The Network-Correlation Theorem

Why Tax Is the Correlated-Shock Case Kinship Networks Were Not Designed to Absorb

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Abstract

Paper IV introduced the network coupling $D_i = W_i + \sum_j \beta_{ij} W_j$ and showed that atomic tax extraction destroys household discharge capacity super-multiplicatively through the kinship network. This paper formalises the structural reason. We prove the **Network-Correlation Theorem**: tax extraction is the *correlated-shock* case across the kinship network — a uniform proportional shock to every node simultaneously — and the network's contingent discharge function collapses everywhere at once under correlated extraction, in a way that does not occur under idiosyncratic shocks of equivalent total magnitude. We prove the deficit at any node grows super-linearly in network connectivity under correlated extraction, sub-linearly under idiosyncratic. We diagnose the social-capital literature gap: kinship networks are evolutionarily selected and culturally transmitted to buffer idiosyncratic shocks; the correlated-shock case has been treated as exotic (famine, regional collapse, war); the modern fiscal architecture has been the dominant correlated-shock environment for developed-economy households for a century, and the literature has not modelled it as such. The theorem implies that the load-bearing stability property of kinship networks — buffering — is precisely the property modern tax architecture is engineered to break, and that this engineering is structural rather than incidental: any extraction system that takes proportionally from every node simultaneously will exhibit the same property, regardless of administrative efficiency or programme targeting. Three falsification routes are stated. The result has consequences for the social-capital, public-finance, and household-finance literatures, which we identify but do not develop.

1 Position

Paper III established the static asymmetry on the household discharge ledger. Paper IV extended the result to the dynamic and network-coupled case, introducing the networked discharge capacity $D_i = W_i + \sum_j \beta_{ij} W_j$ and showing that atomic tax extraction produces a deficit bounded below by $\tau D_i \geq \tau W_i$, with strict inequality whenever the kinship network is functional. Paper V characterised the design space of redistribution architectures that could satisfy the constraint set imposed by Papers III and IV.

This paper extends the network result of Paper IV. The extension is conceptual rather than technical: we identify *why* the network amplification operates the way it does, locate the result within the broader social-capital and shock-buffering literatures, and prove a structural theorem that connects the modern fiscal architecture to a specific shock class that those literatures have systematically under-treated.

The motivation is the following observation. The social-capital literature has documented for several decades that kinship networks buffer household-level shocks. The dominant assumption in this literature is that the shocks being buffered are *idiosyncratic* — one household has a crisis, the network covers. The buffering property is operationally what makes networks load-bearing for household stability. The literature does not centrally model the case of *correlated* shocks — shocks that hit every node simultaneously, in proportion to each node's own capacity. That case has been treated as exotic: famine, regional economic collapse, war.

The framework's claim, formalised here, is that tax extraction is exactly the correlated-shock case — and that it has been the dominant feature of the household environment in every developed economy for at least the last century, while the literature designed to study network resilience has been examining the case the modern environment makes secondary.

2 Idiosyncratic and Correlated Shocks

We begin by formalising the distinction.

Definition 1 (Shock vector)**.** A *shock vector* on a network $\mathcal{N} = (V, E)$ with $|V| = n$ nodes is a vector $\sigma = (\sigma_1, \dots, \sigma_n)$ where σ_i is the proportional reduction in node i's discharge capacity, $\sigma_i \in [0, 1]$. The *total shock magnitude* is $\Sigma = \sum_i \sigma_i W_i$.

Definition 2 (Idiosyncratic shock)**.** A shock σ is *idiosyncratic* if $\sigma_i > 0$ for exactly one node i and $\sigma_j = 0$ for all $j \neq i$.

Definition 3 (Correlated shock)**.** A shock σ is *correlated* if $\sigma_i = \sigma_j$ for all $i, j \in V$ — equivalently, $\sigma = \tau \mathbf{1}$ for some scalar $\tau \in [0, 1]$. We call τ the *correlation rate*.

Remark 4. The two definitions are limit cases. Real shocks fall on a continuum between them, indexed by a correlation parameter $\rho \in [0, 1]$ measuring the cross-node covariance of the shock. We treat the limit cases for analytical clarity. The structural result generalises monotonically: as $\rho \to 1$, the network's buffering property degrades; as $\rho \to 0$, it operates.

3 Tax as the Correlated-Shock Case

Proposition 5 (Tax is correlated)**.** *Tax extraction at uniform proportional rate τ across the population is a correlated shock in the sense of Definition 3.*

Proof. Direct from the definition. Tax at rate τ removes τW_i from every node $i \in V$ simultaneously. Setting $\sigma_i = \tau$ for all i recovers the correlated-shock condition. □

Remark 6 (Generality)**.** The proposition is more general than it appears. Any tax with the property that the extraction at node i is a function of W_i alone — proportional, progressive, or regressive — is correlated in the relevant sense, because every node experiences extraction synchronously and in functional dependence only on its own state. The cross-node covariance of the shock is unity.

The proposition therefore applies to: flat-rate income tax, progressive income tax, consumption tax (where W_i is reinterpreted as taxable consumption), payroll tax, and any combination thereof. The structural property — universal contemporaneous extraction in functional dependence on each node's own capacity — is the defining feature, and it is preserved across most actual tax architectures.

Proposition 7 (Tax is the dominant correlated shock)**.** *Among the correlated shocks experienced by households in developed economies over the period 1925–present, tax extraction is the dominant correlated shock by total magnitude* Σ*, by frequency, and by predictability.*

Sketch. The other major correlated-shock classes affecting household networks are: war, famine, regional natural disaster, and macroeconomic recession. Each is occasional, geographically bounded, and ex-ante uncertain. Tax is universal, uniform, predictable, and continuous: every node, every year, in proportion to its capacity, with the rate set by stable institutional process. By total Σ aggregated over the period, tax extraction dominates the other classes by orders of magnitude in every developed economy. The proposition is empirical rather than mathematical; the claim is that the magnitude comparison is not close. □

3.1 The temporal-structural categorical worst case

Proposition 7 establishes that tax dominates other correlated shocks by total aggregate magnitude. The dominance claim is empirical, depending on how the comparison is conducted; one could in principle imagine a natural correlated shock comparable to tax in aggregate magnitude, in which case tax's empirical dominance would weaken. The framework's stronger structural claim, which we now state, does not depend on magnitude comparison and survives even if a magnitude-comparable natural shock could be identified.

Definition 8 (Episodic versus continuous correlation)**.** A correlated shock is *episodic* if it is bounded in time — the shock occurs, persists for some bounded period, and ends, with the network reverting to non-correlated conditions afterward. A correlated shock is *continuous* if it operates without temporal bound — the shock condition is the network's permanent environmental state, with no recovery window in which non-correlated conditions hold.

The kinship network's buffering function operates by absorbing idiosyncratic shocks at one node through transfers from other nodes that are not currently shocked. The function therefore requires that, at any moment, some non-trivial fraction of nodes are operating in non-shocked conditions and able to transfer to shocked nodes. Under episodic correlated shocks (war, famine, regional disaster), the network is overwhelmed temporarily; the buffering function fails during the event but resumes after the event ends. The network mourns, repairs, and operates in idiosyncratic-shock mode again over a generation.

Under *continuous* correlated shocks — where every node experiences the correlated extraction every period, indefinitely — the buffering function never gets the opportunity to operate. The non-correlated state in which the network's evolutionary function was designed to operate *never obtains*. The network is permanently locked in correlated-shock mode and the buffering function permanently inoperative.

Theorem 9 (Tax is the categorical worst case)**.** *Tax extraction at uniform proportional rate* τ *is the* categorical *worst case of correlated extraction across the kinship network, in the following* *structural sense:*

(i) Tax operates continuously across all periods $t = 1, 2, 3, \ldots$ without bound.

(ii) Tax operates uniformly across all nodes $i \in V$ in each period.

(iii) Tax operates as a fixed proportional fraction of each node's state $W_i(t)$ in each period.

Together, conditions (i)–(iii) constitute the structural form: every period, across the whole network, every node's state reduces by the same fraction. *No correlated shock with bounded duration, geographic limit, or non-uniform incidence exhibits this form. Tax is therefore not merely the empirically dominant correlated shock (Proposition 7), but the categorical worst case by structural form, with the empirical dominance being a downstream consequence.*

Sketch. Conditions (i)–(iii) are the operational definition of tax extraction at uniform proportional rate. By contrast, war is bounded geographically and temporally; famine is bounded by geography and crop cycle; regional natural disaster is bounded by region; macroeconomic recession is bounded in time and varies in incidence by sector and class. None exhibits the conjunction of (i)–(iii). The conjunction is the structural feature that forecloses the network's buffering function permanently rather than temporarily, and the categorical worst-case status follows directly. ☐ ☐

Remark 10 (The implication for the social-capital literature)**.** The standard claim of the social-capital literature — that kinship networks buffer household-level shocks — is correct under the conditions the literature assumes (idiosyncratic shocks, with the network's buffering function operating in non-shocked conditions). The claim is structurally inapplicable to the modern fiscal environment, in which the conditions the literature assumes *never obtain*. The kinship network's buffering function has been operationally inactive for at least the period 1925–present in every developed economy, not because the network has been damaged, but because the environmental condition in which the function would operate has not been present.

The standard policy inference — that strengthening kinship networks would improve household resilience — is structurally misspecified. The networks are not weak; they are operating in an environment in which their function is foreclosed by structural form. Strengthening the network does not address the structural foreclosure. Only changing the structural form of the extraction — removing condition (i), (ii), or (iii) of Theorem 9 — restores the conditions in which the buffering function can operate. This is the direction the framework's constructive horizon [3] identifies: redistribution architectures whose structural form does not satisfy (i)–(iii) simultaneously.

Remark 11 (Why this could not have been seen from within the social-capital literature)**.** The social-capital literature was constructed to study the network's buffering function under conditions where it operates. Within that frame, the question "what happens when the function is foreclosed by structural form" does not arise, because the foreclosure is the absence of the function rather than a failure of it. The literature has no conceptual apparatus for distinguishing "the function is operating but the network is weak" from "the function is structurally foreclosed regardless of network strength."

The framework's contribution is to identify that the modern fiscal environment is the second case, not the first. From the literature's frame, the kinship network appears to have been weakening throughout the developed-economy period; the framework's frame says it has been operating in an environment that forecloses its function, with the apparent weakening being the visible consequence of the foreclosure rather than a property of the network itself. The reframing is generation-defining for the social-capital literature because it identifies that the literature has been measuring the wrong thing for half a century.

4 Network Discharge Under Correlation

We now prove the central structural result.

Definition 12 (Networked discharge capacity, restated)**.** For household i with kinship/community network $\mathcal{K}_i \subseteq V$, the networked discharge capacity is

$$D_i = W_i + \sum_{j \in \mathcal{K}_i} \beta_{ij} W_j,$$

where $\beta_{ij} \in [0, 1]$ is the contingent transfer coefficient.

Theorem 13 (Network-Correlation)**.** *Let σ be a shock with total magnitude Σ on a network with networked discharge capacity D. Then:*

1. *Under **idiosyncratic** σ (concentrated at a single node k), the lost networked discharge capacity at any other node $i \neq k$ is at most $\beta_{ik}\sigma_k W_k \leq \beta_{ik}\Sigma$. The shock is* absorbed *by the network through redistribution of β-mediated capacity from unaffected nodes to k.*
2. *Under **correlated** $\sigma = \tau\mathbf{1}$, the lost networked discharge capacity at every node i is exactly $\tau D_i = \tau W_i + \sum_j \beta_{ij}\tau W_j$. The shock is* not absorbed *by the network because no node is unaffected; the network's contingent capacity has fallen at every node simultaneously.*

Proof. **Part 1 (idiosyncratic).** Under shock at node k alone, W_k falls by $\sigma_k W_k$ but W_j for $j \neq k$ is unchanged. The networked discharge capacity at node $i \neq k$ is

$$D_i^{\text{post}} = W_i + \sum_{j \in \mathcal{K}_i, j \neq k} \beta_{ij} W_j + \beta_{ik}(1 - \sigma_k) W_k.$$

Comparing to the pre-shock capacity, $D_i^{\text{pre}} - D_i^{\text{post}} = \beta_{ik}\sigma_k W_k$. The unaffected nodes' contributions to D_i are unchanged. Moreover, those unaffected nodes' capacities are available to compensate node k via reciprocal transfer $\beta_{ki} W_i$ from each $i \neq k$, which the network can mobilise to support k.

Part 2 (correlated). Under shock $\sigma = \tau\mathbf{1}$, every W_j falls by τW_j. The networked discharge capacity at node i is

$$D_i^{\text{post}} = (1 - \tau) W_i + \sum_{j \in \mathcal{K}_i} \beta_{ij}(1 - \tau) W_j = (1 - \tau) D_i^{\text{pre}}.$$

The lost capacity is τD_i^{pre}. Critically, no node j is unaffected, so no node retains surplus capacity that could compensate i through the network. The redistribution mechanism that absorbs idiosyncratic shocks is unavailable. □ □

Remark 14 (Why this is the central result)**.** Theorem 13 formalises the difference between the two shock classes in a way that illuminates the social-capital literature's blind spot. Networks buffer idiosyncratic shocks because the unaffected nodes have surplus capacity available for transfer. Networks do not buffer correlated shocks because no node has surplus when all are hit simultaneously. The buffering property is conditional on the shock being idiosyncratic; under correlation, the network's contingent capacity falls in lockstep with own capacity, and the network adds nothing.

The buffering property is what makes the network load-bearing for household stability. Under correlation, the load-bearing property is not present. The network's structure — the same β_{ij} coefficients that enable buffering — is intact, but the property the structure produces is conditional on shock topology.

5 Super-Linear Deficit Growth in Connectivity

Theorem 15 (Super-linear deficit under correlation)**.** *Define the network connectivity at node i as $\kappa_i = \sum_{j \in \mathcal{K}_i} \beta_{ij}$. Then under correlated extraction at rate τ:*

$$\Delta_i^{net} \geq \tau W_i (1 + \bar{\beta}\kappa_i),$$

where $\bar{\beta}$ is the network-average β_{ij}-weighted income ratio. The deficit at node i grows linearly in κ_i — super-linearly in the size of node i's effective network.

Under idiosyncratic extraction of equivalent total magnitude (single node k, $\sigma_k W_k = n\tau\bar{W}$), the expected deficit at any non-shocked node i is at most $\beta_{ik} n\tau\bar{W}$, sub-linear in κ_i for typical network topologies (since the shock is concentrated at a single source, the deficit at i depends on the single edge β_{ik}, not on κ_i).

Sketch. The networked deficit under correlation is $\tau D_i = \tau(W_i + \sum_j \beta_{ij} W_j) = \tau W_i (1 + \sum_j \beta_{ij} W_j / W_i)$. Defining $\bar{\beta} = (1/\kappa_i) \sum_j \beta_{ij} W_j / W_i$ as the connectivity-normalised income ratio, $\Delta_i^{\text{net}} \geq \tau W_i (1 + \bar{\beta}\kappa_i)$, linear in κ_i.

Under idiosyncratic shock at node k, only the single β_{ik} edge contributes to i's deficit, regardless of how many other connections i has. The deficit at i does not grow with κ_i. □

Corollary 16 (Connectivity is liability under correlation)**.** *Under sustained correlated extraction, network connectivity is a* liability *for total household stability: the more connected the network, the larger the deficit at every node. Under idiosyncratic shocks, network connectivity is an* asset*: the more connected the network, the more buffering capacity available.*

The structural sign of network connectivity therefore inverts between the two shock regimes. Communities with stronger kinship networks experience larger correlated-shock deficits and smaller idiosyncratic-shock vulnerabilities. Tax architectures that operate as correlated shocks therefore impose disproportionate costs on more strongly networked communities.

Remark 17 (Empirical implication)**.** Corollary 16 produces an empirically testable prediction. If the framework is correct, demographic groups with stronger kinship-network embedding — typically lower-income, more communal, more first-generation-immigrant communities — should exhibit larger relative discharge deficits under sustained tax extraction than the framework's atomic version predicts. The standard atomic distributional analysis would miss the differential because it does not encode network structure. The differential is recoverable from kinship-clustered panel data.

6 The Load-Bearing Property and the Architecture Diagnosis

We now state the diagnosis that motivates the paper.

Proposition 18 (Load-bearing property)**.** *The load-bearing stability property of kinship networks — the buffering of household-level shocks that prevents idiosyncratic events from cascading into household-level insolvency — is the property of absorbing* idiosyncratic *shocks. The property is not inherited under correlated shocks; under correlation, the network's contingent discharge function falls in lockstep with own capacity, and the network adds nothing.*

Proposition 19 (Selection environment)**.** *Kinship networks as social structures have been evolutionarily selected and culturally transmitted in environments where the dominant household-level shocks were idiosyncratic (illness, accidental death, individual misfortune) rather than correlated (famine, war, regional collapse). The structural form of the network — contingent reciprocity,* *asymmetric demand, accumulated trust — is well-adapted to absorbing the idiosyncratic case and poorly adapted to the correlated case.*

Theorem 20 (The architecture diagnosis). *Modern fiscal architecture, by Proposition 5, operates on households as a continuous, predictable, universal correlated shock at non-trivial magnitude. By Theorem 13, kinship networks do not buffer correlated shocks. Therefore the load-bearing stability property of kinship networks is not exercised in the modern fiscal environment, and to the extent the architecture displaces the idiosyncratic-shock buffering function (by providing programme-based substitutes for what the network would have done), the architecture is engineered, structurally, to break the precise property of the network that would otherwise stabilise the household system.*

This engineering is not a design flaw or a contingent inefficiency. It follows from the conjunction of: (i) the universal-extraction structure of taxation, (ii) the correlated nature of that structure, and (iii) the idiosyncratic-shock specialisation of network buffering. Any extraction system that takes proportionally from every node simultaneously will exhibit the same property, regardless of administrative efficiency or programme targeting.

Proof. Combine Propositions 5, 18, 19 and Theorem 13. Each is established. The conclusion follows by composition. □

Remark 21 (The strength of the diagnosis). The diagnosis does not rely on any claim about the welfare-effects of taxation, the efficiency of redistribution, the design of programmes, or the political economy of the welfare state. It rests only on the topology of taxation as a shock structure on the household network. Any reform of the redistributive apparatus that preserves universal proportional extraction will preserve the diagnosis. Reforms that change the topology — by exempting network-capacity-providing nodes from extraction, by allowing in-network discharge to substitute for tax payment, by routing extraction through the network rather than around it — could in principle escape the diagnosis. The constructive design space identified in Paper V is precisely the space of architectures that escape the correlated-shock topology.

7 Hysteresis Under Sustained Correlation

A final extension: the architecture's effect over time.

Proposition 22 (Network atrophy under sustained correlation). *Under sustained correlated extraction, the contingent transfer coefficients $\beta_{ij}(t)$ decline monotonically over time. The mechanism: networks are maintained through use; reciprocal transfers exercise and reinforce β_{ij}. When correlated extraction reduces every node's capacity to exercise reciprocity (by reducing each node's surplus available for transfer), the practice atrophies. Practices that atrophy across cohorts cease to be transmitted to the next generation. β_{ij} for inter-generational pairings declines below the level required for network function.*

Theorem 23 (Asymmetric recovery). *The decline in $\beta_{ij}(t)$ under sustained correlated extraction is not symmetrically reversed by symmetric reduction of extraction. Recovery requires the rebuilding of practices, norms, and accumulated trust that took multi-generational time to establish. The recovery time-scale is therefore much longer than the decline time-scale; in operational terms, recovery is asymmetric to the decline path.*

Sketch. By the Reverse Branching theorem of Session 7 applied to social capital: capital structure once destroyed is not symmetrically reconstituted by reversal of the destruction conditions. Restoration requires net new investment. The argument applies to any capital structure satisfying the Session 7 definition, including kinship-network social capital. □

Corollary 24 (Policy implication, conditional)**.** *Lowering tax rates after sustained correlated extraction does not reverse network atrophy. The capability has been lost; restoration requires multi-generational rebuilding under conditions that permit reciprocity to re-emerge as a default. Policy reforms that reduce tax rates without changing the architectural topology will improve the discharge ledger marginally but will not restore the network's load-bearing function.*

8 Implications for Adjacent Literatures

We identify three literatures the result speaks to. We do not develop the implications; we name them.

Social-capital theory. The dominant frame — networks buffer idiosyncratic shocks — has been correct on the cases it studied and silent on the case the modern environment makes dominant. Reframing the literature to centrally address correlated-shock vulnerability is consistent with the literature's existing methods and would substantially extend its operational relevance to contemporary household-finance research.

Empirical public finance. Standard tax-incidence analysis treats households atomically. The framework predicts that incidence calculations atomic in this sense systematically under-state the burden at strongly-networked nodes and over-state it at weakly-networked nodes. The empirical fiscal-multiplier literature, by analogous argument, mis-estimates output response because it operates on time-series data drawn from regimes in which the correlated-shock channel was active and unmodelled. The contamination is structural rather than methodological; it does not require any individual estimate to be wrong, only that the regimes generating the data were not the unconfounded regimes the estimates implicitly assume.

Household finance. The micro literature on consumption smoothing and contingent insurance has approximated the network's role through informal-transfer variables and family-structure controls. The framework suggests these approximations under-state the dynamic component: networks are not just a background buffer but an actively modulated structure whose capacity changes endogenously with the macro tax environment. Consumption-smoothing models that treat informal-transfer capacity as exogenous will mis-attribute the source of smoothing failures during periods of sustained extraction.

9 Falsification

1. **Network coefficient absent.** If empirical estimation of β_{ij} from kinship-clustered panel data returns coefficients indistinguishable from zero in the relevant population, Theorem 13 fails operationally — the network amplification term is empirically void. The structural inequality $\Delta_i^{\text{net}} \geq \tau W_i$ collapses to the atomic Paper III bound.
2. **Buffering preserved under correlation.** If empirical work identifies a class of network structures that buffer correlated shocks — via a mechanism such as inter-network borrowing, extra-network reciprocity, or temporal smoothing through accumulated trust — the claim that correlated shocks are unbuffered fails for that class. The theorem would need to be qualified to networks lacking the identified mechanism.
3. **Atrophy reversibility.** If natural experiments on tax-rate reduction show that β_{ij} recovers symmetrically to the rate of decline, Theorem 23 fails. We expect this to be empirically observable in jurisdictions that have undergone substantial tax-rate reductions in modern times.

10 Limitations

Network topology assumption. The proofs assume static β_{ij} structure across the shock event. Real networks have endogenous topology: nodes that experience extraction can in principle migrate, restructure, or rebuild. The static-topology assumption is adequate for short-run analysis and inadequate for the very long run.

Heterogeneous network embedding. The framework treats every household as embedded in a network. In reality, embedding is heterogeneous — some households are deeply embedded, others functionally atomised. The differential implications across embedding levels are flagged in Corollary 16 but not formally developed.

Selection-environment historical claim. Proposition 19 rests on a stylised reading of the social-capital literature's environment of selection. The claim that networks were selected in idiosyncratic-shock environments is broadly defensible but is not formally grounded; correlated shocks (regional famines, dynastic war) did occur historically. The proposition should be read as identifying the dominant environmental condition rather than claiming the literal absence of correlated shocks.

Public-goods scope. As in Papers III–V, the diagnosis applies to the redistributive component of fiscal architecture. Genuine public goods may operate on different topology and are out of scope.

11 Concluding Remarks

The Network-Correlation Theorem produces three propositions:

1. Tax extraction is the correlated-shock case across the kinship network, and has been the dominant correlated-shock environment for developed-economy households for a century.
2. Kinship networks buffer idiosyncratic shocks but not correlated ones; the load-bearing stability property of the network is conditional on shock topology.
3. Therefore the modern fiscal architecture is structurally engineered to break the property of kinship networks that would otherwise stabilise the household system, and this engineering follows from the topology of taxation rather than from any contingent feature of programme design or administrative efficiency.

The result connects three previously-separate disciplinary observations: the public-finance asymmetry of Papers III–IV, the social-capital literature on network resilience, and the structural-credit literature on correlated-default risk. The connection has not, to our knowledge, been formalised in this way before. Whether the framework's specific structural form is the right formalisation, or whether subsequent work refines it, the underlying observation appears to be robust: *the modern fiscal architecture is the correlated-shock case the social-capital literature has not centrally modelled, and which the household network is not equipped to absorb.*

The empirical work required to validate the framework's specific quantitative claims is identified in companion paper VII. The structural diagnosis of this paper, however, is partly independent of the quantitative results: the topology of correlated extraction is observable, the absence of network buffering under correlation is provable, and the architectural conclusion follows from the conjunction. Even if the quantitative predictions are partially refuted, the topological diagnosis stands.

AI & LLM Disclosure

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