[10]=VS_CHEAT(cur1->up,"TestMe", cur2);
     WRITES(cur2,"ExpLocFit",v[10]);
    }
    CYCLES(cur1, cur4, "SSBit")
     str[i++]=(int)VS(cur4,"Value");
  }
  v[5]=V("FitFun"); CYCLES(cur, cur1, "SubString")
  {
  v[8]=v[9]=0;  CYCLES(cur1, cur2, "SSBit")
    {
   v[6]=VS(cur2,"IdSSB");
   cur3=SEARCH_CND("IdBit",v[6]);
   v[7]=VS(cur3,"FitContr");
   v[8]+=v[7];  v[9]++;
    }
  WRITES(cur1,"ActLF",v[8]/v[9]);
  }
 WRITELS(cur,"Fitness",v[5],t);
 }
v[5]=V("PeriodShift"); res=v[5]; goto end;
}
```

Table A5.5. (Cont.)

Object FF

Variable InitEvenFF; Used in: InitFF
Using: N EvenK ForeOverlap AftOverlap IdBit IdLink Exist

```
FUNCTION("InitEvenFF") /* Initializes the FF object structure */
v[0]=V("N");
v[3]=V("EvenK");
v[4]=V("ForeOverlap");
v[5]=V("AftOverlap");
cur=SEARCH("Bit");
ADDNOBJ("Bit", v[0]-1, cur);
v[1]=v[6]=1;
v[7]=0;
CYCLE(cur, "Bit")
 {
  cur1=SEARCHS(cur,"Link");
  ADDNOBJS(cur,"Link", v[0]-1, cur1);
  v[2]=1;  CYCLES(cur, cur1, "Link")
   {
    v[8]=(v[6]-1)*v[3]+1;
    v[9]=v[6]*v[3];
    if(v[2]>=v[8] && v[2]<=v[9])      v[10]=1;
    else      v[10]=0;
    if(v[9]>v[0])
     v[9]=v[0];
    if(v[5]>0)
     {//consider the aftoverlap
     if(v[2]>v[9] && v[2]<=v[5]+v[9] )
      v[10]=1;
     if(v[9]==v[10] && v[2]<v[5])
      v[10]=1;
     }
    if(v[4]>0)
     {//consider the foreoverlap
     if(v[2]<v[8] && v[2]>=v[8]-v[4])
      v[10]=1;
     if(v[8]-v[4]<0 && v[2] > v[8]-v[4]+v[0])
      v[10]=1;
     }
    WRITES(cur1,"Exist",v[10]);
    WRITES(cur1,"IdLink",v[2]++);
   }
   v[7]++;
   if(v[7]==v[3])
    {
     v[7]=0;   v[6]++;
    }
  WRITES(cur,"IdBit",v[1]++);
 }
PARAMETER
RESULT(1 )
```

Variable InitFF; Used in: Init
Using: InitEvenFF InitKauffFF TypeFF

```
FUNCTION("InitFF")
/* Initializes the fitness functions */
v[0]=V("TypeFF");
if(v[0]==1)
 v[1]=V("InitEvenFF");
else
 v[1]=V("InitKauffFF");
PARAMETER
RESULT( 1)
```

Table A5.5. (Cont.)

Variable FitFun; Used in: TestMe Fitness Shift
Using: N NumFF IdFF FitContr Exist

```
if(!strcmp(label,"FitFun")) { /* Computes the fitness of the binary point stored in "str". Over-
rules the standard Lsd automatic scheduling system. The equation is computed any time it is
requested and not only once in each time step.*/
last_update--;  if(c==NULL)
 {
 res=-1; goto end;
 }
v[0]=root->cal("N",0); v[13]=V("IdFF"); v[4]=VS(root,"NumFF");
if(inmem==1)
 {
  v[14]=bin2int(str,v[0]);
  if(mydata[(int)v[13]-1][(int)v[14]]!=-1) END_EQUATION(mydata[(int)v[13]-1][(int)v[14]]);
 }
v[1]=0; for(cur=SEARCH("Bit"),v[1]=0,i=0; i<(int)v[0]; i++, cur=go_brother(cur))
 {//for each bit
 v[2]=0; //assume that the fc exists
  for( cur1=SEARCHS(cur,"Link"), cl=&(fc[i].l), j=0; j<(int)v[0] ; j++, cur1=go_brother(cur1))
   {//for each link of the bit
   v[3]=VS(cur1,"Exist");  if(v[3]==1 && str[j]==1)
     {
     if(cl->l1!=NULL)  cl=cl->l1; //the next link exists
     else
       {//create the next link  cl->l1=new dynlink;  cl->l1->l0=NULL;  cl->l1->l1=NULL;
      if(j==(int)v[0]-1)
       {cl->l1->l=new leave;  cl->l1->l->f=new double[(int)v[4]];   for(h=0; h<(int)v[4]; h++)
         cl->l1->l->f[h]=RND; //last link, create the fc
        }
       cl=cl->l1;
      }
     }
    else
     {//create the l0 dynlink
      if(cl->l0!=NULL)   cl=cl->l0; //the next link exists
      else
       {//create the next link
        cl->l0=new dynlink;   cl->l0->l0=NULL;   cl->l0->l1=NULL;
      if(j==(int)v[0]-1)
       {cl->l0->l=new leave;  cl->l0->l->f=new double[(int)v[4]];  for(h=0; h<(int)v[4]; h++)
         cl->l0->l->f[h]=RND; //last link, create the fc
        }
       cl=cl->l0;
      }
     }
   }//end of for through links, therefore cl points to the last element, owning f
   v[1]+=cl->l->f[(int)v[13]-1]; //for the average
   WRITES(cur,"FitContr", cl->l->f[(int)v[13]-1]); //individual fc
 }//end of for through bits
res=v[1]/v[0];
if(inmem==1)  mydata[(int)v[13]-1][(int)v[14]]=res; goto end;
}
```

Table A5.5. (Cont.)

Object Population

Variable Fitness; Used in: Shift
Using: FitFun IdBit FitContr Bidding ActLF Chosen IdAB AValue FlagSString IdSSB Value

```
/* Computes the fitness of the string, as obtained
by the champions of all substrings ensuring that
all sub strings have selected their best performing
agent. */
CYCLE(cur, "SubString")
  VS(cur,"Bidding");
i=0;
CYCLE(cur, "SubString")
 {
  cur1=SEARCH_CNDS(cur,"Chosen",1);
  CYCLES(cur1, cur2, "ABit")
   {
   if(VS(cur2, "FlagSString")==1)
    {
     v[3]=VS(cur2,"IdAB");
     cur3=SEARCH_CNDS(cur,"IdSSB",v[3]);
     v[4]=VS(cur2,"AValue");
     str[i++]=(int)v[4];
     WRITES(cur3,"Value",v[4]);
    }
   }
 }
v[5]=V("FitFun");
CYCLE(cur, "SubString")
 {
  v[8]=v[9]=0;
  CYCLES(cur, cur2, "SSBit")
   {
   v[6]=VS(cur2,"IdSSB");
   cur3=SEARCH_CND("IdBit",v[6]);
   v[7]=VS(cur3,"FitContr");
   v[8]+=v[7];
   v[9]++;
   }
  WRITES(cur,"ActLF",v[8]/v[9]);
 }
RESULT(v[5] )
```

Variable TestMe; Used in: Mutation Shift
Using: FitFun IdBit FitContr IdSS ExpGlobFit IdAB TValue FlagTest FlagSString IdSSB Value

```
/* Provides the fitness of the string com-
posed by the tentative bits of the agent and
the current bits for the other sub-strings.
Writes the global fitness in the parameter
TestFit and returns the local fitness of the
agent */
v[0]=VS(c->up,"IdSS");
i=0;
CYCLES(c,cur1, "ABit")
 {//place in str all bits marked by FlagSS-
tring, and those stored in the common string
for the rest
  if(VS(cur1, "FlagSString")==1)
   str[i++]=(int)VS(cur1, "TValue");
  else
   {
   v[10]=VS(cur1,"IdAB");
   cur=SEARCH_CND("IdSSB",v[10]);
   str[i++]=(int)VS(cur, "Value");
   }
 }
v[5]=V("FitFun"); //computes the fitness,
and set the fitness contributions
WRITES(c,"ExpGlobFit",v[5]);
v[2]=v[4]=0;
CYCLES(c, cur, "ABit")
 {
  if(VS(cur, "FlagTest")==1)
  {
    v[3]=VS(cur,"IdAB");
    cur1=SEARCH_CNDS(p-
>up,"IdBit",v[3]);
    v[2]+=VS(cur1,"FitContr");
    v[4]++;
  }
 }
RESULT(v[2]/v[4] )
```

Table A5.5. (Cont.)

Object SubString

Variable Bidding; Used in: Fitness
Using: Criterion IdAgent Mutation Chosen ExpLocFit ExpGlobFit

```
/* The SubString scans all its agent finding the highest bidding according to a specific 'criterion'.
It then returns the expected fitness. */
v[0]=-1; v[4]=VS(p,"Criterion");
CYCLE(cur, "Agent")
 {
  WRITES(cur,"Chosen",0);   VS(cur,"Mutation");
  if(v[4]==1)   v[1]=VS(cur,"ExpGlobFit");
  if(v[4]==2)   v[1]=VS(cur,"ExpLocFit");
  if(v[1]>v[0])
   {
    v[2]=VS(cur,"IdAgent");   cur2=cur;   v[0]=v[1];
   }
 }
WRITES(cur2,"Chosen",1);
RESULT(v[0] )
```

Object Agent

Variable Mutation; Used in: Bidding
Using: ProbMut TestMe ExpLocFit ExpGlobFit AValue TValue FlagSString

```
/* Attempts a mutation of the current AValues */
v[0]=VS(p->up->up,"ProbMut");  CYCLE(cur, "ABit")
 {
 if(VS(cur, "FlagSString")==1)
  {
   v[1]=VS(cur,"AValue");   WRITES(cur,"TValue",v[1]);
  }
 }
v[2]=VS(p->up->up,"TestMe"); v[4]=V("ExpGlobFit"); CYCLE(cur, "ABit")
 {
 if(VS(cur, "FlagSString")==1)
  { v[1]=VS(cur,"AValue"); if(RND<v[0]) v[1]==1?v[1]=0: v[1]=1;
WRITES(cur,"TValue",v[1]);}
 }
v[3]=VS(p->up->up,"TestMe"); v[5]=V("ExpGlobFit");
if(v[3]>v[2])
 {//TValues are better   CYCLE(cur, "ABit")
 {
 if(VS(cur, "FlagSString")==1)
  {v[1]=VS(cur,"TValue");   WRITES(cur,"AValue",v[1]); }
 }
 //leave the TestFit as it is   v[6]=1;  WRITE("ExpLocFit",v[3]);
 }
else
 {//AValues are better, replace the TestFit, modified by latest use of TestMe
  WRITE("ExpGlobFit",v[4]);   v[6]=0;  WRITE("ExpLocFit",v[2]);
 }
RESULT( v[6])
```

A6 Cluster adaptation to change – Results overview

Table A6.1. Co-ordination mechanisms in the different populations

Pop.	Label	Co-ordination mechanism
1	Individualistic	Agents select strategies that improve their own fitness, i.e. agents in the first group take the fitness of elements n_1-n_6 into account when evaluating their strategy, those in group two care for n_7-n_{12}, etc.
2	Collective	Agents select strategies that improve cluster fitness as a whole, i.e. all agents take the fitness of elements n_1-n_{24} into account when evaluating their strategies.
3	Alliance (1+2, 3+4)	Agents form alliances and select strategies that improve alliance fitness, i.e. agents in the first and second group take the fitness of elements n_1-n_{12} into account, agents in groups 3 and 4 consider n_{13}-n_{24}.
4	Alliance (1+3, 2+4)	Agents form alliances and select strategies that improve alliance fitness, i.e. agents in the first and third group consider the fitness of elements n_1-n_6 and n_{13}-n_{18}, agents in groups 2 and 4 consider n_7-n_{12}/ n_{19}-n_{24}.
5	Alliance (1+4, 2+3)	Agents form alliances and select strategies that improve alliance fitness, i.e. agents in the first and fourth group consider the fitness of elements n_1-n_6 and n_{19}-n_{24}, agents in groups 2 and 3 consider n_7-n_{18}.
6	Leader firm (1)[130]	The cluster has a dominant agent in the first group. All other agents try to improve that agent's fitness alongside their own. Agents in groups 2-4 care for the elements n_1-n_6 alongside those under their control. The leader firm only cares for its own fitness, i.e. elements n_1-n_6.
7	Leader firm (2)	The cluster has a dominant agent in the second group. All other agents try to improve that agent's fitness alongside their own. Agents in groups 1, 3 and 4 care for the effects of their strategies on the fitness of elements n_7-n_{12} alongside those under their control. The leader firm only cares for its own fitness, i.e. elements n_7-n_{12}.
8	Leader firm (3)	The cluster has a dominant agent in the third group. All other agents try to improve that agent's fitness alongside their own. Agents in groups 1, 2 and 4 care for the effects of their strategies on the fitness of elements n_{13}-n_{18} alongside those under their control. The leader firm only cares for its own fitness, i.e. elements n_{13}-n_{18}.
9	Leader firm (4)	The cluster has a dominant agent in the fourth group. All other agents try to improve that agent's fitness alongside their own. Agents in groups 1-3 care for the effects of their strategies on the fitness of elements n_{19}-n_{24} alongside those under their control. The leader firm only cares for its own fitness, i.e. elements n_{19}-n_{24}.

---

[130] In leader firm scenario, the group containing the leading firm consists out of one instead of five agents.

Table A6.2. Landscape complexity and average system fitness (bifurcation)*

FL Complexity Pm**	K	C	Individu-alistic	Collective	Alliance (1+2 3+4)	Alliance (1+3 2+4)	Alliance (1+4 2+3=
4	*2.33*	*0.67*	0.72869	0.73685	0.72962	0.73722	0.72889
5	*2.50*	*1.30*	0.73078	0.73999	0.73293	0.73764	0.73189
7	*3.17*	*2.33*	0.73309	0.73921	0.73213	0.73643	0.72981
9	*4.25*	*3.00*	0.72303	0.73281	0.73332	0.73306	0.72314
8	*3.67*	*3.33*	0.73102	0.74306	0.74217	0.73802	0.73354
10	*3.67*	*4.33*	0.70568	0.72749	0.72368	0.72192	0.71543
11	*3.92*	*5.33*	0.69115	0.71906	0.70773	0.71699	0.70178
12	*5.00*	*6.00*	0.69580	0.71902	0.69791	0.71858	0.69605
13	*4.58*	*6.50*	0.66807	0.71536	0.68786	0.71217	0.68873
14	*4.33*	*7.00*	0.64741	0.71389	0.68223	0.71078	0.67646
15	*4.25*	*7.50*	0.62296	0.70868	0.66676	0.70737	0.67459
16	*4.33*	*8.00*	0.60742	0.70480	0.66699	0.69374	0.66373
17	*4.58*	*8.50*	0.60721	0.70822	0.66405	0.68571	0.66855
18	*5.00*	*9.00*	0.60406	0.70675	0.65926	0.66207	0.66709
19	*4.58*	*10.50*	0.58360	0.69924	0.64337	0.64880	0.65085
20	*4.33*	*12.00*	0.56127	0.68832	0.63241	0.63285	0.62572
21	*4.25*	*13.50*	0.54460	0.67797	0.61924	0.61550	0.61158
22	*4.33*	*15.00*	0.52972	0.67312	0.59629	0.59558	0.60021
23	*4.58*	*16.50*	0.51811	0.66556	0.58046	0.59267	0.58885
24	*5.00*	*18.00*	0.51334	0.66616	0.57491	0.57886	0.58349

FL Complexity Pm**	K	C	Leader firm (1)	Leader firm (2)	Leader firm (3)	Leader firm (4)
4	*2.33*	*0.67*	0.72612	0.72701	0.72839	0.72730
5	*2.50*	*1.30*	0.72984	0.72759	0.72399	0.72612
7	*3.17*	*2.33*	0.72360	0.72886	0.72554	0.72263
9	*4.25*	*3.00*	0.71693	0.71864	0.72542	0.72918
8	*3.67*	*3.33*	0.72593	0.73136	0.74200	0.72832
10	*3.67*	*4.33*	0.70987	0.71490	0.71875	0.70999
11	*3.92*	*5.33*	0.69918	0.70489	0.71020	0.69515
12	*5.00*	*6.00*	0.69651	0.70052	0.69839	0.70353
13	*4.58*	*6.50*	0.69885	0.68511	0.69876	0.69695
14	*4.33*	*7.00*	0.69448	0.67041	0.69482	0.69104
15	*4.25*	*7.50*	0.69037	0.65036	0.69061	0.68720
16	*4.33*	*8.00*	0.68346	0.62834	0.69021	0.68219
17	*4.58*	*8.50*	0.68373	0.61782	0.68310	0.68077
18	*5.00*	*9.00*	0.68020	0.60126	0.67967	0.67778
19	*4.58*	*10.50*	0.66269	0.60036	0.66135	0.66658
20	*4.33*	*12.00*	0.64201	0.58501	0.64470	0.65105
21	*4.25*	*13.50*	0.62414	0.59007	0.62933	0.62761
22	*4.33*	*15.00*	0.61010	0.57918	0.61324	0.60829
23	*4.58*	*16.50*	0.59812	0.57100	0.59370	0.59099
24	*5.00*	*18.00*	0.58167	0.58537	0.57664	0.58532

* All results reported correspond to averages over 100 simulations.

** Pm is the value of LSD parameter EvenK.

Table A6.3. Landscape complexity and standard deviation of system fitness (bifurcation)

FL Complexity			Individualistic	Collective	Alliance (1+2 3+4)	Alliance (1+3 2+4)	Alliance (1+4 2+3)
Pm**	K	C					
4	*2.33*	*0.67*	0.01281	0.01029	0.00961	0.01366	0.01386
5	*2.50*	*1.30*	0.01900	0.01309	0.01600	0.01955	0.01643
7	*3.17*	*2.33*	0.02814	0.01766	0.02036	0.02755	0.02168
9	*4.25*	*3.00*	0.03981	0.02002	0.02723	0.03169	0.02381
8	*3.67*	*3.33*	0.03712	0.01984	0.02429	0.02582	0.01902
10	*3.67*	*4.33*	0.05133	0.02120	0.02656	0.03402	0.02735
11	*3.92*	*5.33*	0.05751	0.02281	0.02546	0.03980	0.03678
12	*5.00*	*6.00*	0.05448	0.02306	0.02284	0.04118	0.04381
13	*4.58*	*6.50*	0.06959	0.02410	0.02894	0.04145	0.04197
14	*4.33*	*7.00*	0.07870	0.02582	0.03663	0.03825	0.04128
15	*4.25*	*7.50*	0.08347	0.02581	0.04126	0.04567	0.04477
16	*4.33*	*8.00*	0.08023	0.02656	0.04855	0.04815	0.04439
17	*4.58*	*8.50*	0.07488	0.02540	0.05961	0.04869	0.04967
18	*5.00*	*9.00*	0.06845	0.02134	0.07044	0.05204	0.04892
19	*4.58*	*10.50*	0.06830	0.02568	0.07315	0.05546	0.05805
20	*4.33*	*12.00*	0.06822	0.02644	0.07831	0.06330	0.06303
21	*4.25*	*13.50*	0.06888	0.02654	0.08101	0.06949	0.06623
22	*4.33*	*15.00*	0.06795	0.02762	0.08378	0.07276	0.07407
23	*4.58*	*16.50*	0.06803	0.02926	0.08570	0.07679	0.07692
24	*5.00*	*18.00*	0.06790	0.02982	0.08893	0.08082	0.08055

FL Complexity			Leader firm (1)	Leader firm (2)	Leader firm (3)	Leader firm (4)
Pm**	K	C				
4	*2.33*	*0.67*	0.01269	0.01306	0.01328	0.01302
5	*2.50*	*1.30*	0.01617	0.01835	0.01953	0.01718
7	*3.17*	*2.33*	0.01793	0.02378	0.02855	0.02327
9	*4.25*	*3.00*	0.02656	0.03212	0.04128	0.02675
8	*3.67*	*3.33*	0.02547	0.03849	0.03841	0.02437
10	*3.67*	*4.33*	0.03197	0.03819	0.04428	0.03414
11	*3.92*	*5.33*	0.03843	0.03902	0.05051	0.04817
12	*5.00*	*6.00*	0.04185	0.04159	0.05302	0.05346
13	*4.58*	*6.50*	0.04667	0.05237	0.06394	0.06146
14	*4.33*	*7.00*	0.05167	0.06129	0.06904	0.06823
15	*4.25*	*7.50*	0.05437	0.06737	0.07095	0.07368
16	*4.33*	*8.00*	0.05620	0.07085	0.07428	0.07150
17	*4.58*	*8.50*	0.05343	0.07008	0.07088	0.07325
18	*5.00*	*9.00*	0.05035	0.06842	0.06723	0.06907
19	*4.58*	*10.50*	0.05513	0.07252	0.07144	0.07514
20	*4.33*	*12.00*	0.06155	0.07729	0.08128	0.07673
21	*4.25*	*13.50*	0.06856	0.07793	0.08125	0.08192
22	*4.33*	*15.00*	0.07512	0.08051	0.08692	0.08533
23	*4.58*	*16.50*	0.07771	0.08278	0.08553	0.08683
24	*5.00*	*18.00*	0.07644	0.07966	0.08611	0.08825

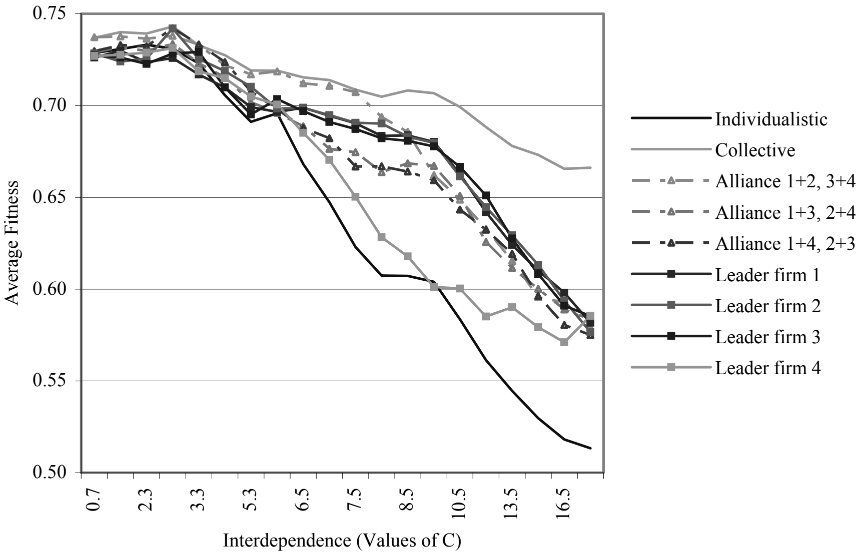


Fig. A6.1. Landscape complexity and adaptive performance (bifurcation)

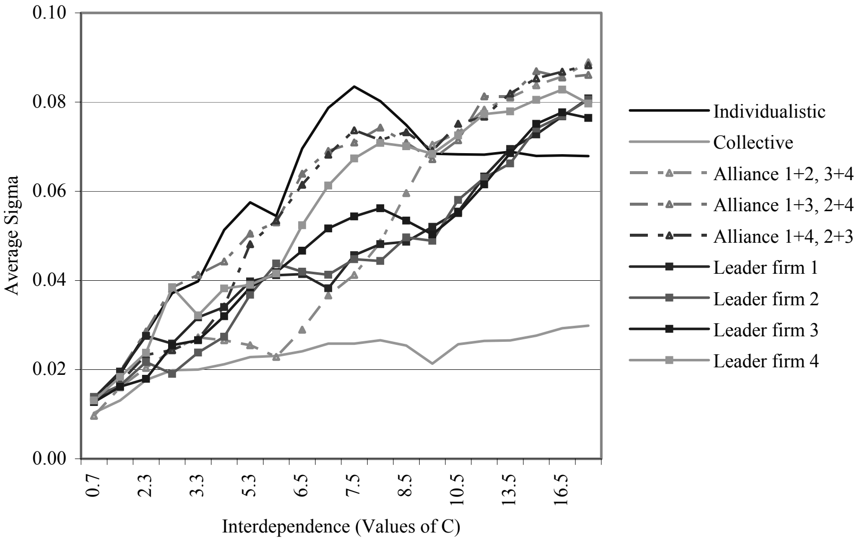


Fig. A6.2. Landscape complexity and stability in adaptation (bifurcation)

Table A6.4. Adaptation and group fitness (bifurcation)

FL Complexity			Individualistic			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.74021	0.72711	0.72341	0.72405
5	*2.50*	*1.30*	0.73321	0.73146	0.72241	0.73605
7	*3.17*	*2.33*	0.75869	0.73424	0.71778	0.72164
9	*4.25*	*3.00*	0.72625	0.70140	0.72601	0.77043
8	*3.67*	*3.33*	0.74243	0.71363	0.69287	0.74319
10	*3.67*	*4.33*	0.70960	0.69163	0.71242	0.70906
11	*3.92*	*5.33*	0.69894	0.68292	0.69303	0.68972
12	*5.00*	*6.00*	0.69998	0.69914	0.69194	0.69213
13	*4.58*	*6.50*	0.66022	0.65744	0.67323	0.68141
14	*4.33*	*7.00*	0.62246	0.62575	0.65667	0.68476
15	*4.25*	*7.50*	0.59270	0.59284	0.63012	0.67618
16	*4.33*	*8.00*	0.57094	0.57144	0.60452	0.68277
17	*4.58*	*8.50*	0.56044	0.55942	0.58263	0.72636
18	*5.00*	*9.00*	0.54747	0.54743	0.54709	0.77426
19	*4.58*	*10.50*	0.53904	0.53950	0.53913	0.71673
20	*4.33*	*12.00*	0.52996	0.53037	0.53060	0.65417
21	*4.25*	*13.50*	0.52528	0.52425	0.52458	0.60428
22	*4.33*	*15.00*	0.51791	0.51807	0.51898	0.56390
23	*4.58*	*16.50*	0.51502	0.51510	0.51583	0.52647
24	*5.00*	*18.00*	0.51343	0.51367	0.51355	0.51269

FL Complexity			Collective			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.75065	0.73130	0.73066	0.73480
5	*2.50*	*1.30*	0.74574	0.73890	0.72549	0.74982
7	*3.17*	*2.33*	0.75424	0.73891	0.73037	0.73332
9	*4.25*	*3.00*	0.74098	0.72820	0.73268	0.77036
8	*3.67*	*3.33*	0.74657	0.72040	0.73156	0.73269
10	*3.67*	*4.33*	0.73351	0.72922	0.70919	0.73804
11	*3.92*	*5.33*	0.72490	0.71338	0.71393	0.72402
12	*5.00*	*6.00*	0.72029	0.71858	0.71866	0.71856
13	*4.58*	*6.50*	0.70661	0.71302	0.72017	0.72162
14	*4.33*	*7.00*	0.70552	0.70590	0.72192	0.72221
15	*4.25*	*7.50*	0.68916	0.69571	0.70496	0.74488
16	*4.33*	*8.00*	0.69103	0.69169	0.70492	0.73155
17	*4.58*	*8.50*	0.67396	0.68799	0.71015	0.76077
18	*5.00*	*9.00*	0.69037	0.68189	0.68045	0.77428
19	*4.58*	*10.50*	0.68574	0.68600	0.67746	0.74776
20	*4.33*	*12.00*	0.66943	0.68094	0.67271	0.73022
21	*4.25*	*13.50*	0.66407	0.67500	0.67105	0.70176
22	*4.33*	*15.00*	0.67794	0.67685	0.66932	0.66838
23	*4.58*	*16.50*	0.67042	0.65476	0.66795	0.66912
24	*5.00*	*18.00*	0.66550	0.67176	0.66407	0.66333

Table A6.4. (Cont.)

FL Complexity			Alliance (1+2, 3+4)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.74523	0.73523	0.73717	0.73127
5	*2.50*	*1.30*	0.74850	0.73223	0.71915	0.75068
7	*3.17*	*2.33*	0.75214	0.75074	0.70799	0.73484
9	*4.25*	*3.00*	0.71935	0.72026	0.74210	0.77035
8	*3.67*	*3.33*	0.74438	0.72758	0.71503	0.74525
10	*3.67*	*4.33*	0.72914	0.70469	0.72196	0.73191
11	*3.92*	*5.33*	0.72171	0.70427	0.72340	0.71858
12	*5.00*	*6.00*	0.71585	0.73105	0.71433	0.71308
13	*4.58*	*6.50*	0.70652	0.71297	0.70194	0.72726
14	*4.33*	*7.00*	0.70529	0.70245	0.70612	0.72924
15	*4.25*	*7.50*	0.69218	0.69300	0.71219	0.73212
16	*4.33*	*8.00*	0.66969	0.67354	0.70363	0.72809
17	*4.58*	*8.50*	0.64706	0.64790	0.68606	0.76181
18	*5.00*	*9.00*	0.62163	0.61432	0.63809	0.77426
19	*4.58*	*10.50*	0.61758	0.61934	0.62941	0.72888
20	*4.33*	*12.00*	0.60833	0.61544	0.62134	0.68629
21	*4.25*	*13.50*	0.60401	0.60286	0.60614	0.64899
22	*4.33*	*15.00*	0.58969	0.58810	0.58884	0.61568
23	*4.58*	*16.50*	0.59260	0.59398	0.59048	0.59360
24	*5.00*	*18.00*	0.58022	0.57709	0.58061	0.57754

FL Complexity			Alliance (1+3, 2+4)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.73854	0.72860	0.72500	0.72343
5	*2.50*	*1.30*	0.73644	0.73169	0.72361	0.73582
7	*3.17*	*2.33*	0.75596	0.72827	0.71656	0.71846
9	*4.25*	*3.00*	0.74415	0.71393	0.69275	0.74175
8	*3.67*	*3.33*	0.72734	0.70676	0.72969	0.77039
10	*3.67*	*4.33*	0.71656	0.69184	0.73514	0.71816
11	*3.92*	*5.33*	0.70506	0.68893	0.71979	0.69335
12	*5.00*	*6.00*	0.69927	0.69607	0.69401	0.69485
13	*4.58*	*6.50*	0.67938	0.68273	0.69121	0.70159
14	*4.33*	*7.00*	0.65849	0.67530	0.66999	0.70206
15	*4.25*	*7.50*	0.65016	0.67296	0.66515	0.71008
16	*4.33*	*8.00*	0.63229	0.65737	0.64734	0.71792
17	*4.58*	*8.50*	0.63732	0.65480	0.63181	0.75027
18	*5.00*	*9.00*	0.62263	0.64910	0.62232	0.77433
19	*4.58*	*10.50*	0.62038	0.63685	0.61711	0.72904
20	*4.33*	*12.00*	0.60233	0.61015	0.60831	0.68207
21	*4.25*	*13.50*	0.60110	0.60293	0.59496	0.64735
22	*4.33*	*15.00*	0.59566	0.59535	0.59127	0.61858
23	*4.58*	*16.50*	0.58771	0.59050	0.58810	0.58912
24	*5.00*	*18.00*	0.58483	0.58667	0.58246	0.58002

Table A6.4. (Cont.)

FL Complexity			Alliance (1+4, 2+3)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.74230	0.72643	0.72496	0.72479
5	*2.50*	*1.30*	0.73524	0.74149	0.71918	0.73582
7	*3.17*	*2.33*	0.75200	0.73137	0.72597	0.71917
9	*4.25*	*3.00*	0.75276	0.71482	0.71083	0.75488
8	*3.67*	*3.33*	0.74083	0.72447	0.73266	0.77073
10	*3.67*	*4.33*	0.72901	0.70828	0.73522	0.72221
11	*3.92*	*5.33*	0.71129	0.69376	0.71558	0.71029
12	*5.00*	*6.00*	0.70020	0.70322	0.69652	0.69168
13	*4.58*	*6.50*	0.68620	0.67830	0.68856	0.69839
14	*4.33*	*7.00*	0.68164	0.66484	0.67506	0.70737
15	*4.25*	*7.50*	0.66493	0.64193	0.65548	0.70468
16	*4.33*	*8.00*	0.66168	0.63944	0.65059	0.71624
17	*4.58*	*8.50*	0.64986	0.62357	0.63793	0.74485
18	*5.00*	*9.00*	0.63552	0.61276	0.61467	0.77408
19	*4.58*	*10.50*	0.62390	0.61334	0.60744	0.72880
20	*4.33*	*12.00*	0.62075	0.61371	0.61027	0.68490
21	*4.25*	*13.50*	0.60506	0.60690	0.60940	0.65562
22	*4.33*	*15.00*	0.58945	0.58870	0.59167	0.61532
23	*4.58*	*16.50*	0.58087	0.57958	0.57893	0.58246
24	*5.00*	*18.00*	0.57317	0.57527	0.57555	0.57566

FL Complexity			Leader firm (1)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.75557	0.70339	0.72173	0.72380
5	*2.50*	*1.30*	0.75467	0.70688	0.72051	0.73730
7	*3.17*	*2.33*	0.75244	0.70850	0.71517	0.71828
9	*4.25*	*3.00*	0.76824	0.64808	0.70664	0.74475
8	*3.67*	*3.33*	0.76341	0.62881	0.74073	0.77076
10	*3.67*	*4.33*	0.76819	0.62604	0.73328	0.71198
11	*3.92*	*5.33*	0.77092	0.61780	0.71093	0.69709
12	*5.00*	*6.00*	0.77308	0.62873	0.69138	0.69286
13	*4.58*	*6.50*	0.78513	0.62785	0.67846	0.70398
14	*4.33*	*7.00*	0.76673	0.63273	0.65661	0.72184
15	*4.25*	*7.50*	0.75930	0.62928	0.63677	0.73612
16	*4.33*	*8.00*	0.75124	0.61840	0.62738	0.73681
17	*4.58*	*8.50*	0.74617	0.61687	0.61493	0.75696
18	*5.00*	*9.00*	0.72174	0.61286	0.61234	0.77386
19	*4.58*	*10.50*	0.71422	0.60917	0.60780	0.71955
20	*4.33*	*12.00*	0.69955	0.59995	0.59749	0.67106
21	*4.25*	*13.50*	0.67929	0.59022	0.59091	0.63615
22	*4.33*	*15.00*	0.67191	0.57849	0.58297	0.60703
23	*4.58*	*16.50*	0.66405	0.57510	0.58003	0.57332
24	*5.00*	*18.00*	0.63426	0.56735	0.56055	0.56452

Table A6.4. (Cont.)

FL Complexity			Leader firm (2)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.72289	0.74039	0.72814	0.72213
5	*2.50*	*1.30*	0.71367	0.76312	0.68533	0.73383
7	*3.17*	*2.33*	0.73539	0.77025	0.66899	0.72754
9	*4.25*	*3.00*	0.71727	0.78514	0.64583	0.75343
8	*3.67*	*3.33*	0.70074	0.79883	0.69792	0.77051
10	*3.67*	*4.33*	0.66884	0.78849	0.70995	0.70773
11	*3.92*	*5.33*	0.64992	0.79709	0.70510	0.68871
12	*5.00*	*6.00*	0.63154	0.77814	0.69110	0.69276
13	*4.58*	*6.50*	0.62941	0.77646	0.67937	0.70982
14	*4.33*	*7.00*	0.62755	0.76379	0.65972	0.72822
15	*4.25*	*7.50*	0.63194	0.75843	0.63918	0.73287
16	*4.33*	*8.00*	0.62596	0.76255	0.63448	0.73785
17	*4.58*	*8.50*	0.61667	0.73498	0.62526	0.75547
18	*5.00*	*9.00*	0.60580	0.72910	0.60963	0.77414
19	*4.58*	*10.50*	0.60236	0.71007	0.61076	0.72220
20	*4.33*	*12.00*	0.60042	0.69890	0.60435	0.67513
21	*4.25*	*13.50*	0.59381	0.69201	0.59106	0.64045
22	*4.33*	*15.00*	0.58067	0.67348	0.58242	0.61638
23	*4.58*	*16.50*	0.57547	0.65329	0.57052	0.57553
24	*5.00*	*18.00*	0.56142	0.62512	0.55907	0.56095

FL Complexity			Leader firm (3)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.73936	0.72430	0.74373	0.70183
5	*2.50*	*1.30*	0.73625	0.69923	0.76674	0.70226
7	*3.17*	*2.33*	0.75617	0.68958	0.77814	0.66662
9	*4.25*	*3.00*	0.75479	0.66395	0.77952	0.71846
8	*3.67*	*3.33*	0.74329	0.62617	0.77324	0.77057
10	*3.67*	*4.33*	0.73490	0.65279	0.77194	0.68032
11	*3.92*	*5.33*	0.71083	0.67321	0.76740	0.62917
12	*5.00*	*6.00*	0.69893	0.69570	0.77028	0.64920
13	*4.58*	*6.50*	0.68189	0.67798	0.78086	0.64708
14	*4.33*	*7.00*	0.66287	0.66684	0.77339	0.66106
15	*4.25*	*7.50*	0.64772	0.64375	0.77228	0.68506
16	*4.33*	*8.00*	0.63664	0.63936	0.75739	0.69537
17	*4.58*	*8.50*	0.61874	0.62489	0.74956	0.72990
18	*5.00*	*9.00*	0.60395	0.61327	0.71986	0.77405
19	*4.58*	*10.50*	0.60686	0.61252	0.72473	0.72220
20	*4.33*	*12.00*	0.60436	0.60783	0.71694	0.67507
21	*4.25*	*13.50*	0.59492	0.59803	0.69302	0.62449
22	*4.33*	*15.00*	0.57829	0.58612	0.66965	0.59908
23	*4.58*	*16.50*	0.56650	0.57685	0.65033	0.57029
24	*5.00*	*18.00*	0.57559	0.56172	0.64145	0.56253

Table A6.4. (Cont.)

FL Complexity			Leader firm (4)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.73921	0.72565	0.69340	0.74978
5	*2.50*	*1.30*	0.73369	0.73175	0.68219	0.76274
7	*3.17*	*2.33*	0.75487	0.73726	0.66992	0.75340
9	*4.25*	*3.00*	0.74626	0.71706	0.64766	0.76358
8	*3.67*	*3.33*	0.72580	0.70754	0.72749	0.76463
10	*3.67*	*4.33*	0.72111	0.67651	0.71069	0.75131
11	*3.92*	*5.33*	0.71375	0.67694	0.67245	0.75643
12	*5.00*	*6.00*	0.69771	0.69972	0.63532	0.76932
13	*4.58*	*6.50*	0.67073	0.67339	0.62193	0.77440
14	*4.33*	*7.00*	0.65208	0.65546	0.61111	0.76298
15	*4.25*	*7.50*	0.61739	0.62067	0.59647	0.76691
16	*4.33*	*8.00*	0.59147	0.59269	0.57490	0.75429
17	*4.58*	*8.50*	0.57246	0.57020	0.56534	0.76328
18	*5.00*	*9.00*	0.54471	0.54651	0.54541	0.76841
19	*4.58*	*10.50*	0.56035	0.56083	0.56099	0.71926
20	*4.33*	*12.00*	0.55616	0.55767	0.55704	0.66917
21	*4.25*	*13.50*	0.56237	0.57578	0.56991	0.65220
22	*4.33*	*15.00*	0.56020	0.56315	0.56214	0.63124
23	*4.58*	*16.50*	0.55473	0.56044	0.55865	0.61018
24	*5.00*	*18.00*	0.56893	0.56383	0.57078	0.63795

Table A6.5. Landscape complexity and average system fitness (perturbation)*

FL Complexity			Individual-istic	Collective	Alliance (1+2; 3+4)	Alliance (1+3; 2+4)	Alliance (1+4; 2+3)
Pm.	*K*	*C*					
4	*2.33*	*0.67*	0.72800	0.73139	0.70885	0.73290	0.71974
5	*2.50*	*1.33*	0.74037	0.74282	0.72313	0.74412	0.72884
7	*3.17*	*2.33*	0.72851	0.73764	0.73210	0.72651	0.73307
9	*4.25*	*3.00*	0.72888	0.73747	0.71668	0.74171	0.72963
8	*3.67*	*3.33*	0.72974	0.73138	0.70820	0.73452	0.72252
10	*3.67*	*4.33*	0.72789	0.73240	0.70053	0.72967	0.72144
11	*3.92*	*5.33*	0.73003	0.72739	0.70351	0.73411	0.72070
12	*5.00*	*6.00*	0.72632	0.72429	0.70733	0.72650	0.72011
13	*4.58*	*6.50*	0.72992	0.73037	0.70681	0.72978	0.71688
14	*4.33*	*7.00*	0.72800	0.73139	0.70885	0.73290	0.71974
15	*4.25*	*7.50*	0.74037	0.74282	0.72313	0.74412	0.72884
16	*4.33*	*8.00*	0.73924	0.73537	0.72038	0.73798	0.72874
17	*4.58*	*8.50*	0.72974	0.73138	0.70820	0.73452	0.72252

* All results reported correspond to averages over 100 simulations.

Table A6.5. (Cont.)

FL Complexity *Pm.*	*K*	*C*	Leader firm (1)	Leader firm (2)	Leader firm (3)	Leader firm (4)
4	*2.33*	*0.67*	0.71103	0.70012	0.69987	0.67411
5	*2.50*	*1.33*	0.73113	0.72480	0.72085	0.71963
7	*3.17*	*2.33*	0.72564	0.72528	0.72474	0.72644
9	*4.25*	*3.00*	0.73095	0.71555	0.69925	0.68963
8	*3.67*	*3.33*	0.72519	0.71150	0.70098	0.69733
10	*3.67*	*4.33*	0.70980	0.70694	0.70604	0.71182
11	*3.92*	*5.33*	0.72502	0.71044	0.70584	0.70321
12	*5.00*	*6.00*	0.71636	0.70996	0.70257	0.70202
13	*4.58*	*6.50*	0.72787	0.70903	0.70725	0.68840
14	*4.33*	*7.00*	0.71103	0.70012	0.69987	0.67411
15	*4.25*	*7.50*	0.73113	0.72480	0.72085	0.71963
16	*4.33*	*8.00*	0.73039	0.72771	0.72314	0.71656
17	*4.58*	*8.50*	0.72519	0.71150	0.70098	0.69733

Table A6.6. Landscape complexity and standard deviation of system fitness (perturbation)

FL Complexity *Pm.*	*K*	*C*	Individual-istic	Collective	Alliance (1+2; 3+4)	Alliance (1+3; 2+4)	Alliance (1+4; 2+3)
4	*2.33*	*0.67*	0.03646	0.03627	0.04705	0.04036	0.04359
5	*2.50*	*1.33*	0.03510	0.02870	0.03701	0.02612	0.02509
7	*3.17*	*2.33*	0.03645	0.03003	0.02937	0.03637	0.02922
9	*4.25*	*3.00*	0.03680	0.03310	0.04116	0.02730	0.03082
8	*3.67*	*3.33*	0.03829	0.03584	0.04601	0.04002	0.04227
10	*3.67*	*4.33*	0.03777	0.03643	0.04521	0.03376	0.03888
11	*3.92*	*5.33*	0.03615	0.03373	0.04158	0.02531	0.03217
12	*5.00*	*6.00*	0.03823	0.03619	0.04003	0.03250	0.02885
13	*4.58*	*6.50*	0.03579	0.03519	0.04212	0.04178	0.03714
14	*4.33*	*7.00*	0.03646	0.03627	0.04705	0.04036	0.04359
15	*4.25*	*7.50*	0.03510	0.02870	0.03701	0.02612	0.02509
16	*4.33*	*8.00*	0.03345	0.03143	0.03943	0.03081	0.02850
17	*4.58*	*8.50*	0.03829	0.03584	0.04601	0.04002	0.04227

FL Complexity *Pm.*	*K*	*C*	Leader firm (1)	Leader firm (2)	Leader firm (3)	Leader firm (4)
4	*2.33*	*0.67*	0.05495	0.06321	0.05895	0.07622
5	*2.50*	*1.33*	0.02421	0.02417	0.02202	0.02455
7	*3.17*	*2.33*	0.03652	0.03266	0.02917	0.03136
9	*4.25*	*3.00*	0.03951	0.05225	0.05724	0.06644
8	*3.67*	*3.33*	0.04422	0.05515	0.05724	0.06722
10	*3.67*	*4.33*	0.04028	0.04574	0.04607	0.04345
11	*3.92*	*5.33*	0.03411	0.04403	0.04611	0.04456
12	*5.00*	*6.00*	0.03872	0.04341	0.04498	0.05152
13	*4.58*	*6.50*	0.04142	0.03987	0.04509	0.05572
14	*4.33*	*7.00*	0.05495	0.06321	0.05895	0.07622
15	*4.25*	*7.50*	0.02421	0.02417	0.02202	0.02455
16	*4.33*	*8.00*	0.03027	0.02993	0.02333	0.02663
17	*4.58*	*8.50*	0.04422	0.05515	0.05724	0.06722

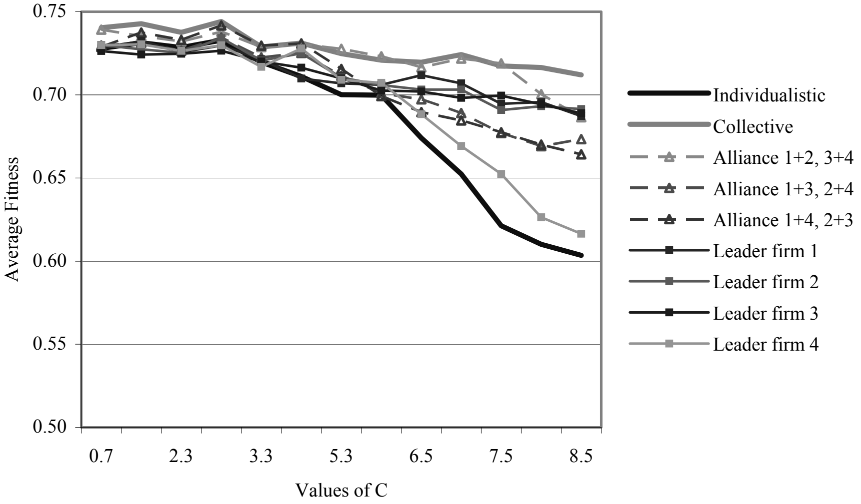


Fig. A6.3. Landscape complexity and adaptive performance (perturbation)

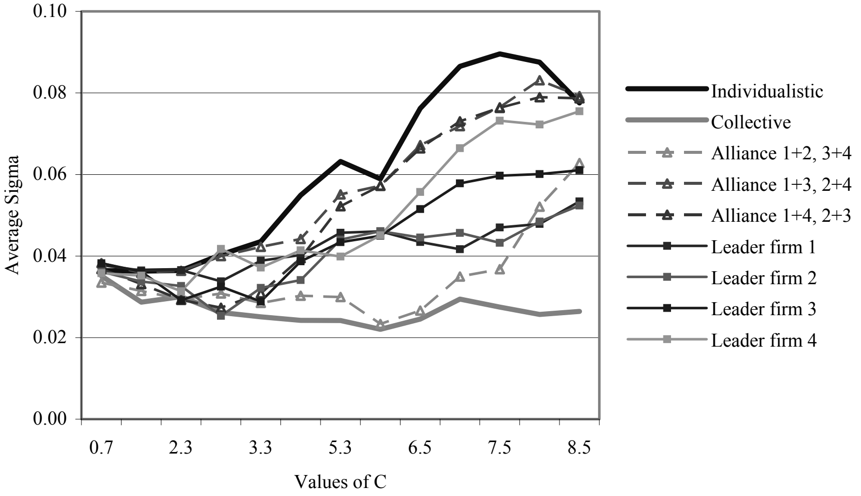


Fig. A6.4. Landscape complexity and stability of adaptation (perturbation)

Table A6.7. Adaptation and group fitness (perturbation)

FL Complexity			Individualistic			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.73260	0.72405	0.72638	0.72896
5	*2.50*	*1.30*	0.74478	0.71520	0.72891	0.73667
7	*3.17*	*2.33*	0.76350	0.72588	0.71509	0.70958
9	*4.25*	*3.00*	0.73746	0.70769	0.72627	0.76018
8	*3.67*	*3.33*	0.73468	0.70018	0.70641	0.73768
10	*3.67*	*4.33*	0.71987	0.70128	0.71098	0.71198
11	*3.92*	*5.33*	0.70343	0.69292	0.70395	0.70020
12	*5.00*	*6.00*	0.69244	0.69803	0.70477	0.70424
13	*4.58*	*6.50*	0.66335	0.66760	0.68153	0.68398
14	*4.33*	*7.00*	0.62990	0.63066	0.66505	0.68425
15	*4.25*	*7.50*	0.59312	0.59531	0.62838	0.66819
16	*4.33*	*8.00*	0.57506	0.57556	0.60683	0.68326
17	*4.58*	*8.50*	0.55471	0.55615	0.57738	0.72591

FL Complexity			Collective			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.74116	0.73787	0.74334	0.73909
5	*2.50*	*1.30*	0.76510	0.71915	0.73425	0.75279
7	*3.17*	*2.33*	0.76069	0.72125	0.75740	0.71124
9	*4.25*	*3.00*	0.74697	0.73755	0.73161	0.76034
8	*3.67*	*3.33*	0.73003	0.73823	0.72404	0.72308
10	*3.67*	*4.33*	0.74082	0.72419	0.70858	0.75093
11	*3.92*	*5.33*	0.73201	0.72381	0.73837	0.70502
12	*5.00*	*6.00*	0.72450	0.71857	0.72861	0.71170
13	*4.58*	*6.50*	0.70299	0.72340	0.72857	0.72355
14	*4.33*	*7.00*	0.70947	0.72941	0.73246	0.72546
15	*4.25*	*7.50*	0.71028	0.72530	0.71918	0.71484
16	*4.33*	*8.00*	0.70510	0.69627	0.71940	0.74504
17	*4.58*	*8.50*	0.68631	0.69272	0.70135	0.76789

FL Complexity			Alliance (1+2, 3+4)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.74230	0.73611	0.74283	0.73571
5	*2.50*	*1.30*	0.76101	0.70090	0.72843	0.75115
7	*3.17*	*2.33*	0.74651	0.73903	0.72003	0.72283
9	*4.25*	*3.00*	0.73427	0.71515	0.74226	0.76023
8	*3.67*	*3.33*	0.72940	0.72466	0.72778	0.73312
10	*3.67*	*4.33*	0.73822	0.71852	0.71807	0.74675
11	*3.92*	*5.33*	0.73870	0.72129	0.72821	0.72265
12	*5.00*	*6.00*	0.71451	0.73123	0.70226	0.74455
13	*4.58*	*6.50*	0.71556	0.71943	0.70356	0.72770
14	*4.33*	*7.00*	0.71282	0.71091	0.73714	0.72646
15	*4.25*	*7.50*	0.70621	0.70675	0.72580	0.73716
16	*4.33*	*8.00*	0.67703	0.67533	0.69619	0.75313
17	*4.58*	*8.50*	0.64991	0.65140	0.68912	0.75576

Table A6.7. (Cont.)

FL Complexity			Alliance (1+3, 2+4)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.73288	0.72517	0.72866	0.73226
5	*2.50*	*1.30*	0.74584	0.71201	0.73028	0.73738
7	*3.17*	*2.33*	0.76134	0.71861	0.71510	0.71098
9	*4.25*	*3.00*	0.73935	0.70934	0.72930	0.76006
8	*3.67*	*3.33*	0.74041	0.70353	0.70670	0.73943
10	*3.67*	*4.33*	0.73140	0.69897	0.73938	0.73101
11	*3.92*	*5.33*	0.70884	0.70502	0.72786	0.70427
12	*5.00*	*6.00*	0.69848	0.70127	0.70168	0.70248
13	*4.58*	*6.50*	0.68911	0.70572	0.69339	0.70112
14	*4.33*	*7.00*	0.66623	0.68916	0.68608	0.71463
15	*4.25*	*7.50*	0.66103	0.67478	0.65903	0.71322
16	*4.33*	*8.00*	0.64535	0.66860	0.64477	0.71793
17	*4.58*	*8.50*	0.63583	0.66857	0.64042	0.74887

FL Complexity			Alliance (1+4, 2+3)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.73305	0.72283	0.72849	0.73116
5	*2.50*	*1.30*	0.74657	0.72653	0.74060	0.73617
7	*3.17*	*2.33*	0.76451	0.71334	0.74047	0.71394
9	*4.25*	*3.00*	0.75129	0.72643	0.72877	0.76037
8	*3.67*	*3.33*	0.75282	0.71710	0.70484	0.74375
10	*3.67*	*4.33*	0.74203	0.71380	0.73952	0.72847
11	*3.92*	*5.33*	0.72123	0.71554	0.71597	0.70948
12	*5.00*	*6.00*	0.69827	0.69821	0.70292	0.69762
13	*4.58*	*6.50*	0.68364	0.68121	0.69280	0.70088
14	*4.33*	*7.00*	0.68145	0.66509	0.68013	0.71192
15	*4.25*	*7.50*	0.67717	0.66257	0.65887	0.71148
16	*4.33*	*8.00*	0.66852	0.63595	0.65823	0.71794
17	*4.58*	*8.50*	0.65096	0.62823	0.63236	0.74559

FL Complexity			Leader firm (1)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.75437	0.69146	0.72751	0.73820
5	*2.50*	*1.30*	0.76691	0.69635	0.73072	0.73564
7	*3.17*	*2.33*	0.77150	0.69986	0.72211	0.70911
9	*4.25*	*3.00*	0.79331	0.63369	0.73143	0.76026
8	*3.67*	*3.33*	0.77015	0.66288	0.71403	0.73870
10	*3.67*	*4.33*	0.76852	0.62057	0.72716	0.72296
11	*3.92*	*5.33*	0.78296	0.61863	0.72014	0.70604
12	*5.00*	*6.00*	0.77971	0.64389	0.70157	0.69899
13	*4.58*	*6.50*	0.78815	0.65001	0.68500	0.72412
14	*4.33*	*7.00*	0.78594	0.63884	0.66112	0.74183
15	*4.25*	*7.50*	0.77151	0.64282	0.62794	0.73643
16	*4.33*	*8.00*	0.77650	0.63831	0.62594	0.74198
17	*4.58*	*8.50*	0.75974	0.61337	0.61492	0.76084

Table A6.7. (Cont.)

FL Complexity			Leader firm (2)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.70561	0.75298	0.72749	0.73403
5	*2.50*	*1.30*	0.72011	0.75071	0.70275	0.73600
7	*3.17*	*2.33*	0.74182	0.77700	0.67084	0.71147
9	*4.25*	*3.00*	0.68288	0.80065	0.69270	0.76022
8	*3.67*	*3.33*	0.70794	0.78352	0.64841	0.74293
10	*3.67*	*4.33*	0.68632	0.79758	0.70947	0.70670
11	*3.92*	*5.33*	0.64272	0.79812	0.70763	0.69330
12	*5.00*	*6.00*	0.64450	0.77581	0.70106	0.70198
13	*4.58*	*6.50*	0.63956	0.77161	0.68423	0.71745
14	*4.33*	*7.00*	0.63532	0.77024	0.66869	0.73848
15	*4.25*	*7.50*	0.63287	0.76819	0.62713	0.73548
16	*4.33*	*8.00*	0.63169	0.77141	0.62531	0.74432
17	*4.58*	*8.50*	0.62843	0.76170	0.61843	0.75748

FL Complexity			Leader firm (3)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.73309	0.72467	0.75326	0.69427
5	*2.50*	*1.30*	0.74406	0.68300	0.77607	0.69402
7	*3.17*	*2.33*	0.76285	0.68603	0.79434	0.65572
9	*4.25*	*3.00*	0.75117	0.63252	0.76224	0.76007
8	*3.67*	*3.33*	0.74406	0.62937	0.79767	0.70935
10	*3.67*	*4.33*	0.74378	0.65502	0.77759	0.68907
11	*3.92*	*5.33*	0.71643	0.68557	0.78849	0.64936
12	*5.00*	*6.00*	0.69507	0.70060	0.78203	0.63258
13	*4.58*	*6.50*	0.68218	0.68854	0.79896	0.63838
14	*4.33*	*7.00*	0.67734	0.66635	0.78159	0.66764
15	*4.25*	*7.50*	0.67372	0.66558	0.77333	0.68558
16	*4.33*	*8.00*	0.64325	0.65638	0.77167	0.70613
17	*4.58*	*8.50*	0.63066	0.62873	0.76528	0.73128

FL Complexity			Leader firm (4)			
Pm.	*K*	*C*	Group 1	Group 2	Group 3	Group 4
4	*2.33*	*0.67*	0.73244	0.72349	0.70995	0.75379
5	*2.50*	*1.30*	0.74348	0.71886	0.69197	0.76718
7	*3.17*	*2.33*	0.76144	0.73007	0.66851	0.74573
9	*4.25*	*3.00*	0.73508	0.70348	0.72307	0.75750
8	*3.67*	*3.33*	0.73960	0.71483	0.64254	0.77055
10	*3.67*	*4.33*	0.73885	0.69550	0.70997	0.76715
11	*3.92*	*5.33*	0.71629	0.67908	0.67950	0.76126
12	*5.00*	*6.00*	0.70008	0.70375	0.65033	0.77485
13	*4.58*	*6.50*	0.67509	0.67885	0.62137	0.77829
14	*4.33*	*7.00*	0.64584	0.64710	0.61128	0.77266
15	*4.25*	*7.50*	0.62347	0.62621	0.59629	0.76363
16	*4.33*	*8.00*	0.58909	0.58984	0.56278	0.76380
17	*4.58*	*8.50*	0.56840	0.56903	0.55750	0.77122

Table A6.8. Payoff for individualistic and egoistic groups (bifurcation)

FL Complexity			*Individualistic*			
Pm.	*K*	*C*	*Group 1*	*Group 2*	*Group 3*	*Group 4*
4	*2.33*	*0.67*	*0.74021*	*0.72711*	*0.72341*	*0.72405*
5	*2.50*	*1.30*	*0.73321*	*0.73146*	*0.72241*	*0.73605*
7	*3.17*	*2.33*	*0.75869*	*0.73424*	*0.71778*	*0.72164*
9	*4.25*	*3.00*	*0.74243*	*0.71363*	*0.69287*	*0.74319*
8	*3.67*	*3.33*	*0.72625*	*0.70140*	*0.72601*	*0.77043*
10	*3.67*	*4.33*	*0.70960*	*0.69163*	*0.71242*	*0.70906*
11	*3.92*	*5.33*	*0.69894*	*0.68292*	*0.69303*	*0.68972*
12	*5.00*	*6.00*	*0.69998*	*0.69914*	*0.69194*	*0.69213*

FL Complexity			**Collective**			
Pm.	*K*	*C*	**Group 1**	**Group 2**	**Group 3**	**Group 4**
4	*2.33*	*0.67*	**0.75065**	**0.73130**	**0.73066**	**0.73480**
5	*2.50*	*1.30*	**0.74574**	**0.73890**	**0.72549**	**0.74982**
7	*3.17*	*2.33*	**0.75424**	**0.73891**	**0.73037**	**0.73332**
9	*4.25*	*3.00*	**0.74657**	**0.72040**	**0.73156**	**0.73269**
8	*3.67*	*3.33*	**0.74098**	**0.72820**	**0.73268**	**0.77036**
10	*3.67*	*4.33*	**0.73351**	**0.72922**	**0.70919**	**0.73804**
11	*3.92*	*5.33*	**0.72490**	**0.71338**	**0.71393**	**0.72402**
12	*5.00*	*6.00*	**0.72029**	**0.71858**	**0.71866**	**0.71856**

FL Complexity			Egoistic group 1			
Pm.	*K*	*C*	**Group 1**	*Group 2*	Group 3	Group 4
4	*2.33*	*0.67*	**0.76234***	*0.72064*	0.73520	0.73847
5	*2.50*	*1.30*	**0.75680**	*0.72277*	0.71457	0.74804
7	*3.17*	*2.33*	**0.76393**	*0.70712*	0.73040	0.72414
9	*4.25*	*3.00*	**0.76888**	*0.66695*	0.72879	0.74553
8	*3.67*	*3.33*	**0.76599**	*0.67863*	0.73847	0.76529
10	*3.67*	*4.33*	**0.76538**	*0.65358*	0.71310	0.72564
11	*3.92*	*5.33*	**0.77342**	*0.64126*	0.71451	0.71415
12	*5.00*	*6.00*	**0.77657**	*0.66662*	0.72230	0.72236

FL Complexity			Egoistic group 2			
Pm.	*K*	*C*	*Group 1*	**Group 2**	Group 3	Group 4
4	*2.33*	*0.67*	*0.72445*	**0.75436**	0.73313	0.74035
5	*2.50*	*1.30*	*0.72182*	**0.75981**	0.70461	0.74070
7	*3.17*	*2.33*	*0.74782*	**0.77278**	0.67850	0.73043
9	*4.25*	*3.00*	*0.72499*	**0.77032**	0.67194	0.74122
8	*3.67*	*3.33*	*0.69737*	**0.79052**	0.69367	0.76525
10	*3.67*	*4.33*	*0.67611*	**0.78425**	0.69653	0.72683
11	*3.92*	*5.33*	*0.65692*	**0.77378**	0.71610	0.70240
12	*5.00*	*6.00*	*0.65694*	**0.77390**	0.71716	0.72104

* Numbers in **bold** represent the fitness of the egoistic agent group, numbers in *italics* that of its neighbour. Comparing these numbers to the benchmark scenarios of *individualistic* and **collective** modes of co-ordination yields the aforementioned prisoner's dilemma payoff structure where: **Egoistic group**>**Collective**>*Individualistic*>*Egoistic neighbour*.

Table A6.8. (Cont.)

FL Complexity			*Individualistic*			
Pm.	*K*	*C*	*Group 1*	*Group 2*	*Group 3*	*Group 4*
4	*2.33*	*0.67*	*0.74021*	*0.72711*	*0.72341*	*0.72405*
5	*2.50*	*1.30*	*0.73321*	*0.73146*	*0.72241*	*0.73605*
7	*3.17*	*2.33*	*0.75869*	*0.73424*	*0.71778*	*0.72164*
9	*4.25*	*3.00*	*0.74243*	*0.71363*	*0.69287*	*0.74319*
8	*3.67*	*3.33*	*0.72625*	*0.70140*	*0.72601*	*0.77043*
10	*3.67*	*4.33*	*0.70960*	*0.69163*	*0.71242*	*0.70906*
11	*3.92*	*5.33*	*0.69894*	*0.68292*	*0.69303*	*0.68972*
12	*5.00*	*6.00*	*0.69998*	*0.69914*	*0.69194*	*0.69213*

FL Complexity			**Collective**			
Pm.	*K*	*C*	**Group 1**	**Group 2**	**Group 3**	**Group 4**
4	*2.33*	*0.67*	**0.75065**	**0.73130**	**0.73066**	**0.73480**
5	*2.50*	*1.30*	**0.74574**	**0.73890**	**0.72549**	**0.74982**
7	*3.17*	*2.33*	**0.75424**	**0.73891**	**0.73037**	**0.73332**
9	*4.25*	*3.00*	**0.74657**	**0.72040**	**0.73156**	**0.73269**
8	*3.67*	*3.33*	**0.74098**	**0.72820**	**0.73268**	**0.77036**
10	*3.67*	*4.33*	**0.73351**	**0.72922**	**0.70919**	**0.73804**
11	*3.92*	*5.33*	**0.72490**	**0.71338**	**0.71393**	**0.72402**
12	*5.00*	*6.00*	**0.72029**	**0.71858**	**0.71866**	**0.71856**

FL Complexity			Egoistic group 3			
Pm.	*K*	*C*	Group 1	Group 2	**Group 3**	*Group 4*
4	*2.33*	*0.67*	0.74209	0.74722	**0.74439**	*0.71495*
5	*2.50*	*1.30*	0.74960	0.70120	**0.76570**	*0.70662*
7	*3.17*	*2.33*	0.75059	0.71582	**0.78545**	*0.68549*
9	*4.25*	*3.00*	0.74056	0.67850	**0.77368**	*0.73207*
8	*3.67*	*3.33*	0.74076	0.65827	**0.77342**	*0.76540*
10	*3.67*	*4.33*	0.72620	0.68165	**0.76635**	*0.67713*
11	*3.92*	*5.33*	0.72258	0.71732	**0.76987**	*0.65547*
12	*5.00*	*6.00*	0.71279	0.72224	**0.77171**	*0.66743*

FL Complexity			Egoistic group 4			
Pm.	*K*	*C*	Group 1	Group 2	*Group 3*	**Group 4**
4	*2.33*	*0.67*	0.74995	0.73952	*0.71053*	**0.75444**
5	*2.50*	*1.30*	0.75027	0.73103	*0.69040*	**0.76313**
7	*3.17*	*2.33*	0.75001	0.74638	*0.68507*	**0.75684**
9	*4.25*	*3.00*	0.75145	0.71921	*0.67591*	**0.77285**
8	*3.67*	*3.33*	0.72241	0.73323	*0.73553*	**0.76531**
10	*3.67*	*4.33*	0.72285	0.71307	*0.70414*	**0.74924**
11	*3.92*	*5.33*	0.70792	0.72226	*0.67161*	**0.76315**
12	*5.00*	*6.00*	0.70295	0.71639	*0.65000*	**0.77480**

Table A6.9. Payoff for individualistic and egoistic groups (perturbation)

FL Complexity			*Individualistic*			
Pm.	*K*	*C*	*Group 1*	*Group 2*	*Group 3*	*Group 4*
4	*2.33*	*0.67*	*0.73260*	*0.72405*	*0.72638*	*0.72896*
5	*2.50*	*1.30*	*0.74478*	*0.71520*	*0.72891*	*0.73667*
7	*3.17*	*2.33*	*0.73617*	*0.70862*	*0.69087*	*0.69977*
9	*4.25*	*3.00*	*0.73468*	*0.70018*	*0.70641*	*0.73768*
8	*3.67*	*3.33*	*0.73746*	*0.70769*	*0.72627*	*0.76018*
10	*3.67*	*4.33*	*0.71987*	*0.70128*	*0.71098*	*0.71198*
11	*3.92*	*5.33*	*0.70343*	*0.69292*	*0.70395*	*0.70020*
12	*5.00*	*6.00*	*0.69244*	*0.69803*	*0.70477*	*0.70424*

FL Complexity			**Collective**			
Pm.	*K*	*C*	**Group 1**	**Group 2**	**Group 3**	**Group 4**
4	*2.33*	*0.67*	**0.74116**	**0.73787**	**0.74334**	**0.73909**
5	*2.50*	*1.30*	**0.76510**	**0.71915**	**0.73425**	**0.75279**
7	*3.17*	*2.33*	**0.74073**	**0.72266**	**0.71482**	**0.71432**
9	*4.25*	*3.00*	**0.73003**	**0.73823**	**0.72404**	**0.72308**
8	*3.67*	*3.33*	**0.74697**	**0.73755**	**0.73161**	**0.76034**
10	*3.67*	*4.33*	**0.74082**	**0.72419**	**0.70858**	**0.75093**
11	*3.92*	*5.33*	**0.73201**	**0.72381**	**0.73837**	**0.70502**
12	*5.00*	*6.00*	**0.72450**	**0.71857**	**0.72861**	**0.71170**

FL Complexity			Egoistic group 1			
Pm.	*K*	*C*	**Group 1**	*Group 2*	Group 3	Group 4
4	*2.33*	*0.67*	**0.75342***	*0.72324*	0.74486	0.74124
5	*2.50*	*1.30*	**0.75539**	*0.70813*	0.73180	0.75285
7	*3.17*	*2.33*	**0.76816**	*0.69622*	0.73068	0.73051
9	*4.25*	*3.00*	**0.75621**	*0.66920*	0.73224	0.73881
8	*3.67*	*3.33*	**0.77977**	*0.66032*	0.73019	0.76054
10	*3.67*	*4.33*	**0.78230**	*0.65971*	0.71908	0.74948
11	*3.92*	*5.33*	**0.78297**	*0.64755*	0.71914	0.70989
12	*5.00*	*6.00*	**0.78019**	*0.65581*	0.72092	0.72627

FL Complexity			Egoistic group 2			
Pm.	*K*	*C*	*Group 1*	**Group 2**	Group 3	Group 4
4	*2.33*	*0.67*	*0.70013*	**0.76893**	0.75643	0.73382
5	*2.50*	*1.30*	*0.70957*	**0.77020**	0.67533	0.75947
7	*3.17*	*2.33*	*0.74181*	**0.78014**	0.67406	0.72524
9	*4.25*	*3.00*	*0.71910*	**0.78972**	0.66924	0.74497
8	*3.67*	*3.33*	*0.70407*	**0.79572**	0.70797	0.76036
10	*3.67*	*4.33*	*0.68534*	**0.79056**	0.70436	0.74703
11	*3.92*	*5.33*	*0.66237*	**0.78446**	0.71385	0.70268
12	*5.00*	*6.00*	*0.65522*	**0.78030**	0.71133	0.72401

* Numbers in **bold** represent the fitness of the egoistic agent group, numbers in *italics* that of its neighbour. Comparing these numbers to the benchmark scenarios of *individualistic* and **collective** modes of co-ordination yields the aforementioned prisoner's dilemma payoff structure where: **Egoistic group**>**Collective**>*Individualistic*>*Egoistic neighbour*.

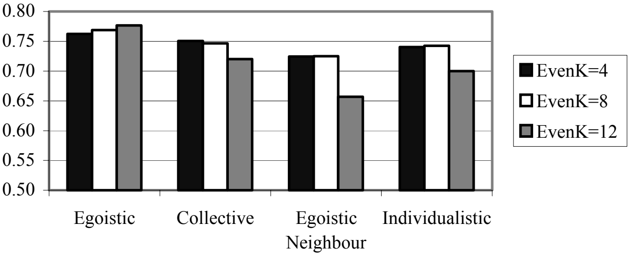
Table A6.9. (Cont.)

FL Complexity			*Individualistic*			
Pm.	*K*	*C*	*Group 1*	*Group 2*	*Group 3*	*Group 4*
4	*2.33*	*0.67*	*0.73260*	*0.72405*	*0.72638*	*0.72896*
5	*2.50*	*1.30*	*0.74478*	*0.71520*	*0.72891*	*0.73667*
7	*3.17*	*2.33*	*0.73617*	*0.70862*	*0.69087*	*0.69977*
9	*4.25*	*3.00*	*0.73468*	*0.70018*	*0.70641*	*0.73768*
8	*3.67*	*3.33*	*0.73746*	*0.70769*	*0.72627*	*0.76018*
10	*3.67*	*4.33*	*0.71987*	*0.70128*	*0.71098*	*0.71198*
11	*3.92*	*5.33*	*0.70343*	*0.69292*	*0.70395*	*0.70020*
12	*5.00*	*6.00*	*0.69244*	*0.69803*	*0.70477*	*0.70424*

FL Complexity			**Collective**			
Pm.	*K*	*C*	**Group 1**	**Group 2**	**Group 3**	**Group 4**
4	*2.33*	*0.67*	**0.74116**	**0.73787**	**0.74334**	**0.73909**
5	*2.50*	*1.30*	**0.76510**	**0.71915**	**0.73425**	**0.75279**
7	*3.17*	*2.33*	**0.74073**	**0.72266**	**0.71482**	**0.71432**
9	*4.25*	*3.00*	**0.73003**	**0.73823**	**0.72404**	**0.72308**
8	*3.67*	*3.33*	**0.74697**	**0.73755**	**0.73161**	**0.76034**
10	*3.67*	*4.33*	**0.74082**	**0.72419**	**0.70858**	**0.75093**
11	*3.92*	*5.33*	**0.73201**	**0.72381**	**0.73837**	**0.70502**
12	*5.00*	*6.00*	**0.72450**	**0.71857**	**0.72861**	**0.71170**

FL Complexity			Egoistic group 3			
Pm.	*K*	*C*	Group 1	Group 2	**Group 3**	*Group 4*
4	*2.33*	*0.67*	0.72860	0.74718	**0.75974**	*0.71431*
5	*2.50*	*1.30*	0.75139	0.68587	**0.76440**	*0.71887*
7	*3.17*	*2.33*	0.75495	0.72070	**0.77503**	*0.67120*
9	*4.25*	*3.00*	0.73662	0.66662	**0.78608**	*0.71622*
8	*3.67*	*3.33*	0.74388	0.66368	**0.76473**	*0.76036*
10	*3.67*	*4.33*	0.72998	0.68700	**0.77797**	*0.70311*
11	*3.92*	*5.33*	0.72715	0.70629	**0.77244**	*0.64337*
12	*5.00*	*6.00*	0.72772	0.72892	**0.78621**	*0.65469*

FL Complexity			Egoistic group 4			
Pm.	*K*	*C*	Group 1	Group 2	*Group 3*	**Group 4**
4	*2.33*	*0.67*	0.73103	0.74793	*0.72123*	**0.74839**
5	*2.50*	*1.30*	0.75630	0.71589	*0.71952*	**0.76104**
7	*3.17*	*2.33*	0.75970	0.74876	*0.68045*	**0.75911**
9	*4.25*	*3.00*	0.72308	0.74081	*0.67640*	**0.75567**
8	*3.67*	*3.33*	0.72850	0.75610	*0.72706*	**0.73372**
10	*3.67*	*4.33*	0.73716	0.72078	*0.70477*	**0.77092**
11	*3.92*	*5.33*	0.72852	0.71155	*0.68596*	**0.74120**
12	*5.00*	*6.00*	0.72143	0.73018	*0.65985*	**0.77701**



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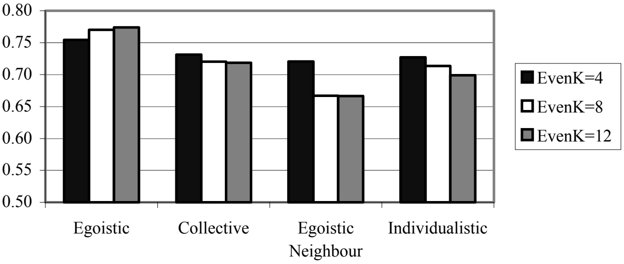

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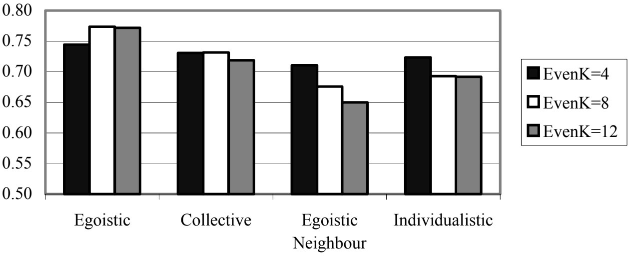

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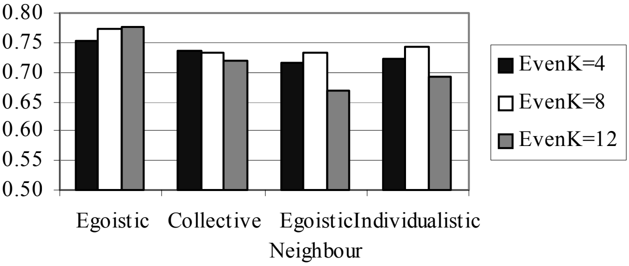

Group 4

Fig. A6.5. Group payoff structures for selected parameters (bifurcation)

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