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Can a Growing City be Unhealthy?

How Cities Metabolize Capital

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SECTION I

The Athlete and the Patient

In the past few seasons, the University of Notre Dame has fielded one of the best defensive units in college football. Anchoring the defense is a linebacker corps composed of former four- and five-star recruits, evaluated by scouts to be among the best athletes in their national cohort. As an alumnus and South Bend resident I share a few things in common with these players, but nothing in my profile as a middle-aged father of three would suggest fitness is one of them. Yet by the body mass index (BMI), one of the most widely used benchmarks in healthcare, I am a near match for the average starting linebacker (29.84) and come in below the average of the starting front seven (32.14), a figure that exceeds the threshold for obesity defined by the Centers for Disease Control and Prevention.¹

BMI itself is not wrong. It measures what it was designed to calculate: the ratio of body mass to frame. That said, clinical guidelines and insurers use BMI thresholds as a proxy for health and the basis for eligibility for certain treatments, including the new generation of weight-loss drugs. On paper much of the front seven would qualify. On its own, BMI cannot tell the athlete from the patient. It registers how much body there is, not what the body is made of or how well it works.

Regional economies are measured and managed in much the same way. Growth in population, output, and income are the BMI of a local economy: measures of size that say little about composition. Everyone who allocates capital to places relies on these headline measures for growth: public agencies and incentive programs, philanthropy, lenders, and private investors. Quarterline & Rock counts itself among them, and our conversations with business owners, civic leaders, and investors across the region keep returning to questions existing measures cannot answer.

Two places can post the same growth and same per capita income while one builds and retains value locally and the other's equity, earnings, and decisions sit elsewhere.

Ownership is not a technicality. Those who hold the claims on a place's firms, property, and capital decide where its earnings are reinvested, when its enterprises are sold, and whether the next generation of businesses starts there or somewhere else.

The measures we rely on treat a regional economy as a quantity of mass, focusing on its scale and pace of growth. Yet cities, as complex adaptive systems behave more like a living organism. What if we were to borrow from biology as much as we do from physics in our understanding of regional economies? This essay introduces a lens to read a local economy the way a physician interprets a metabolic panel, asking not how much capital moves through a place, but whether that place converts it into productive capacity, retains the gains, and renews what it owns.



SECTION II

The Metabolic Lens

In 1965 *Scientific American* article, “The Metabolism of Cities” author Abel Wolman likened the sourcing, consuming, and processing of food, water, energy and other natural resources in cities to the process of metabolism, which encompasses the continuous conversion, circulation, and disposal of resources for growth and regeneration.² The article has inspired a growing body of research literature and case studies that have led to advances in material flow accounting.³ The metaphor is an organizing concept in *The Well Tempered City* in which Jonathan Rose examines how energy and resource consumption in cities shaped the course of civilization. According to Rose, the scale of the city or metropolitan region is where the structure of an

1. Heights and weights are as listed on the official 2026 University of Notre Dame football roster (fightingirish.com/sports/football/roster, accessed 10/9/2026). BMI was calculated for each player as weight in pounds multiplied by 703, divided by height in inches squared, then averaged across the 2-deep linebacker depth chart (n=5) and the starting front seven per the 10/10/2026 game vs Stanford depth chart. The Centers for Disease Control and Prevention defines adult obesity as a BMI of 30.0 or greater (cdc.gov/bmi/adult-calculator/bmi-categories.html).

2. Wolman, A. (1965). The metabolism of cities. *Scientific American*, 213(3), 179–190. <https://doi.org/10.1038/scientificamerican0965-178>

3. Kennedy, Christopher, Stephanie Pincetl, and Paul Bunje. “The Study of Urban Metabolism and Its Applications to Urban Planning and Design.” *Environmental Pollution* 159, no. 8–9 (2011): 1965–1973. <https://doi.org/10.1016/j.envpol.2010.10.022>

economy can most usefully be acted upon to improve the sustainability and resilience of broader society.

*The most powerful way to enhance the adaptability of systems is to connect their inputs, outputs, and information, and create conditions in which they can respond to changing stresses. Cities and their metropolitan region are at just the right scale to make the shift to the economics of prosperity and well-being that result in a more integrated system.*⁴

The capital metabolism framework borrows the metabolic lens and its regional orientation but shifts the focus from material throughput and consumption to capital flows and ownership structures. With this lens, the framework can spot conditions that typical resource-flow accounting and conventional economic development measurement both miss. Like a panel, it does not isolate one indicator, but rather the measurements are interpreted through the combination of the results to reveal the pertinent conditions.



SECTION III

Capital Metabolism

Metabolic systems are a product of anatomy (structure) and its physiology (function). The two components are defined in the context of each other. Of the two, physiology is the harder to see and the more decisive. A city can inherit a handsome downtown, sound infrastructure, and attractive housing, and still decline if capital stops circulating, converting, and renewing within it. Mapping these to the regional economy provides an organizing principle to understand the dynamics of capital flows, the performance of which is read through the diagnostic panel.

⁴. Rose, Jonathan. *The Well-Tempered City: What Modern Science, Ancient Civilizations, and Human Nature Teach Us about the Future of Urban Life*. Harper Wave. 2016.

Anatomy: System Components

In the metabolism of cities, the **capital stock** is the “body”: the buildings, infrastructure, businesses, and property a place has accumulated over generations. It is what the metabolism sustains, and what, over time, the metabolism either builds up or wears down. Capital, talent, knowledge, and materials, are the primary **resource inputs**, analogous to oxygen, hydration, and nutrients for a living organism. Local wealth and retained earnings serve as stored energy that can be mobilized for future investments. Cash flow and profits are the core nutrients or energy flowing through the system. Firms, banks, philanthropy, investment funds, and institutions are the **key actors**, akin to the organs and cells that perform specialized functions in the body.

The regulatory apparatus, public incentives, philanthropy operate as the **homeostatic mechanisms**, governing the metabolic process. These mechanisms exist to correct failures and help the system withstand shocks, the way body temperature or blood sugar is held within a range. Public incentives and subsidies are akin to medicine and therapeutic support, providing targeted interventions where market mechanisms are not functioning.

The capital stock presents two faces: the physical face of the built environment and infrastructure, and the ownership face of business equity and property title. These are not separate categories of capital; they are the same stock viewed from two vantage points. One lens is focused on what exists here; the other is looking to see who holds the claims on it. Maintaining both faces in view simultaneously is an important feature of this framework. It is also what distinguishes this application of the metabolic analogy from its established use in urban metabolism literature, where the object of study is material and energy rather than capital.

Physiology: Six Related Functions

Metabolism is achieved through the continuous interplay of the following functions. The order below is expository and is not to suggest sequential flow. Included in the descriptions for each is an example of a failure mode, *pathology*, that extends the analogy to illustrate the relations and consequences of certain modes of capital.

Exchange

Can a community productively exchange resources with the wider markets?

The import and export of goods, services, and talent, like the process of respiration and eating, is the primary means for a city to access capital and net new resources. New value is created through the reciprocation of ideas, goods, and culture between people.⁵ The more opportunities for exchange, the greater diversity of ideas and goods, drives a virtuous cycle of value creation and cultural variety.⁶

Nations impose embargoes because severing trade starves an economy. Metro regions rarely face anything that dramatic. The applicable pathology is *Hypoxia* - chronic oxygen deprivation: A place still trades but its connections to outside markets, investors, and talent are too thin or too narrow to bring in what it needs, or its export base stops renewing.

Circulation

Can appropriate capital reach the places it's needed?

The distribution of capital throughout the city, via local transactions, investments and lending, to productive uses is akin to circulation.⁷ The activities of banks and large investment funds are the major arteries through which the capital flows, whereas local investment networks operate like the capillaries, distributing capital to smaller opportunities overlooked by conventional channels.

When capital exists but cannot reach viable local opportunities, it is akin to *poor perfusion*. As an example, lending to small businesses and property owners may be limited when the options are limited to collateral-based debt. Circulation failures have near-term consequences whereas the impairments to functions like accumulation and regeneration may not be evident until later.⁸

5. Greenberg, Mike. *Poetics of Cities: Designing Neighborhoods that Work*. Ohio State University Press. 1995.

6. Jacobs, Jane. *The Economy of Cities*. Random House Press. 1969.

7. Guiso, Sapienza, and Zingales, "Does Local Financial Development Matter?," *Quarterly Journal of Economics* 119, no. 3 (2004).

8. Circulation concerns whether capital reaches viable opportunities across the economy, including firms, neighborhoods, and borrowers that conventional channels overlook. Gaps in that reach are evidence about how the function performs. Whether a given distribution of capital or income is fair is a separate, important normative question about what a thriving city should be, and one this framework does not attempt to answer.

Conversion

Does capital become genuine productive capacity?

The translation of capital by businesses and entrepreneurs to create new capacity in the form of new businesses, wealth (economic surplus), innovation, real estate, and infrastructure relates to the creation of new energy, cells, and tissue in the body.

When outside investment enters the local economy and results in productive uses, but local capacity to do so never advances, with the pattern continuing, the local economy is reliant upon external capital, a circumstance like a patient on dialysis. For example, in a scenario where every major downtown or neighborhood redevelopment project is undertaken by a non-local developer and lender. No local firm can underwrite, finance, and execute at the scale and conditions required and so an external firm is recruited and incentivized by the community. The buildings get built and projects are realized, but each project results in the expertise, developer fee and equity leaving the market. In the absence of new local capacity, subsequent projects will follow suit.

Accumulation

Does the community retain and build value that can support future activity?

Accumulation represents the retention of surplus as equity, reserves, patient wealth, rather than consuming, distributing or exporting it. It is the anabolic storage arm, building glycogen and bone, not just burning glucose. A healthy system not only transforms capital, it retains enough of the gain locally to draw upon in the future.

When value is removed from an economy without reinvestment in the underlying system, it is like a *parasitic load* on the body. For example, when an investor - often an externally based LLC - acquires a significant share of a neighborhood's housing stock, converts the properties into rentals, collects the rents, but defers the maintenance, and extracts the value elsewhere. The declining quality of the rental portfolio reduces adjacent homeowners property values, which in turn, erodes the community's tax base. The investor can do well for years while the host community weakens, the parasitic feature. The test is whether the holder of an asset continues to draw upon value from it while letting it decline, regardless of where the owner lives.

Regeneration

Does the system maintain, repair, reproduce, and renew its productive capacity?

Regeneration occurs through the replenishment of the existing capital stock, businesses and properties, for continued and future productive use. This entails maintenance and adaptation through the continual development of products, services, skills, and talent, similar to the turnover and repair processes in the body, in which worn components are broken down and rebuilt so the structure itself endures. In a healthy system, the regeneration of assets and succession of ownership preserve agency and capacity within the local system for future generations.

One failure mode of regeneration is a hemorrhage, a condition in which capital, owners, or enterprises are leaving an economy faster than new ones form. This is a particularly salient issue in Indiana, which is facing a generational transition of private sector ownership. A State report finds that the majority of the private sector revenue is tied to company owners over 55.⁹ When an owner is ready to sell, but no local successor or buyer exists, the enterprise sells to an external buyer and the proceeds often follow. As a knock-on effect, contracts with local banks, accounting, and legal firms are replaced by the external acquirer's own providers, reducing the level of capital in local circulation.

Clearance

Can the system remove obsolete capacity and release reusable resources?

Clearance releases businesses, buildings, and land from obsolete or underperforming uses into productive uses where it can be, or removed as waste where it cannot, the way apoptosis removes cells the body no longer needs. In doing so, it frees up capacity and resources to serve more productive uses. Healthy systems operate in an overall equilibrium, with clearance counterbalancing accumulation and growth.

When businesses, land, and buildings remain in unproductive uses it can have adverse effects on the surrounding economy. The metabolic parallel is *necrotic tissue* the body fails to clear. Left in place, the necrotic tissue can lead to infection and damage the surrounding tissue. This is what happens with an abandoned house to its surrounding

⁹ Indiana Business Research Center, *Indiana's "Silver Tsunami": Revenue at Stake from Aging Businessowners* (prepared for the Indiana Office of Entrepreneurship and Innovation, March 2026).

block. It not only stops producing value; it is contributing to declining property values, and higher incidences of crime.¹⁰

Clearance can fail in the other direction, akin to an *autoimmune response* in which healthy tissue is removed along with the dead. Mid-century urban renewal is a significant example, one that deserves fuller treatment than this essay can give it.



SECTION IV

Reading the Panel: Capital Fitness

Fitness is a measure of performance not volume. The metabolic framework is a means to evaluate an economy in terms of its performance against its potential, the capacity the system already holds: the intermediaries, ownership structures, institutions, and assets present in the market. The gap between that capacity and what the system actually does becomes legible by examining how well the local economy performs each of the six core metabolic functions, so as to reveal how capital flows through the economy, where it is held, and whether value created in a place is retained or extracted.

The metabolic framework provides a structure for a diagnostics screen to capture representative data for each function along three dimensions: capacity, flow, and outcomes. Where possible, these draw upon known data sets and common indicators employed in economic analysis. There is a notable asymmetry in available data. Some functions, like exchange, have plenty of descriptive sources whereas for others, such as the location of ownership and equity claims, no established data exists and will need to be gathered through conversations in the market and modeled to assess. The panel also invites a reading of conditions across multiple variables rather than in isolation. A place can be highly efficient on one function and fragile across the system and a single indicator reads the efficiency while missing the fragility.

One implication of this structure is that the “fitness” or health of a local economy can occur regardless of market-size. What matters more than volume or velocity of capital

are the two attributes of the existing capital stock that correspond to its two faces. In the downtown redevelopment scenario described above, the buildings are built (the physical face), while the ownership equity, developer fee, expertise and equity leave (ownership face). A city can be well configured and externally owned. It can also be locally owned and configured so that little exchange occurs. Fitness requires both, which is why the diagnostic reads the two faces together rather than one after the other.



SECTION V

Conclusion

The essay opened with a measure that cannot tell the athlete from the patient. The more serious failure is one no scale can detect. A patient with a normal BMI may have a failing metabolic panel, and because the BMI does not raise the alarm, no one orders the bloodwork. Regional economies share the same blind spot. A place can grow on every measure we track while ownership of its firms, property, and capital quietly shifts elsewhere. If every locally owned bank in a growing metro area were acquired by an out-of-state institution tomorrow, the headline measures would barely move. But decisions about who gets a loan, and where the deposits are put to work, would now be made somewhere else.

This is the distinction the framework is built to make legible. Growth tells us a place is getting bigger. Capital metabolism asks whether that growth becomes productive capacity, whether the value it creates is retained and renewed, and who holds the claims. **A thriving city has a healthy capital metabolism:** it exchanges productively with wider markets, circulates capital to where it is needed, converts it into productive capacity, retains enough of the gain to build on, renews what it has, and clears what is obsolete. And it does so on a stock of capital that is both well configured and held by those with a stake in the community's future.

10. Hye-Sung Han, "The Impact of Abandoned Properties on Nearby Property Values," *Housing Policy Debate* 24, no. 2 (2014): 311-334; Lin Cui and Randall Walsh, "Foreclosure, Vacancy and Crime," *Journal of Urban Economics* 87 (2015): 72-84.

The articles that follow will examine the functions in further detail, the data that can measure them, and the question this essay only opened: how local ownership shapes the way capital moves through a place.

