

THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
BOARD OF TRUSTEES
INNOVATION & IMPACT COMMITTEE
Wednesday – July 23, 2014
2:30 p.m.
The Carolina Inn – Chancellor’s Ballroom West

OPEN SESSION

FOR INFORMATION ONLY

(No formal action is requested at this time)

1. “The Logic of Economic Development: Definitions, Measurement and Metrics” (Attachments A/B)
Maryann Feldman, Heninger Distinguished Professor, Dept. of Public Policy

2. Discussion of Innovation and Impact Committee Agenda and Plans (Attachment C)
Phillip Clay, UNC Board of Trustees

*Some of the business to be conducted is authorized by the N.C. Open Meetings Law to be conducted in closed session.

Committee Members
Phillip (Phil) L. Clay, Chair
Steve Lerner, Vice Chair
Jefferson (Jeff) Brown
Peter T. Grauer
Kelly Hopkins
Andrew H. Powell
Sallie Shuping-Russell
Administrative Liaison:
Barbara Entwisle, Vice Chancellor for Research

The Logic of Economic Development: A Definition and Model for Investment

Maryann Feldman*
Theodora Hadjimichael**
Tom Kemeny^
Lauren Lanahan****

D R A F T 27 June 2104

Abstract: Despite significant public resources devoted to promoting innovation and entrepreneurship there is little agreement about how to measure outcomes towards achieving the larger objectives of economic development. This paper starts by defining economic development and then considers the role of government, arguing that public policy should focus on building capacities that are beyond the ability of the market to provide. This shifts the debate towards a neutral role of government as a builder of capacities that enable economic agents, individuals, firms or communities to realize their potential.

Acknowledgements: We would like to acknowledge funding from the Economic Development Administration of the U.S. Department of Commerce. This work has benefitted from discussions with Andrew Reamer, Kari Nelson, Burt Barnow and Hal Wolman from the George Washington Institute for Public Policy. Our UNC colleagues Alex Graddy-Reed and Nichola Lowe deserve special mention. Input from EDA's Office of Regional Affairs and Performance and National Programs Division, in particular, Bryan Borlik, and Thomas Guevara, Samantha Schasberger and Hillary Sherman, and participants at the EDA regional directors meeting have been instrumental in defining this project. Comments are appreciated from Pontus Braunerhjelm, Joe Cortright, Joshua Drucker, Irwin Feller, Ed Feser, Jon Fjeld, Janet Hammer, Victor W. Hwang, Julia Lane, Mark Partridge, Ken Poole, Karl Seidman, Roland Stephan, Scott Stern, Michael Storper, Alfred Watkins, Howard Wial, and David Wolfe.

Key words: economic development, innovation, entrepreneurship, capacity building, government

JEL codes: R11, R12, O32, O33

* Corresponding author: maryann.feldman@unc.edu, University of North Carolina, Chapel Hill, NC 27514; ** University of North Carolina, Chapel Hill (thadji01@email.unc.edu); ^ London School of Economics (t.e.kemeny@lse.ac.uk); **** University of North Carolina, Chapel Hill (llanahan@email.unc.edu)

Material prosperity and high quality of life are universal goals for democratically elected governments. However, the precise way to best achieve these goals is the subject of considerable theoretical and political debate. More recently, in the face of the most painful recession of the post-war period, policy agendas have become dominated by austerity and macroeconomic considerations. As the recession fades, there is widespread recognition that long-term growth and the competitiveness of industrial economies relies on innovation, entrepreneurship and production – decidedly microeconomic concerns. Unfortunately, although these topics have gained currency, they remain only one element in a chaotic and divisive debate on the role of government in the economy and in particular in supporting future economic growth.

The policy debate is further confused because growth and economic development are often conflated. We lack a clear and shared understanding of what we mean when we talk about economic development. In this journal nearly 30 years ago, Haider (1986) argued that the consensus about the meaning and function of economic development was still emerging – the same remains true today. Yet a careful contrast between development and growth is instructive. While economic growth is simply an increase in aggregate output, economic development is concerned with positioning the economy on a higher growth trajectory through quality improvements, risk mitigation innovation, and entrepreneurship. While economic growth is a function of market forces and tied to macroeconomic conditions, economic development is the product of long-term investments in the generation and dissemination of new ideas, as well as infrastructure. Economic development addresses the fundamental conditions necessary for the microeconomic functioning of the economy. Economic development depends on institutions, social capital, mobility, and income and wealth equity (Crescenzi, ; Fagerber et al. 2013; Pilketty 2014). Economic development requires collective action and large-scale investments that feature long time horizons. Economic development relies on cooperation between the public sector and private enterprise but is predicated on public investments and conditions defined by government.

In defining economic development, it is seemingly impossible not to articulate a role of government, however this discussion is largely absent in theoretical as well as policy-focused conversations. Having dominated global public discourse for over 30 years, the Reagan-Thatcher agenda to reduce government, and its corollary in international development thinking – the Washington Consensus – has run its course. Yet there is no counter argument on the appropriate

role of government to take its place (Rodrik, 2006, Easterly, 2007). There is a need to achieve a consensus definition of economic development with clearly articulated goals and an underlying logic model before undertaking investment and evaluating progress. While business aims to maximize profit or shareholder value, government is the vehicle for accomplishing the common good. Government is the only entity that has the mandate to promote wellbeing and prosperity and the mechanisms to keep the economy on course. Government is the economic entity that is best positioned to make long run, and risky investments. Only the most committed Libertarians recognize no limits for the role of the market in society; all but the most entrenched believers in free-markets recognize that government was the only entity capable of saving the global financial system from collapse in the last recession. Government has been important to the American economy from Alexander Hamilton's tariffs on manufacturing imports to John Kennedy's space race and DARPA's investment in the early Internet. Arguably, this kind of active involvement in development characterizes most of the examples of successful national catch-up during the 20th century (Freeman, 1987; Page, 1994; Rodrik, 1994). Most simply, government is a vehicle for collective action and for achieving mutually defined objectives: the agent for whom the principal is the citizens and the businesses within its borders, with a host of ensuing principal-agent problems.

For too long, economic development has been associated with lagging regions and poverty eradication, often with an international focus (Massey, 1988). Yet the concept of economic development is increasingly relevant in advanced economies. All regions are vulnerable to economic restructuring and need to consider how to adapt to the changing economy. Places once prosperous have been humbled by international competition and struggle to redefine themselves (Feldman & Lanahan, 2010; Christopherson et al, 2010). Even places currently doing well realize their economic base could quickly evaporate, leaving them insecure about future prospects. Continual restructuring is now the new norm; the universal concern is how to best secure an economic future. The concept of economic development is now relevant to the full range of nations, places and communities.

With so much at stake there is a need to clearly define economic development as distinct from economic growth. Though it is certainly possible to have growth without development in the short or even medium-term, economic development creates the conditions that enable long-run economic growth. Based on a review of the literature, we define economic development as

the development of capacities that expand economic actors' capabilities. These actors may be individuals, firms, or industries. While actors have different perceived potential, it is difficult to predict the next new idea or to understand how genius may arise. In contrast to a resource-based economy, where location was constrained to natural endowments, a modern, knowledge-based economy depends on capacity that is constructed over time. The success of many regional economies may have been initiated by historical accident, whether we are thinking of William Shockley's mother, or (another example – optics? something else?) . But fortune favors the prepared: the ability to benefit from serendipity relies on underlying capabilities (Feldman & Francis 2003). Advantage is due to capacity investments that yield a long-term return (Rodríguez-Pose and Storper, 2006). In the absence of any clear bets, the best strategy is to enable as many individuals to fully participate in society. New examples of economic development strategies include infrastructure projects that now extend to the digital realm to include the creation and use of knowledge, or the support of education and literacy in a time when the labor force usually requires a bachelor's degree with the expectation of continued lifetime education and training. The private sector can then leverage these capabilities to create economic growth, which ultimately enhances the wellbeing of individuals, communities and society. Of course, the distribution of spoils in the modern knowledge economy is notoriously unequal (Rosen, 1981). The difficulty in advancing the public interest is to find balance that scaffolds economic transactions while not over regulating, and provides support and incentives without discouraging initiative.

Moreover, there is a need to consider the underlying logic of economic development to guide public investment decisions. Government investments are commonly evaluated using private sector metrics, such as return on investment (ROI); they are also measured using well-known but much-criticized techniques such as economic impact multipliers. Focusing efforts on estimating impact, despite many sophisticated evaluations, have proven unsatisfactory (GAO). Instead, new metrics are needed that properly incentivize economic development. For example, jobs are a central concern of government policy: for growth what matters is the number of jobs while for economic development the focus is wages, career advancement opportunities, and working conditions. This requires a logic model or theory of change to discern the mechanisms by which government investment in economic development can achieve the desired objective.

Economists tend to be skeptical of place-based economic development strategies, considering the tradeoff with national welfare – while local places certainly benefit. The contention is that resources are simply being redistributed to the detriment of overall national welfare. There is little empirical work on this topic and theoretical work tends to focus on the default, mathematically tractable assumption of constant returns to scale. However, the major contribution of the new growth theories is to recognize that knowledge benefits from increasing returns to scale rather than the constant or decreasing returns associated with physical commodities. Activities that create knowledge and the sharing of knowledge create increasing returns that would lead to increased national welfare. But at this point neither theoretical nor empirical economics can address this question. Policy makers cannot afford to wait. As Klein and Moretti conclude, “Second best may, in practice, be very attractive relative to the status quo.”¹The case for place-based policies is accepted for the remediation of localized market imperfections. Economists agree that a key role of governments is to provide services that raise the quality of life of local residents.

The ultimate goal of economic development is to create economic prosperity and high quality of life. Intermediate goals - for example, to increase innovation or to reduce barriers to entrepreneurship and private sector investment - are the means to the ultimate end of creating this prosperity. The investment challenge is to ascertain progress towards these goals in complex environments, and under conditions for which impact is difficult to attribute to any one specific investment. It is certainly possible to consider the impact of investment on outcomes for individual firms. However, economic development investments aim to build capacity that extends beyond individual firms to benefit the larger ecosystem.

Defining Economic Development

Economic development is simultaneously a concept, an activity and a professional practice. Not only is economic development a popular topic of discussion, it is also an activity for which there are high expectations, and significant investments of public money. Perhaps the only agreement currently is that economic development is difficult to define (add cites) Nevertheless defining economic development is a necessary prerequisite to advance the

¹ Klein and Moretti. 2013:34.

discussion towards objective policy discussion and robust measurement. There are many works that focus on economic development but never articulate a definition (Schumpeter ; Sen) There is a rich academic literature that focuses on economic development that defines theory and practice (Greely). What is lacking is a simple definition.²

A first step in defining economic development is distinguishing it from the concept of economic growth. Economic growth has a strong theoretical grounding and is easily quantified as an increase in aggregate output. In theorizing economic growth, David Ricardo (1819), and later Robert Solow (1956) and many others conceptualize an economy as a machine that produces economic output as a function of inputs such as labor, land, and equipment. Growth occurs when output increases. Output can increase either when we add more inputs or use technology or innovation in order to enhance the efficiency with which we transform inputs into outputs. In part because of this straightforwardness, economic growth, with its emphasis on increases in population, employment or total output dominates the debate, despite the fact that increases in any or all of these could be associated with both improvements and/or declines in prosperity and quality of life. The consensus is that development is a fuzzier and more far-reaching idea. Nobel laureate Robert Lucas (1988:13) quips, “we think of (economic) growth and (economic) development as distinct fields, with growth theory defined as those aspects of economic growth we have some understanding of, and development defined as those we don't.”

One of the differences between growth and development lies in the time frame for realizing impact. Our preoccupation with short-term growth is an often-discussed problem (Barton 2011). For a private firm, growth in sales and profits is a measure of market success. However, taken to the extreme, publicly traded companies that succumb to the pressure to constantly better last quarter’s earnings often disregard long-term strategic opportunities (Greve 2013). Places that are fast growing benefit from an increased tax base, but congestion leads to higher costs of services, which can outweigh the benefits of growth. Unfortunately promoting all and any growth is too often an easy victory to win at the expense of longer-term goals and objectives (Rubin 1988). Indeed, many of our conceptual tools may not be quite up to the task of economic development. Douglas North (1984) argues that neoclassical economics’ focus on short-run optimal resource allocation is simply not well suited to the dynamic, long-term

² This work was undertaken under the direction of the U.S. Department of Commerce, Economic Development Administration, with the articulated need for such a definition.

orientation that defines the process of economic development. Consider that it takes seven years for an academic discovery to be incorporated into an industry (Mansfield) or 18 years of education to produce a scientist.

While economic growth is easily quantified and measured, economic development is more qualitative, although today the indexing of ethereal and relative concepts like happiness is commonplace (Frey and Stutzer, 2002; Blanchflower and Oswald, 2004). Economic growth provides slack resources that, if invested well in economic development, provide the basis for future economic growth (Amsden 1997). For example, the Indian economy has a surplus of uneducated labor, suggesting that attracting low wage industry would be a viable economic growth strategy. However, as part of an economic development strategy begun in the 1960s, the Indian government chose to make significant investment in engineering and technology education. In what initially appeared to be a prototypical form of brain drain, U.S. universities attracted students from India. But decades later the result was an Indian diaspora in Silicon Valley that benefitted both countries through social ties that facilitated knowledge flows and investment (Saxenian 2002, 2006). The result has been the emergence of a major Indian software engineering industry, concentrated in Bangalore (Arora and Athreye 2002). Korea followed a similar example of capacity building investments in economic development that subsequently yielded a high rate of economic growth. Faced with devastation after the Second World War and Korean Wars, Kim (1997) documents the government's long-term growth strategy that invested in education and research while simultaneously developing export industries to absorb this capacity. Both of these examples highlight the long-term nature of economic development investments.

Economic development may be viewed as a precursor to economic growth. <Placeholder – add Piketty and literature on equity> Indeed, examples abound of national economies that have experienced significant increases in economic output, due to either population growth or large-scale resource extraction, with little broad-based improvement in individuals' quality of life and ability to realize human potential. There are numerous countries in sub-Saharan Africa, Central and South American and Oceania that provide examples of growth without development (Acemoglu et al. 2002; De Soto, 2000; Moyo, 2009). These economies are increasing their ranks of highly educated professional elites, skilled workers, and officials occupying high-level positions in international NGOs; at the same time they receive substantial support from foreign

aid. National income will grow, coupled with notable investments made by the public sector. Despite these indicators, as the Overseas Development Institute (2009) highlights, little progress has been made on health outcomes such as infant mortality, morbidity rates and life expectancy. Moreover, these nations suffer from significant income inequality and limited educational attainment, especially among women and immigrants, and growing polarization (Wolfson 1997). Despite international aid many countries are unable to provide adequate medical, social, and educational institutions that enable the entire population to thrive. With insufficient support for economic development, longer-term outcomes that lead to broad-based improvements in quality of life and widespread prosperity remain inaccessible. Keefer and Knack (2001:146) find evidence that income inequality and polarization – what we associate with the lack of economic development – fosters an environment of uncertainty. This erodes the enforcement of property and contractual rights that, “affect growth directly, by influencing the choice of production process and the efficiency with which production is carried out, and indirectly by reducing incentives to invest.” Weak economic development erodes capacities and places limits on economic growth in the future. Of course, growth provides slack resources that may either be appropriated by rent-seeking elites or invested in economic development to provide the basis for future economic growth. When long-run prosperity rests not on resource extraction but on the ongoing production of ideas, investments in economic development become even more essential as a precursor to growth.

If economic development is not the same as economic growth, then what exactly is it? Amartya Sen’s (1999) international work, while never providing a precise definition, considers economic development to be the strengthening of autonomy and substantive freedoms, which allow individuals to fully participate in economic life. Hence, economic development occurs when individual agents have the opportunity to develop the capacities that allow them to actively engage and contribute to the economy. In the aggregate, this should lower transaction costs and increase social mobility. Rather than being reduced to a static factor in a production process, individuals become the agents of change in the process of economic development: they have the freedom to realize their potential. The greater the number of individuals able to participate in the economy and the society, the greater the opportunity for new ideas to circulate and be put into action. Economic development is measured by rising real per capita income, Gini coefficients and other measures of the distribution of income and wealth as well as indicators of quality of

life, that range from life expectancy to crime statistics to environmental quality. From this standpoint, economic development differs from growth in terms of a focus on a broader set of metrics. Although Sen's work was rooted in the context of some of the world's poorest countries, this definition and criteria are equally relevant to the range of regional economies.

Defining development in this way, and contrasting with growth gives sense to the expected outcomes of economic development. Economic development, according to Joseph Schumpeter (1961), involves transferring capital from established methods of production to new, innovative, productivity-enhancing methods. Schumpeter's conceptualization was focused on understanding the origins of the business cycle and the conditions that gave rise to new opportunities that propelled the economy forward to a higher economic growth trajectory. Schumpeter discusses the emergence of systems of complementary capabilities that develop around key radical innovations to create economic growth. For example, the industrial revolution was driven in part by changes in the means of production in the textiles industry; these changes generated a variety of social and economic effects that then extended to other complementary sectors, and diffused throughout the economy. During the industrial revolution, the factory became the unit of production, moving people off farms and into cities and required clocks and accounting systems to regulate working hours. The result was a sustained increase in the standard of living, albeit not without certain adjustment costs.

In Schumpeter's view, economic development entails a fundamental transformation of an economy. This includes altering the industrial structure, the educational and occupational characteristics of the population, and indeed the entire social and institutional fabric. While growth is measured by putting more people to work within an existing economic framework, economic development is aimed at changing that framework so that people work more productively, and the economy shifts toward higher-value activities. One important conclusion from this is that, while economic growth can be measured quarterly, realizing gains in economic development may take decades or generations.

Schumpeter's attention to innovation and entrepreneurship proved ahead of its time; these concerns now lie center stage in policy discussions about economic development. Entrepreneurs are the agents of change in an economy and the source of increased productivity – those actors who recognize opportunity and garner resources to create value. Innovation and entrepreneurship are two sides of the same coin: Entrepreneurs identify opportunity and innovate, while

innovation is the commercial realization of value from a new idea or invention from an entrepreneur. Innovation may result in new products introduced to the market, new production processes or new organizational forms. While radical new breakthrough advances hold our imagination, there are many more mundane industries and incremental forms of innovation that are within reach and that rely on different types of knowledge. Successful firms often arise in unusual locations, serving unanticipated customer needs in unexpected ways.

Seen from this point of view, efforts to foster innovation and entrepreneurship are the long-term solution to current concerns over the long-term decline in productivity that seems to have afflicted the U.S. Since 1973, growth in productivity has been lagging compared to historic rates, except for periods leading up to economic bubbles. Gordon (2010) argues that current productivity rates represent the slowest growth in measured American living standards over any two-decade interval recorded since the inauguration of George Washington, while Cowen (2011) describes the last several decades as “the Great Stagnation.” There is clear cause for concern. Macroeconomic policy has not been able to engineer a solution. Understanding the microeconomic foundations of innovation and economic development offers perhaps the best, and maybe the only, policy prescription.

Despite the pervasive image of the lone genius, innovation is a social activity that requires a mix of individuals with different skills to collaborate to create value. Rather than distributed uniformly through time and across geographic space, innovation tends to cluster both temporally and spatially. This creates cycles of boom and bust, causing disruption for people who move to follow opportunity, as well as the many who remain. One of the reasons why regions, and in particular, cities, have moved to the center of attention is that inventors heavily rely on local information or knowledge in generating novel products or processes. When an industrial activity dominates a landscape, the factors of production become tailored and result in increasing returns. These factors of production include specialized skilled labor, which is often referred to as *talent* but extends to all the workers involved in production. Related and subsidiary activities, which support and create economies of scope and both formal and informal institutions, which share expertise and define a future trajectory are all part of the factors of production. Observing that much industrial know-how defies formal capture through market transactions, Alfred Marshall (1890) is noted to have said, *the secrets of the industry are in the air*. Despite the Internet and advances in teleconferencing, innovation still requires debating

ideas, unpredictable epiphanies and chance encounters. Innovation is interesting to study because it is essentially unpredictable – rooted in the creative sparks that make us human and the serendipity that makes life interesting.

This has implications for economic development in both creating the capacities that promote innovation as well as easing the transitions for places. Of course, predicting what will be the next *big thing* or even next important industry is difficult, and most likely too difficult. Location becomes important not only for recognizing opportunity but also for providing an environment that is responsive to the entrepreneurs' activity, which in turn lowers the cost of innovating (Audretsch & Feldman, 1996). Innovation and entrepreneurship require economic agents to venture into uncharted domains and test the limits of their capabilities to realize potential rewards. Even the most accomplished venture capital investors and stock analysts make bad investments from time to time. It is no easier for government than for private investors to decide which companies will be successful or how markets will develop. We never know which new opportunities will yield a high return and which projects or companies will fail. The best way to hedge society's bets is building the capacity of individuals to fully and creatively participate in economic and social life, and to incentivize companies to more fully realize their capability to add to the economy. By facilitating industrial upgrading and improving infrastructure, government lowers transaction costs to expedite economic exchanges. By investing in institutions, government lowers risk and supports the utilization of private sector capabilities.

Economists conclude that the development of high quality institutions is the major factor behind economic growth (Rodrik et al. 2002). Lipset (1959) argues that the efficiency of a political jurisdiction's social and economic institutions define economic development. Institutions are the rules of the game, enforcement mechanisms or the accepted standard of behavior in a society (Ostrom 1986). Institutions operate with specific rules and procedures that lower transaction costs and inspire confidence by certifying the range of potential outcomes. High quality institutions support productive activities and encourage capital accumulation, skill acquisition, invention, and technology transfer (North and Thomas 1973). Rosenberg and Birdzell (1987) highlight how the development of institutions conducive to capitalism was a driving force in *How the West Grew Rich*. Two points about institutions are relevant to solidifying our understanding of economic development. First, there is no single institution, such

as the legal system or property rights that supports economic development. What matters is an underlying capability and orientation of the social and economic organization of a society, especially the capacity to instill confidence in the future. Formal and even informal institutions create predictability and order that allow individuals and businesses to make investment decisions. Second, institutions are endogenous – that is, they are the product of history, culture and historical accidents. Institutions evolve in unexpected and idiosyncratic ways. However desirable, it is mostly not possible to transplant organizations or sets of incentives wholesale from where they originate to other contexts where they appear to be needed. Instead, organizations and incentives need to flow from existing institutional arrangements. Engaging in economic development means building or augmenting existing institutions that are critical to progress.

Michael Porter (1998:19-20), in his very influential work, *The Competitive Advantage of Nations*, considers that, “Economic development seeks to achieve long-term sustainable development in a nation’s standard of living, adjusted for purchasing power parity.” The term sustainable, as defined by Tatyana Soubbotina at the World Bank (2004:9 – 10), could “be otherwise called equitable and balanced, meaning that, in order for development to continue indefinitely, it should balance the interests of different groups of people...in three major interrelated areas—economic, social, and environmental.” But in defining standard of living, Porter unfortunately conflates economic growth with economic development: “Standard of living is determined by the productivity of a nation’s economy, which is measured by the value of the goods and services (products) produced per unit of the nation’s human, capital, and physical resources.” When economic development is confused with economic growth, then private sector constructs are often adopted uncritically as means by which public investments ought to be evaluated.

It is not uncommon for policy makers to talk about return on investment (ROI), yet this belies the fact that government invests in those activities that the private sector does not find lucrative enough to warrant their own investment in the short term, or for which the capital requirements are so large and the number of actors so complex that collective action is required. Porter (1998) does not articulate a role for government policy, but instead considers government as a background condition with influence on all of the factors in what has become known as Porter’s Diamond. Porter’s emphasis, however, does highlight what the private sector requires to

be profitable and internationally competitive. Porter advances the idea of geographic clustering of industries in a model that includes the nature and extent of the inputs required by firms to produce goods or services; the type and intensity of local rivalry; the quality of demand for local services; and the extent and quality of local suppliers and related industries. These factors certainly define firm and industry capabilities as one of the important components of a regional economy. However, Porter does not directly consider capabilities that support and sustain innovation and new firm formation. The focus on existing industries precludes an emphasis on the nascent or emerging industries that offer the most in terms of upside economic potential. In the *Innovator's Dilemma*, Clayton Christensen (1997) points out that innovative firms that focus solely on their currently profitable activities are eclipsed by their more innovative competitors. Of course, the trick is to appreciate potential before the opportunity becomes obvious.

Clusters appear to occur spontaneously as a result of the natural tendency for industrial activity, especially innovative activity to cluster spatially, however they build on existing capacities (Audretsch and Feldman 1996). In many cases the design and cultivation of competitive industry clusters, often seen as a policy panacea, has failed to produce meaningful economic development (Martin and Sunley 2003; Duranton, 2011). This failure has also contributed to dissatisfaction with government policy (Lerner 2009). One reason perhaps is that the cluster model obscures the role of government and fails to consider how industrial competitiveness translates into economic development outcomes for an economy. The concept of competitiveness, while operational at the individual firm and industry level, does not translate fruitfully into economic development activities and often creates bidding wars between adjacent jurisdictions that would benefit from working together. Despite all the attention to lowering tax rates and increasing a pro-business climate, the evidence suggests that these factors have little effect on economic growth, while actually decreasing the potential for economic development (Goetz et al, 2011; Hungerford 2012).

Economic development is also a professional practice that uses definitions more inclusively than those of academic economists. Two influential American planners, Fitzgerald and Leigh (2002:33) propose that, "...economic development preserves and raises the community's standard of living through a process of human and physical infrastructure development based on principles of equity and sustainability." This adds to the concept of community and expands the objectives of economic development to explicitly embrace equity

and also highlights sustainability. In this conceptualization, economic development is about creating choice or expanding the opportunity set for both consumers and businesses. Equitable and sustainable economic development fosters economic growth that – at the same time – renews and improves the capacities and conditions that make growth possible. While industrial activity certainly benefits from location, the resulting profits are often not distributed back to local residents or reinvested in those same places that provided the advantage to firms and industries. Pieces of the economic development puzzle are missing and require greater articulation.

Inspired above all by Sen, and building on the prior work discussed above, we offer the following definition: *Economic development is the expansion of capacities that contribute to the advancement of society through the realization of individuals', firms' and communities' potential. Economic Development is a sustained increase in prosperity and quality of life through innovation, lowered transaction costs, and the utilization of capabilities towards the responsible production and diffusion of goods and services. Economic development requires effective institutions grounded in norms of openness, tolerance for risk, appreciation for diversity, and confidence in the realization of mutual gain for the public and the private sector. Economic development is essential to creating the conditions for economic growth and ensuring our economic future.*

By capacities, we mean conditions conducive to promoting an array of intermediate outcomes that set the stage for the realization of potential. This potential may be realized at multiple levels– for an individual, a firm or set of firms or industry, a community of people or a place. One lesson that history teaches is that the limits of potential are unbounded and lie in uncharted domains. Building capacities allows for a better platform to accommodate an uncertain future and the ability to meet many possible contingencies. Economic development thus depends on the expansion of human capital in its broadest sense, such that individuals can more fully participate in the economic, social and cultural patterns of behavior that encourage initiative, engagement, co-operation and competition. This vision represents a stark contrast to the commonplace picture of an adversarial relationship between government and business.

Rationale for Government Investment in Economic Development

Capacity building requires government investment: there is simply no other entity that has societal benefit as its main objective and is able to command the resources required to have

significant impact. Government is a vehicle for collective action: an agent for whom the principal is its citizens and the businesses within its borders. While the not-for-profit and even for-profit sector has taken over many functions previously allocated to government (Salamon 2002), the results of this privatization are mixed. Government is the principal inclusive vehicle for organizing economic, social and civic life. In contrast, markets are concerned with transactions and coordinate activity through prices. The invisible hand works on the logic that firms attempt to maximize profits or shareholder value while workers seek to maximize their wages. The result is the all too familiar race to lower costs through relocation or the de-skilling of the labor force. This market logic does not account for longer-term potential firm benefits due to worker suggestions for new product improvements or even Henry Ford's epiphany that if he paid his workers more they could afford to buy his cars.

Government seeks to allocate resources for the collective good and tries to simultaneously satisfy a large number of constituencies. In reality, the profit maximization goal of private business is much easier to achieve than satisfying the diverse goals required for the achievement of government effectiveness. While it has become popular to bemoan the quality of government services, a reasonable benchmark may be our levels of satisfaction with mobile phone service, computer operating system, insurance claims or consumer choice in many product markets. We hold government to a higher standard because, implicitly at least, we acknowledge its functions are critically important.

Giving primacy to the market hides the fact that markets would be very primitive without government. When government works well, the private sector benefits through greater productivity and efficient use of resources. Government also mitigates risk through a relatively stable and predictable system of laws and money. Government provides rules and incentives – the conditions under which modern markets are even possible, and enable the private sector to realize its potential. More broadly, government provides for social order and predictability in contracts and daily life. The difficult balance for the government to strike is to provide for the realization of potential while not reducing incentives in the private sector.

Economists have traditionally relied on the theory of market failures to justify government investment in economic activity. The longstanding rationale is that, in order to increase efficiency, the government must intervene in situations where the market does not function optimally. Markets are concerned with transactions. In a variety of circumstances,

specifically those concerning public goods; information asymmetries; industry conditions that provide a barrier to new firms being able to enter; and the difficulty of pricing externalities, markets yield less than efficient outcomes. Efficiency, for economists, refers to the use of resources that maximizes the production of goods and services. As described in almost every economic textbook, market failures lead to sub-optimal outcomes and inefficient use of resources.

An easy illustration of the market failure justification for government investment is Research and Development (R&D) investment. Nelson (1959) cogently argues for federal funding to support R&D activity within the U.S. by observing that “when the marginal value of a ‘good’ to society exceeds the marginal value of the good to the individual who pays for it, the allocation of resources that maximizes private profits will not be optimal.” Strict reliance on the private sector results in an under-investment in R&D (Bush, 1945). Econometric estimates provide evidence that the rate of return on R&D investments are higher than for ordinary capital; moreover, the social returns are even higher (Hall, Mairesse and Mohnen 2009). However, R&D does not exist in a vacuum; investing in R&D critically depends on complementary social capabilities and infrastructure to support and bolster economic growth (Fagerberg et.al forthcoming).

Market failure has become a primary rationale for all government investment in the economy. The logic of market failures, though appropriate to justify R&D investment, should not be uncritically extended to all government investment. In the discourse of market failure, the market takes primacy while the government’s role is minimized. Amsden (1997: 470) makes the case that the market failure approach, while useful in considering economic exchanges, is inadequate when the focus is on economic development, which requires building and sustaining markets and communities. Markets only work when there are well-defined property rights, a valid medium of exchange and enforceable contracts. These require agreement, collection action and enforcement.

There are many attempts to substitute market mechanisms for government provisions using economic logic. For example, support for public funding for higher education has eroded (Bok, 2009). The argument is frequently made that educated individuals receive higher wages as a result of their investment in human capital (Spence, 1973). This suggests that it is rational for individuals to make the investment rather than use public funding. However, job markets are

highly uncertain and individuals invest without a guaranteed return (Green & Zhu, 2010). Moreover, having a well educated workforce generates larger social returns (Greenstone, Hornbeck and Moretti 2010). The consensus in both the theoretical and empirical literature is that spillovers have a positive significant impact on firm and industry productivity, and economic growth (Jaffe & Trajtenberg, 1993). These positive spillovers represent a subsidy that is impossible to price or even attribute, but they are nonetheless real. In contrast to market logic, public provision of higher education has long been justified in the U.S. as a building of capacity to allow citizens to fully participate in social and economic life (Nash 1963).

Neoclassical economics is centrally concerned with the efficient allocation of goods. It treats the creation of knowledge as exogenous – ideas simply appear (Arrow, 1962; Romer 1995). A fuller consideration of the benefits of government R&D investment suggests that the private benefit may be recast as increased capacity. Indeed, Salter and Martin (2001) highlight that government R&D investments creates additional long-term dynamic externalities as skills and capabilities are developed. This in turn lowers the cost of subsequent inventive activity. Investments in R&D offer opportunities for experimentation and learning that enhance the ability to solve complex technological problems and extend the scope of inquiry. Finally, government R&D investments make it easier for firms to absorb information and improve private sector decision-making and ability to innovate (Cohen & Levinthal, 1990).

With a more nuanced understanding of the nature of innovation and entrepreneurship, the case for government involvement is stronger (Feldman & Kelly, 2003). At the point when technology has the greatest potential for creating new industries, the frontiers are poorly defined and the chances of failure are high. Complex new technologies require collaboration and information sharing; however, the cost of establishing research and development partnerships and making them work productively is a disincentive to the private sector despite the high potential to create new industries. As evidenced by pharmaceutical manufacturers' current focus on blockbuster life-style drugs, the profit motive favors short-term activity with large market potential. Based on short-run profit motive alone, much of value may be left on the table.

By contrast, government is the actor in the economy best positioned to act with an eye to the long run, undertaking investments that provide a platform for economic growth. There are exemplary cases of government investment in the development of nascent but transformative technologies, such as radar, penicillin, atomic energy, the Internet, and space travel. Firms have

only weak incentives to invest in new technologies that are radically different from those that already exist. Formerly radical new technologies required decades of public support to reach the threshold of commercial viability. Direct government investment is essential, given the long-term, risky and commercially unpredictable nature of basic research. Entrepreneurial firms have been most innovative when given the opportunity to capture economic rents opened up by complementary public investment.

Rather than relying on the market-based rationales for public investment, it is important to define the function of the public sector as building and bolstering capacity. Rather than viewing individuals and firms as objects on the receiving end of public initiatives, economic development requires that they be considered as active agents. This prioritizes improving quality of life and wellbeing by enhancing capabilities and ensuring that agents have freedom to achieve their potential as productive members of society. When every actor in society is capable of being an active agent with the potential for full participation in economic and communal life, society makes better use of available resources.

If we reconsider the rationale for government investment through a capacity building lens, then government serves as a facilitator for the population at large, including the private sector. By promoting capacity, the public sector's contribution extends beyond improving efficiency and equality towards bolstering a foundation upon which long-term growth and development can be sustained.

Evidence suggests that at a time when market fundamentalism has come to guide policy debates, government has actually become more and more immersed in the economy through its technology policies (Block & Keller, 2009) and public institutions (Schrank & Whitford, 2009).³ The nature of scientific research has changed due to the decentralization of industrial networks and open innovation. Rather than being confined to the R&D labs of large corporations, collaborative activity is now embedded in networks of scientific collaborators between both public and private institutions (Stephan, 2012). This decentralization not only encourages more organizations to work in concert, but also fosters a greater dependence on government programs

³ While the most recent estimates of public investment in university R&D show slight declines, this is attributable to financial constraints that resulted from the recent economic recession rather than a changing shift in public support for R&D. Source: <http://www.insidehighered.com/news/2012/01/23/state-funds-higher-education-fell-76-2011-12#.Tx1RreVDRX4.mailto>

to coordinate these networks. In their examination of the *R&D 100*, which catalogs cutting-edge premier innovations, Block and Keller (2009) observe that organizations have moved away from vertical integration toward relying more heavily on complex collaborations that include governmental agencies or government programs as important conveners and intermediaries. Inter-agency collaborations like the United States' Jobs and Innovation Accelerator Challenge are a perfect example of this emergent practice.⁴

At the same time, bolstering capacity as a rationale for government intervention is as old as the American republic. As Alexander Hamilton (1791) highlighted in his Manufacturing Report presented to the House of Representatives, the government holds the responsibility to build a foundation so that the private sector can flourish. He emphasized the role of manufacturing in leading the country toward economic growth and prosperity. Hamilton saw manufacturing as a complement to other economic activities, providing for the “employment of persons who would otherwise be idle (and in many cases a burden on the community), and increasing the viabilities of communities.” Following Hamilton’s advocacy, tariffs were imposed on imported manufactured goods. These tariffs were the major source of government revenue until the imposition of the federal income tax. This infant industry policy supported the development of U.S. manufacturing, which became the backbone the economy.⁵

Capacity building has been instrumental throughout the American experience. Investments in building the TransAmerican railroad or supporting the World Wide Web by the Department of Defense and the National Science Foundation have served to enhance the private sector abilities. In the United States, there have been cyclical debates about the role of government with the waning and waxing of regulations, tariffs and social policies. Yet the role of government in building scientific and research capacity has never been questioned. A long-term contract between the public and private sector has been the foundation for American prosperity, providing the opportunity for the private sector to create, build, employ, trade and innovate.

Capacity is essential to innovation and entrepreneurship. Innovation relies on creativity and we are never sure where genius originates. Our investments in building innovation capacity come with a certain level of necessary risk because the results cannot be immediately observed nor can we accurately predict how they will be affect products and processes over time. For

⁴ <http://www.eda.gov/challenges/jobsaccelerator/>

⁵ Unfortunately, too often tariffs have been used to support mature industries.

example, J.K. Rowling was a welfare mother when she wrote her first *Harry Potter* manuscript. The result demonstrates the potential of small, seemingly inconsequential efforts (Bell 2012). It took Rowling 12 attempts to find a willing publisher. Once published, the novel did well. It created an entire new category of fiction for young teens – an audience that publishers felt was moribund. Of course, Rowling had the capacity to pursue her ambition: she was well educated and public assistance gave her the chance to pursue her ambitions. As reported in the *Financial Times* in 2003, J.K. Rowling became wealthier than the Queen of England.⁶ Like a true entrepreneur, her ideas have created wealth and jobs through subsequent films, video games, toys, and now even, a theme park. The underlying idea from this simple example is that it is impossible to predict which ideas will create the desired outcomes. But the greater the capacity in the total population, the more likely that unexpected ideas can take hold and innovation will propel the economy forward.

A common argument against industrial policy is the idea that government will become captive to vested interests. While there is broad consensus that innovation serves as an integral catalyst in leading the trajectory of an economy and even society forward, the emphasis in economic development policy remains on traditional attraction and retention incentives. This is often directed at specific businesses, which is largely a zero-sum game with little or no broader effects for economic development. In addition, local governments tend to support the same policies over time, adding incremental changes to preexisting strategies, rather than a wholesale reconsideration of investment strategy. The emphasis recently has shifted towards boutique, targeted policies. Yet, as we consider that the greatest economic growth potential is expected from the development of new industries, the difficulty of predicting what will be the next big thing is a daunting task for venture capitalists, investment bankers and other experts. Our argument is that government has a vital role in promoting capacities that enable the fullest variety of human endeavors and potential, including a variety that cannot be foreseen.

Policy efforts aimed at fostering equity are commonly criticized as handouts that produce perverse incentives to diminish effort. Despite intentions to “even the playing field”, the American public has notable reservations in supporting redistributive programs (Pittau, et al. 2013). Up until the recent economic recession, many espoused anti-regulation and pro-

⁶ "In the News." *Financial Times* [London, England] 28 Apr. 2003: 3. *Financial Times*. Web. 30 Aug. 2013.

privatization practices. Nevertheless, as we reflect on economic practices over the past few decades, many are questioning the tenets of the Chicago School of Economics: rent-seeking behavior associated with widespread deregulation and retraction of government involvement in the marketplace and society is widely considered to have contributed to the growing socioeconomic rifts across the U.S. population as well as the dramatic economic downturn that began in 2008. In his recent book, *The Price of Inequality*, Nobel Prize winning economist Joseph Stiglitz (2012) argues that equity and efficiency must be considered in tandem. The skewed distribution of wealth in the U.S. has grave consequences for the economy and society. Those occupying the middle and lower rungs of the income distribution are unable to follow the American Dream because they lack the capabilities to fully participate in the economy. If this cycle continues there is potential for subsequently even greater divergence in income and opportunity, leaving those who are disadvantaged less able to gain access to education, finance and opportunity. Moreover, as Brenner and Pastor (2013) emphasizes, the increasingly unequal distribution of income inhibits entrepreneurship, slows economic growth, and destabilizes the economy of American cities. Rather than viewing equity and efficiency at odds, they appear to be complements. Reconsidering the role of government argues for a broader framework focused on building capacities designed to benefit the entire population.

The Goals of Government Investment in Economic Development

For the private sector, the objectives are clearly defined as profit maximization and organizational survival. For government, articulating a vision and meeting a set of broad objectives is more difficult as a result of competing interests, the need to consider diverse perspectives, and the inability to divest mandated but unprofitable and sometimes unpopular activities. In the absence of an accepted consensus vision for government, it is too easy to give in to competing short term demands or become diverted to serve other purposes. An articulated vision for government is crucial to following a long run course.

From a societal point of view, increases in quality of life, which includes long-term prosperity, is the ultimate vision of economic development for democratic governments. Prosperity and quality of life are often synonymous with the concept of the *good life*, which encompasses a sense of material comfort as well as psychological satisfaction and health (Lane 1994). Indeed, the concept of the American Dream is an ideal of a good life based on a classless

society with meritocratic advancement and continual progress (Cullen 2003). High quality of life is an integral outcome for government policy. It would be difficult to argue for the opposite as an articulated objective for government in any democracy.

Economic development is the means to achieve the objective of high quality of life and prosperity. The notion behind greater prosperity and better quality of life is that they are earned by working hard, realizing potential, and being successful. Employers reward professional success and innovativeness with higher wages or more prestigious jobs, which then translates into higher income. But underlying this ideal is the reality that individuals are educated and prepared for gainful employment, and that high quality jobs are available, with opportunities for advancement. Reaching this objective requires the public and private sector work together for their mutual gain and the greater good of society.

Prosperity and high quality of life are laudable long-term goals. More intermediate realized outcomes, however, may be used to measure more tangible progress, such as, the quality and quantity of jobs created, the earnings and wealth of individuals, the types of new innovative goods and services introduced to the market and investments made and the growth and exporting of firms. These intermediate outcomes are only realized through the actions of the private sector and require that firms have incentives to take risk and are actively engaged in the production and distribution of goods and services. Economic development requires effective institutions grounded in norms of openness, tolerance for risk, appreciation for diversity, and confidence in the realization of mutual gain for the public and the private sector. These are the ideal goals for a better functioning economy.

Conclusion

We define economic development as activities that expand capacities to realize the potential of individuals, firms or communities who contribute to the advancement of society through the responsible production of goods and services. Economic development addresses the functioning of the microeconomics of the economy. Without economic development, economic growth is limited. The ultimate result of economic development is greater prosperity and higher quality of life; however, these goals can only be realized through sustained innovation, activities that lower transaction costs through responsive regulation, better infrastructure and increased education and opportunities for more fruitful exchange. Only by appreciating the role of

government as a vehicle for collective action, , and not simply a corrective against market failure, can we ensure our economic future.

The logic of economic development requires certain capacities that require collective action through government. For government to be effective in creating economic development there is a need for performance and impact measurement systems that are able to provide decision support for strategic investments, to assess progress made in the catalytic capacity-building function, and to assess the limitations and barriers that prevent the utilization of capacity that government investments build. More than simply ex-post evaluation, there is potential for continuous improvement and adjustment when metrics are monitored. However, it is important to be sure that measurement is done well and reflects an understanding of the complex process of economic development. In this paper, we have built a foundation for understanding economic development and the role of government that should permit the future development of such performance and impact measurement systems.

References

- Acemoglu, D., S. Johnson, and J. A. Robinson (2002). Reversal of Fortune: Geography and Institutions in the Making of the Modern World Income Distribution. *The Quarterly Journal of Economics* 117 (4): 1231-1294.
- Audretsch, D. B. and M. P. Feldman. (1996). R&D Spillovers and the Geography of Innovation and Production. *American Economic Review*, 86(3): 630–640.
- Amsden, A. H. (1997). Editorial: Bringing production back in—Understanding Government's economic role in late industrialization. *World Development*, 25(4), 469-480.
- Arora, A., & S. Athreye. (2002). The software industry and India's economic development. *Information Economics and Policy*, 14(2), 253-273.
- Arrow, K. (Ed.). (1962). *Economic welfare and the allocation of resources for invention*. Princeton, NJ: Princeton University Press.
- Beine, M., F. Docquier, & H. Rapoport, (2001). Brain drain and economic growth: theory and evidence. *Journal of Development Economics*. 64(1): 275-289.
- Bell, M. (2012). J K Rowling and the Publishers' Moan, *The Independent*. September 23. Accessed online (August 27, 2013) <http://www.independent.co.uk/voices/comment/j-k-rowling-and-the-publishers-moan-8165843.html>
- Blanchflower, D. G., & Oswald, A. J. (2004). Well-being over time in Britain and the USA. *Journal of public economics*, 88(7), 1359-1386.
- Block, F., & M. R. Keller. (2009). Where do innovations come from? Transformations in the US economy, 1970–2006. *Socio-Economic Review*, 7(3), 459-483.
- Bok, D. (2009). *Universities in the marketplace: The commercialization of higher education*. Princeton University Press.
- Brenner, C. and M. Pastor (2013). Buddy, Can You Spare Some Time? Social Inclusion and Sustained Prosperity in America's Metropolitan Regions. Working paper was presented at the Building Resilient Regions closing symposium at the Urban Institute, Washington, DC.
- Bush, V. (1945). Science, the endless frontier. *Transactions of the Kansas Academy of Science*, 48(3), 231-264.
- Christensen, C. (1997). *The innovator's dilemma: when new technologies cause great firms to fail*, Harvard Business Press.
- Christopherson, S., Michie, J., & Tyler, P. (2010). Regional resilience: theoretical and empirical perspectives. *Cambridge Journal of Regions, Economy and Society*, 3(1), 3-10.
- Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative science quarterly*, 128-152.
- Cowen, T. (2011). *The Great Stagnation: How America Ate All The Low-Hanging Fruit of Modern History, Got Sick, and Will (Eventually) Feel Better: A Penguin eSpecial from Dutton*. Penguin. com.
- Cullen, J. (2003). *The American dream: A short history of an idea that shaped a nation*. Oxford University Press.
- De Soto, H. (2000). *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*, New York: Basic Books.
- Duranton, G. (2011). California dreamin': the feeble case for cluster policies. *Review of Economic Analysis*, 3(1), 3-45.

- Easterly, W. (2001). The political economy of growth without development: A case study of Pakistan. Paper for the Analytical Narratives of Growth Project, Kennedy School of Government, Harvard University.
- Easterly, W. (2007). Was development assistance a mistake?. *The American economic review*, 328-332.
- Fagerberg, J, M.P. Feldman and M. Srholec (forthcoming) Technological Dynamics and Social Capability: Comparing U.S. States and European Nations, *Journal of Economic Geography* .
- Feldman, M. P. and J. Francis. (2003). Fortune Favors the Prepared Region: The Case of Entrepreneurship and the Capitol Region Biotechnology Cluster. *European Planning Studies*, 11 (7): 765-788.
- Feldman, M. P., & Kelley, M. R. (2003). Leveraging research and development: Assessing the impact of the US Advanced Technology Program. *Small Business Economics*, 20(2), 153-165.
- Feldman, M., & Lanahan, L. (2010). Silos of Small Beer: A case study of the efficacy of federal innovation programs in a key midwest regional economy. In S. Progress (Ed.), (Vol. September 23, 2010). Washington DC: Center for American Progress.
- Fitzgerald, J., & N. G. Leigh. (2002). *Economic revitalization: Cases and strategies for city and suburb*. Sage Publications, Incorporated.
- Freeman, C. (1987) *Technology, policy, and economic performance: lessons from Japan*. Pinter Publishers.
- Frey, B. S., & Stutzer, A. (2002). What can economists learn from happiness research? *Journal of Economic literature*, 402-435.
- Goetz S J, Partridge M D, Rickman D S, Majumdar S, (2011) Sharing the gains of local economic growth: race-to-the-top versus race-to-the-bottom economic development, *Environment and Planning C*, 29(3), 428 – 456
- Gordon, R. J. (2010). Okun's law and productivity innovations. *The American Economic Review*, 100(2), 11-15.
- Green, F., & Zhu, Y. (2010). Overqualification, job dissatisfaction, and increasing dispersion in the returns to graduate education. *Oxford Economic Papers*, 62(4), 740-763.
- Greenstone, M., R. Hornbeck, & E. Moretti. (2010). Identifying Agglomeration Spillovers: Evidence from Winners and Losers of Large Plant Openings. *The Journal of Political Economy*, 118(3): 536-598.
- Hall, B. H., J. Mairesse & P. Mohnen. (2009). *Measuring the Returns to R&D*. National Bureau of Economic Research.
- Hamilton, A. (1791). Report on Manufacturers. In D. Communicated to the House of Representatives, 1791 (Ed.). Washington DC.
- Hammer, J. (2009) Development that Adds Up: Accounting for the Social Bottom Line of Triple Bottom Line Investment. Social Equity and Opportunity Forum. College of Urban and Public Affairs. Portland State University.
- Hoyman, M., & Faricy, C. (2009). It Takes a Village A Test of the Creative Class, Social Capital, and Human Capital Theories. *Urban Affairs Review*, 44(3), 311-333.
- Hungerford, T. L. (2012). *Taxes and the Economy: An Economic Analysis of the Top Tax Rates Since 1945 (Updated)*. CRS Report for Congress.

- Jaffe, A. B., Trajtenberg, M., & Henderson, R. (1993). Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. *The Quarterly Journal of Economics*, 108(3), 577-598.
- Keefer, P. and S. Knack. (2002). "Polarization, Property Rights, and the Links Between Inequality and Growth. *Public Choice* 111(1-2):127-54.
- Kim, L. (1997). *Imitation to innovation: The dynamics of Korea's technological learning*, Harvard Business Press.
- Lane, R. E. (1994). Quality of Life and Quality of Persons A New Role for Government? *Political theory*, 22(2), 219-252.
- Lerner, J. (2009). *Boulevard of broken dreams: why public efforts to boost entrepreneurship and venture capital have failed--and what to do about it*. Princeton University Press.
- Lerner, J. (2010). *Geography, Venture Capital and Public Policy*. Rappaport Institute/Taubman Center.
- Lipset, S. M. (1959). Democracy and working-class authoritarianism. *American Sociological Review*, 482-501.
- Lucas, R. E. (1988). On the mechanics of economic development. *Journal of monetary economics*, 22(1), 3-42.
- Marshall, A. (1890). *Principles of economics*. London: MacMillan for the Royal Economic Society, 1961.
- Martin, R., & P. Sunley. (2003). Deconstructing clusters: chaotic concept or policy panacea? *Journal of Economic Geography*, 3(1), 5-35.
- Massey, D. S. (1988). Economic development and international migration in comparative perspective. *The Population and Development Review*, 383-413.
- Moyo, D (2009) *Dead aid: Why aid is not working and how there is another way for Africa*. London: Allen Lane.
- Nash, M. (1963). Approaches to the study of economic growth. *Journal of Social Issues*, 19(1), 1-5.
- Nelson, R. (1959). The simple economics of basic scientific research. *Journal of Political Economy*, 67, 297-306.
- North, D. C. (1984). Government and the Cost of Exchange in History. *Journal of Economic History*, 44(2), 255-264.
- North, D. C. and R.P. Thomas (1973) *The Rise of the Western World: A New Economic History*. By Douglass C. North and Robert Paul Thomas. New York: Cambridge University Press.
- Ostrom, E. (1986). An agenda for the study of institutions. *Public Choice*, 48(1), 3-25.
- Overseas Development Institute (2009). *Growth without development: Looking beyond inequality*. Briefing paper 47, February.
- Page, J. (1994). The East Asian miracle: four lessons for development policy. In *NBER Macroeconomics Annual 1994, Volume 9* (pp. 219-282). MIT Press
- Pittau, M.G., R. Massari and R. Zelli (2013) Hierarchical modelling of disparities in preferences for redistribution, *Oxford Bulletin of Economics and Statistics*, 75(4): 556-84.
- Porter, M. E. (1998). *Competitive advantage of nations*. New York: Free press.
- Putnam, R. D., Leonardi, R., & Nanetti, R. Y. (1994). *Making democracy work: Civic traditions in modern Italy*: Princeton University Press.
- Ricardo, D., Gonner, E. C. K., & Li, Q. (1819). *The principles of political economy and taxation*: World Scientific.

- Rodrik, D. (2006). Goodbye Washington consensus, hello Washington confusion? A review of the World Bank's economic growth in the 1990s: learning from a decade of reform. *Journal of Economic literature*, 44(4), 973-987.
- Rodrik, D. (1994). Getting interventions right: how South Korea and Taiwan grew rich (No. w4964). National Bureau of Economic Research.
- Rodrik, D., A. Subramanian, & F. Trebbi. (2002). Institutions rule: the primacy of institutions over geography and integration in economic development. National Bureau of Economic Research.
- Romer, P. (1995). Beyond the knowledge worker. *World Link*, 28, 56-60.
- Rosen, S. (1981). The economics of superstars. *The American Economic Review*, 71(5), 845-858.
- Rosenberg, N., & Birdzell, L. E. (1987). How the West grew rich: The economic transformation of the industrial world: Basic Books.
- Ruttan, V. W. (2006). Is war necessary for economic growth? Military procurement and technology development: University of Minnesota, Department of Applied Economics.
- Salamon, L. M. (Ed.). (2002). The tools of government: A guide to the new governance. Oxford University Press.
- Salter, A. J., & B. R. Martin,. (2001). The economic benefits of publicly funded basic research: a critical review. *Research Policy*, 30(3), 509-532. doi: 10.1016/s0048-7333(00)00091-3
- Saxenian, A. (2006). The new argonauts: regional advantage in a global economy. Cambridge, Mass.: Harvard University Press.
- Saxenian, A. L. (2002). Brain Circulation: How high-skill immigration makes everyone better off. *Brookings Review*, 20(1), 28-31.
- Schrank, A., & J. Whitford. (2009). Industrial Policy in the United States: A Neo-Polanyian Interpretation. *Politics & Society*, 37(4), 521-553. doi: 10.1177/0032329209351926
- Schumpeter, J. A. (1961). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle (Vol. 55). Transaction Books.
- Schumpeter, J. A. a. (2011). The entrepreneur : classic texts by Joseph A. Schumpeter. Stanford, California: Stanford University Press.
- Sen, A. (1999). Commodities and Capabilities. Oxford: Oxford University Press.
- Soete, L. (2001). The new economy: a European perspective: Maastricht University.
- Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1), 65-94.
- T. P. (2004). Beyond Economic Growth: An Introduction to Sustainable Development: World Bank Publications.
- Spence, M. (1973). Job market signaling. *The quarterly journal of Economics*, 87(3), 355-374.
- Stephan, P. (2012). How economics shapes science. Cambridge, MA: Harvard University Press.
- Stiglitz, J. E. (2012). The price of inequality: How today's divided society endangers our future. WW Norton & Company.
- Tracey, P., Phillips, N., & Haugh, H. (2005). Beyond philanthropy: community enterprise as a basis for corporate citizenship. *Journal of Business Ethics*, 58(4), 327-344.
- Wilson, J. Q., & Kelling, G. L. (1982). Broken windows. *Atlantic Monthly*, 249(3), 29-38.
- Wolfson, M. (1997). Divergent Inequalities: Theory and Empirical Results, *Review of Income and Wealth*, 43(4): 401-21.

Triangulating Regional Economies: The Promise of Digital Data

Maryann Feldman and Nichola Lowe
University of North Carolina, Chapel Hill

January 2014

Abstract: Innovative data sources offer new ways of studying the spatial and temporal development of regions. Our approach is to study the development of an entrepreneurial regional economy through a comprehensive analysis of its constituent firms and institutions over time. Our study region is defined by the location of large multinationals recruited to North Carolina's Research Triangle Park and the adjacent area. Over the past 4 years we have built a database of 4,000, technology-intensive entrepreneurial firms that draws on over 30 distinct data sources and includes details on company founders, annual firm employment and engagement with the entrepreneurial ecosystem. We supplement these quantitative data with archival materials to provide historical context, as well as oral histories with firm founders, corporate executives and institutional actors. By outlining our approach in this paper, our primary objective is to create a transferable framework for analyzing regional dynamics in other locations.

Keywords: geography of innovation, entrepreneurship, regional dynamics, organizational change

Corresponding Author: Email address: maryann.feldman@unc.edu

Acknowledgements: Support for this project is from UNC's Office of Economic and Business Development and the Odum Institute for Social Science Research. The Science of Science Policy Program at the National Science Foundation has provided funding.

Understanding how organizations and institutions work together, adapt and improvise to define a functioning innovative economy is a salient research question, with broad academic and policy interest. Existing research suggests that economic growth is driven by the performance of innovative local economies; however, we currently lack an understanding of the underlying dynamic processes within regions that lead to, and sustain, innovation and entrepreneurship. The literature on economic geography and innovation provides an understanding of the cross-regional differences that contribute to observed patterns; however, comparative analysis common to this literature often assumes static or time-invariant institutional features and therefore is unable to capture the processes by which organizations and institutions within a region change and adapt over time. Thus, we are left to assume that regional institutional features are deterministic rather than the socially constructed result of improvisation involving a complex set of actors and specific interactions in a temporal varying regional setting. An unfortunate disconnect exists between the theoretical definition of region as integrated contiguous economic units and the political and Census geography for which data are readily available. Moreover, consideration of the role of firms—as dynamic actors with evolving capabilities and temporally delineated strategic investments in a region—is inexplicably absent from much of the literature on innovative regional economies. As a result, fundamental questions about overlapping and evolving pathways for innovation and regional economic growth remain obscure.

A more nuanced understanding of the sources of spatial and temporal variation *within* a regional economy is possible by combining data from a variety of sources to gain a more complete picture of constituent organizations, their relationships and the ways in which inventors and entrepreneurs transverse institutional and geographic space. Digital data sources now permit the construction of detailed firm records useful to studying regional industrial and institutional dynamics. This paper describes our efforts to combine and integrate public and private data source to create detailed time-series micro-level data. Our framework is to study the development of the region by studying existing and emergent firms and institutions, triangulating sources to gain a more complete understanding of the development of firms. The data are organized in a relational database that can support multiple forms of analysis, including mapping and network visualization, statistical modeling or more qualitative approaches. Focusing in-depth on one region removes unobserved heterogeneity that falls to the error term in cross-sectional intraregional comparisons and permits an examination of the dynamics of innovative economies, specifically how innovative organizations and institutions work together, adapt and improvise to define a functioning regional economic and social system. By recognizing sources of variation within a regional

economy, we not only gain a more sophisticated framework for identifying concurrent pathways for nurturing the development of innovative firms but also a better understanding of why certain regional attributes predominate and contribute to regional advantage. As such, we not only gain a framework for situating economic actors within an institutional environment, but also for examining how their actions and interactions contribute to institutional transformation over time.

The primary purpose of this paper is to describe our method for combining and creating digital data. Our illustrative project integrates annual data from third-party data sources and tools into a digital infrastructure that is organized around both established and entrepreneurial firms in North Carolina's Research Triangle region. This project extends efforts to bring new electronic sources of private sector data and new analytic tools to the study of dynamic regional economies (Feldman et al. 2012). We describe a 6-year intensive data collection effort that defines the region by examining the location of firms and tracking their development and program participation through annual events that are collected from a variety of sources. In partnership with UNC's Renaissance Computing Institute (RENCI) we have designed and implemented a relational database organized around records for over 4,200 technology-intensive firms.

Our database design is organized around three components that are discussed in turn. The first is a relational database that tracks firms over time, using a variety of third party data sources. The second component is a data archive that preserves and catalogues studies that collected survey data and other single occurrence variables so that other scholars can re-examine these from their disciplinary perspective. The third component adds context through a digital archive of public documents, reports, and oral histories. Combining these elements, we create a time series data platform linking individual, firm and institutions while providing historical context to their interactions. Our objective is the creation of a replicable digital template that would enable scholars to conduct comprehensive data intensive studies to address fundamental questions about innovation, regional growth and economic development. Though our particular research focus is the Research Triangle region located around North Carolina's Research Triangle Park in this paper we describe a replicable methodology. We offer our project as an example of how digital data sources can be integrated to better understand regional economies.

Defining Regions by Studying Firms¹

The availability of new digital third party data sources calibrated to individual firm addresses provides a means to define a region. After all, places like Silicon Valley or Route 128 are not easily identified on any map; however, they are well known as organizing platforms for innovative economic actors and activity. In practice, innovative locations are defined by the location of firms. Silicon Valley, the prototype for an innovative region, is so named because it was the epicenter for the silicon-based

semiconductor industry. Personal computer component makers followed semiconductors, subsequently followed by networking and Internet companies – all creating a revolution in electronics miniaturization and computers, fueled by entrepreneurial firms (Lecuyer 2008). The local community adopted the name *Silicon Valley*, which was important to establishing regional identity. Geographically Silicon Valley now encompasses all of the Santa Clara Valley and the southern East Bay. As with any desirable real estate, the boundaries have expanded over time, following yet also influencing the location of entrepreneurial firms, who at times cannot afford prime real estate but want to identify with, and be part of, Silicon Valley.

The innovative and entrepreneurial regions we study are socially constructed in so far as they do not conform neatly to rigid political boundaries or government statistical units. In reality, the functional boundaries of the regional economies are reinforced instead by the location of prominent institutions, often universities, government labs or large successful firms, and are influenced by existing transportation routes and land use patterns—factors that in turn influence and reflect firm location. The definition of region is also fluid and expands over time due to idiosyncratic and serendipitous economic and social events. Spatial patterns follow a logic that motivates firms to locate near others with similar products, and markets, and close to employees with the requisite workforce skills. The location patterns of related firms define the region. The definition of the region evolves as more firms form and grow, and are attracted to the region.

The Research Triangle, our study region, offers an illustrative example. Research Triangle can refer to the Research Triangle Park (RTP), a 7,000-acre industrial park with its own dedicated zip code. But the RTP is a 1960 style low-density research campus of mostly large multinational firms, which until recently had real estate covenants that precluded entrepreneurial firms. Most of the entrepreneurial activity in the region is located in the contiguous communities adjacent to the Park – places with names like Morrisville, Cary and Apex that are not well recognized on their own but are integral locations for industrial activity. Often these communities are counted as part of the metropolitan areas of Raleigh or Durham, reflecting the tradeoff between industry detail and geographic specificity. Often finer geographic data are suppressed to maintain confidentiality as required for government data collections. Alternatively, regions are often defined by government entities. For example, the state of North Carolina considers the Research Triangle Region to be a 13 county planning region that stretches to the Virginia border and provides data aggregated over this large and diverse region. In reality, there are important synergies between the Research Triangle and the cities of Greensboro and Winston Salem and firms gravitate towards those locations, which are out of the state-defined region. In addition, the larger 13 county region masks the micro-geography, as firms in specific sectors may agglomerate in close proximity that is dilute when considered against activity in the larger region.

Examining available geographic units such as metropolitan areas or counties can mask cross-border activity and often lead jurisdictions to act as though they are in competition when they could gain from collaboration. Equally important, the geographic collocation of innovative, creative firms in small places such as multi-tenant buildings, neighborhoods, or industrial parks is often invisible when data are available only for larger, administrative units. Firm address level data are important to understanding innovative geographies and allows us to define the region of study based on the behavior of firms rather than the other way around: what appears to be an agglomeration at the county level may indeed be several geographically (and often technologically) distinct groups of firms each with different social relationships and underlying patterns of development.

The technology-intensive firms driving regional economies are themselves fluid and difficult to classify using standard industrial classification schemes. As firms struggle to survive, they often pivot to modify their products or services, but there is no incentive and limited opportunity to update their standard industrial classifications—the main mechanism primarily used to understand industrial activity. New industrial activities, such as ‘clean tech’ or even optical science defy more standard classifications. Therefore, by using keywords or combinations of phrases or membership organizations we are able to better assess a broad range of activities and technology applications (Feldman and Lendel 2010). Both patents and product announcements provide additional information on the technology and market orientation of firms. Understanding forward-moving industrial activity requires classification schema to be fluid and malleable, based on text mining of patents and product announcements or algorithmic programming to define relational attributes. Static classification schemes will never provide a full understanding of the emerging technologies that have the greatest promise for building new industries and setting regions on a new growth trajectory.

Circling the Triangle

Our project focuses on North Carolina’s Research Triangle region. While the history of the Research Triangle Park (RTP) is well known (Link 1995; 2002), less is known about the entrepreneurial ecosystem that developed around the park. Our study region offers the advantage of being the spatial scientists’ ideal *featureless plain* when the RTP started in 1958. The region, where the soil had become nutritionally poor from over-farming, was described as dominated by “scrub pines and ‘possums” and was defined by the three universities, the University of North Carolina, North Carolina State University and Duke University, that define the points of the triangle (Wilson 1999). Our data collection efforts benefit from a punctuated beginning that provides a clear genesis date from which to begin data collection.

At the center of this project is a unique relational database that was initially curated by Dr. William (Bill) F. Little, a longtime faculty member in Chemistry at the University of North Carolina at Chapel Hill, and former Vice President of the UNC system. Bill Little began his career at UNC in 1955 just as North Carolina's Research Triangle Park was getting organized and was a member of the inaugural board of the Research Triangle Park Foundation, an affiliation he maintained until his death in 2009. Unconvinced by a reporter's off-hand comment about a perceived lack of entrepreneurial potential in the region, Bill Little commissioned a study of technology-intensive entrepreneurial start-up firms in 1990. His initial list contained 117 firms and included a number of early 'home-grown' entrepreneurial successes, such as Troxler Electronic Laboratories (founded in 1958 by William Troxler in the basement of his Raleigh home), SAS (founded in 1976 by James Goodnight, then a professor at North Carolina State University), and Quintiles (founded in 1982 by Dennis Gillings, then a professor at the University of North Carolina, Chapel Hill). By 2005, Dr. Little had grown the database to 1,800 entrepreneurial firms, most of which he identified from regional newspaper articles and through personal correspondence with company founders.

Over the past six years we have significantly expanded the Bill Little dataset by vetting and verifying the original data, triangulating against other data sources, adding more recent new firm startups, and including firm in software, gaming and other sectors that were excluded in initial rounds of data collection². As a first step, we verified information from the original Bill Little list through a mix of newsprint and online sources, as well as through company and membership directories gathered from prominent support organizations in North Carolina, including the *North Carolina Biotechnology Center*, *Research Triangle Foundation*, the *Microelectronics Center of North Carolina*, and records from the university technology transfer offices, incubators and technical assistance programs. In expanding this data source, our objective is to capture, as much as possible, the full universe of entrepreneurial firms in the region. As of December 2013, the database includes over 4,200 firm records, with 3,800 initially classified as technology-intensive entrepreneurial start-ups, more than doubling Bill Little's initial pool. The following sections describe the organization of the firm database, the data sources used and the founder data we have collected.

Figure 1 Here – Database Contents

The Firm Database

As captured in Figure 1, the basic organizing unit of analysis for our relational database is the individual firm, specifically defined here by *establishment* address location.³ Establishments are classified under two broad headings: first, large multi-jurisdiction or multi-national firms with establishments located within the boundaries of the Research Triangle Park or that have an establishment in the surrounding region and second, entrepreneurial establishments that were started within the region. To track the large multinationals, we use the *RTP Directory*, which has been published annually since 1968, augmented with the *Triangle Business Journal's Book of Lists*, which catalogues regional economic activity, every year starting in 1992.

For entrepreneurial firms our objective is to capture technology-intensive establishments that are scalable and have the potential to sell goods and services outside the region. We identify new startups through partnerships with local incubators, membership associations, the region's three major research universities, government labs such as the National Institutes of Environmental Health and the Environmental Protection Agency, and other organizations such as the Research Triangle Institute. We also draw heavily from sector specific support organizations, which maintain detailed and searchable directories of entrepreneurial firms, including *North Carolina Biotechnology Center* and the *Microelectronics Center of North Carolina*. We also use newspaper clippings and web scraping to track new firm formation and development. Many mentions of new firms occur when the idea is still in the formative stage. Other firms are identified when they apply for patents or receive financing, beginning with little fanfare or public notice. Our strategy therefore has been to triangulate and validate information, noting discrepancies to understand potential bias in different sources.

When determining whether a firm should be included in our database, we look for at least three mentions in the various sources we track (see Table 1). As one source, we rely on records from the North Carolina Secretary of State, which requires all firms conducting business in the state to register and pay an annual fee. It is often difficult to pinpoint the exact startup date for an entrepreneurial firm, as different dates appear to promulgate for different purposes. Similar to individuals, firms want to be older when they are getting started as a means to establish legitimacy and report a later date when they want to appear fresh and innovative. The date of incorporation or registration to conduct business is therefore used as the recorded date when a project or idea becomes a firm and is included in the database. The Secretary of State also permits a tracking of firm deaths, given that firms registration lapse when the firm ceases to exist.⁴ Indeed, over 40% of the entrepreneurs in the database are no longer in existence, having been acquired, merged or gone out of business. Thus, these data provide a resource to study the complexity of regional industrial dynamics while avoiding a common truncation of the phenomenon by studying only a subset of firms that have survived, thereby biasing the analysis (Lichtenstein et al., 2007).

Table 1 Here

Firm Specific Data Sources

Once a decision is made to include a firm in the database, detailed information at the firm and establishment is first gathered from company websites, annual reports, press releases, newspaper articles and social networking sites. While company webpages and press coverage are a good source of information they require special handling to place into a form useable for a database. There are a plethora of third party data sources that are digitally available to track firm activity. These data can be used to capture annual events such as inventive activity, new product announcements or annual financial performance and employment. Many third party data sources are available through university libraries and research labs. These data are often used for business analysis and their use is often limited to projects in finance in business schools. However, the third party datasets that we examine have great utility for examining firm dynamics. For example, patent data are a good source of inventive activity as covered by other papers in this special issue. But other sources such as Thomas.Net provides information on new product announcements. Other sources track employment, sales and new investment.

Third party data offer the advantages over collecting original survey data. These sources cover a population of firms and avoid the limitations of self-reporting, and low response rates that make original data collection difficult. Instead of relying on a single data source it is possible to integrate different data sources matched to firm name and address. Our common frame of reference allows us to evaluate how differences in empirical findings, for example related to employment growth or venture capital financing, are driven by the choice of data source (Donegan 2014). Moreover, rather than wait for government data to be released these data sources are updated continuously, offering an opportunity to gather timely information useful to policy makers.

As outlined in Table 1 we have used these distinct data sources, matching on firm name and address to track firms over time. We supplement these data with annual information about employment (from the National Employment Time Series (NETS) and the Quarterly Census of Employment and Wages (QCEW)⁵); financial performance and investment (NETS; S&P Capital IQ; *National Venture Capital Association*); patenting activities (Delphion); and product development (U.S. Food and Drug Administration; Thomas.net). These data are digitally available through our university library. The *National Establishment Time Series* (NETS), created by Don Walls, also provides us with information on company location and changes over time and details on name changes, mergers, acquisitions and closures. We also monitor newsfeeds to augment these sources.

For entrepreneurial ventures in particular, we have collected detailed information on Initial Public

Offerings (IPO), funding from the *Small Business Innovation Research* (SBIR) and state programs, notably the North Carolina Biotechnology Center and One NC Small Business Program. We also track participation in programs run by local entrepreneurial support programs, such as the Council for Entrepreneurial Development and local incubators, accelerators, and angel groups. For each firm, we trace the annual level and sequence of institutional support.

Using firms as our common frame of reference allows us to evaluate the total sum of resources that entrepreneurial firms use in their development and the ways in which interactions between resources shape firm development. The literature has tended to focus on firms emanating from *either* research institutions (Shane 2004; Rothaermel et al. 2007) or being spawned from existing incumbent firms (Klepper 2001; Klepper 2002; Klepper & Sleeper 2005; Klepper & Thompson 2010; Burton et al. 2002), and has focused on single transactions, such as venture capital investments (Stuart & Sorenson 2003; Audretsch & Keilbach 2004), government investments, such as the Small Business Innovation Research (SBIR) program or participation in incubator and accelerator programs (Siegel et al. 2003). Typically, econometric analyses evaluate individual programs, treating them as if they were the only intervention for the entrepreneurial firm. In reality, entrepreneurial firms move from one program to another, and it is the combination of interventions that affect ultimate success. Studies frequently debate the impact of different funding types without considering their interactions and the totality of resources required for the successful launch of an entrepreneurial venture. Moreover, by studying one region, over time and in depth, we can examine how the various developmental pathways develop and co-evolve over time, while holding regional conditions constant.

The Founders

We have designed our database to capture detailed career and educational histories for all entrepreneurial founders. Our database allows us to trace numerous entrepreneurial firms in the Research Triangle region back to prominent North Carolina universities via official university technology transfer channels. But this is not the only source of firm genesis. Large multi-jurisdictional corporations in the region have also helped to incubate entrepreneurial talent and skill. By studying firm founders and their career histories we are able to identify the co-existence of these pathways and thus, open up the potential for comparative analysis. Ultimately founder data, combined with other statistical and qualitative sources, enables us to study the construction and evolution of multiple entrepreneurial pathways and in the process, identify distinct and intersecting organizational and institutional influences.

Founder information was gathered from a number of digital and archival sources. Media accounts of new firm formation often include the names and prior organizational affiliations of members of a founding team. In addition, the names of firm founders are available through incorporation documents

filed with the North Carolina Secretary of State. Extending from these sources, we rely heavily on social media, namely *LinkedIn*, news sources, company websites, alumni records and interviews to capture detailed information on founder education and career histories. Where possible, we have tried to include founder information for university or college degrees earned at public, private, large and small universities both within and outside the region. Using past employment information from *LinkedIn*, we also trace firm founders back to prominent multinational firms within the region, such as Glaxo, Burroughs Wellcome, Becton Dickinson, and IBM, among others. But equally, we capture past employment at ‘home-grown’ establishments, including smaller firms like Addrenex, or Icagen, thereby allowing us to identify second-generation entrepreneurs.

We are also in the process of conducting interviews and oral histories with firm founders and top-ranked executives to understand more about the regional entrepreneurial experience. We treat these qualitative data sources as especially valuable to the study of regional innovation and as a resource for contextualizing statistical patterns and econometric relationships and also for supporting a mixed-method research design. With that in mind, we have initiated collaboration with the Southern Oral History Project (<http://sohp.org/>), a rich digital repository stored at the UNC-Chapel Hill containing over 4000 southern oral histories. Staff from Southern Oral History Project provide training for graduate students and faculty on our project, in exchange for contributions to the Collection of taped and transcribed oral histories with entrepreneurial founders.

The Case of GSK

One important part of the genesis and development of regional economies is the ‘spawning’ of new entrepreneurial firms from the stock of existing and well-established firms (Chatterji 2009; Klepper 2001). Spawns are distinct from firms that spin-out from government laboratories or universities. Spawning instead refers to an employment relationship when the new company founder was previously employed at another private sector entity. Spawns may be either formal or informal spinoffs from a parent company. Thus while the number and type of entrepreneurial startups in a region is an important indicator of economic robustness, the number and type of spawns provides additional information about the connections between large and small firms in the region and the degree to which founders benefit from employment and social ties to other regional firms.

As an illustrative example, founder employment records compiled from *LinkedIn* and other sources have enabled us to trace 144 firms to GlaxoSmithKline and its antecedents of Burroughs Wellcome and Glaxo Wellcome (Feldman and Lowe 2014). The vast majority of these new firms were established in the wake of acquisitions, mergers and major corporate restructurings, which resulted in both voluntary and involuntary employment termination. Our relational database enables us to track the

formation and development of these entrepreneurial spawns overtime, including business type, technology specialization, commercial success, employment growth and level of institutional support, including external financing. Equally, we are able to capture founder employment rank at the Glaxo firms, which in turn affected their level of severance support and access to intellectual property upon departure. Combining these data with founder interviews and archival materials gathered on the history of the Glaxo group, allows us to trace changes in the way GSK and its predecessors supported entrepreneurial development in the region. In turn, we are able to contextualize distinct patterns of entrepreneurial development that we observe with each merger or major transition event.

Changing organizational strategies at GSK and its predecessors have influenced the types of new business establishments it has spawned over the years and affected the industrial structure in the region. As evidence for this, we find that a sizeable share of the firms that were established in the wake of the first merger between Glaxo and Burroughs-Wellcome specialized in contract research and clinical trial management organizations rather than *de novo* drug discovery or new product development. This coincided with a 1990s strategy shift at Glaxo-Wellcome towards greater outsourcing of research and clinical trial development. This first wave of service-oriented entrepreneurial spawns contributed greatly to the build out of North Carolina's burgeoning contract research (CRO) industry—today, the Research Triangle region is home to approximately 150 CROs, the largest regional concentration in the world. Our interviews also reveal the importance of statistical expertise at local universities and the presence of firms like SAS that provided sophisticated analytical tools and thus, a competitive edge for newcomers in contract research. Equally, early CRO firms in the region, like Quintiles and Pharmaceutical Product Development (PPD), helped provide a role model and inspired others to follow suit. Still, the development of this specialized sub-sector of life science was strongly influenced by the practices and strategies of Glaxo-Wellcome as an influential anchor firm, a contribution that the current literature has yet to fully recognize. In fact, executives at Glaxo-Wellcome were especially supportive, encouraging former employees to set up regional CROs with promises of long-term contracts.

Based on our analysis, 55% of entrepreneurial firms created shortly after the merger of Glaxo and Burroughs-Wellcome specialized in some form of contract research or analytics support. In contrast, the vast majority (61%) of new firms created in the wake of the 2000 merger involving Glaxo-Wellcome and SmithKline Beecham specialized in new drug discovery or medical device development—with significantly less (32%) focusing on contract research and related analytics. Some of this shift in focus reflected the establishment of formal licensing agreements with GlaxoSmithKline (GSK) that enabled bench scientists to take their research program and ideas with them to their new firms. Strong internal channels for asset development and out licensing supported this. But equally, regional institutions were

far more developed at the time of the second merger and our interviews with firm founders confirm these institutions offered a wider range of support services for technology and business development.

GSK and its predecessors are not alone in creating a lasting regional entrepreneurial imprint. As a result of our continued data collective efforts, we have identified a dozen or so large multi-jurisdictional firms other than those in the Glaxo group that have spawned sizeable numbers of entrepreneurial firms. These include IBM, Nortel, Sony-Ericson, Red Hat and Becton-Dickinson & Co, to name a few. Spawning by these firms is so essential to the regional entrepreneurial economy that we find virtual parity in the number of entrepreneurial start-ups attributable to the regions three major research universities and those attributable to the top three spawning corporations. While several of these spawn-producing firms experienced periods of downsizing, others like Red Hat and Becton-Dickinson have been operating mostly in high-growth mode thus allowing us to examine additional factors that might shape cross-organizational differences in entrepreneurial spawning. As we consider the potential influence of large anchor firms on industrial and entrepreneurial development in the region, we are also taking steps to identify entities that are less likely to spawn new establishments. One important example in the Research Triangle is SAS Software, a firm that initially spun-out of North Carolina State University in 1976, however has not resulted in many next generation start-ups. That said, SAS still has a regional entrepreneurial influence, which our research allows us to define.

Institutional Context and Change

In the process of compiling firm-level and statistical data, we have also amassed a large and growing collection of archival materials from quasi-public, private and non-profit organizations and support institutions located in the region. These documents range from organizational directories and annual reports, to meeting minutes for committees created to design technology support policies and programs. They also include the names of institutional board of directors, as well as historic information on firms and individuals receiving early programmatic support. These efforts complement an existing archive at the UNC Library on the Research Triangle Foundation, which contains 88,000 items constituting 125 feet of linear shelf space. Our objective was to broaden this collection to include activity outside the Park, which is the focus of the Foundation and to also create a digital archive.

Far too often institutional documents and policy reports important to understanding the historical development of the regional economy are in danger of being lost. In some cases these historic documents have been retrieved by what may only be described as *dumpster diving* as organizations have changed locations or mission resulting in a need to cull earlier collections and paperwork (Feldman and Lowe 2010). Some organizations keep updated digital records on firms they support. The North Carolina Biotechnology Center, for example, maintains a rich, continually updated source of annual reports, new

releases and programmatic information. Their collection is well cataloged and digitally preserved, allowing for ease of use and document retrieval. For the now defunct or under-resourced regional support agencies lacking a formal archival method, annual reports become essential for identifying their earlier contributions to industry and firm development. In other cases, we have collected documents from the personal files of individuals we have interviewed. We intend for these archived data sources to be regularly updated, thereby providing interdisciplinary research teams with a more meaningful contextually grounded research experience and encouraging mixed-method research on this region.

The risk of losing valuable knowledge about the regional economy motivates us to continue to collect and digitize older publications and reports. In turn, these documents support more in-depth and contextual understandings and interpretations of firm and founder-level data. But equally, these archival documents allow us to understand the broader policy environment and influence on firm formation and development.

By incorporating and categorizing information on various regional support programs, we are able to gauge the scope and depth of regional institutional engagement by individual firms. Still our interest in collecting institutional data is not simply an attempt to understand the institutional impact on firm performance. Our goal is to also situate firms as actors within a changing institutional landscape. In this regard, we recognize firms as more than mere inheritors of a regional institutional environment. They are also active participants influencing and inspiring institutional change over time as they move through a regions' institutional space. Using archival sources therefore allows us to see how the changing institutional landscape of the Research Triangle region is influenced by firm-level strategy. But equally, we use these sources to identify other actors—including those within and outside established regional institutions—that shape how those institutions respond to new pressures and challenges and in ways that may deviate from the intended impact of intervening firms, including those with considerable power and authority. In this regard, we recognize institutional change as an evolving and mediated process, involving multiple actors and open to negotiation and reinterpretation (Feldman & Lowe, 2011a).

The NC Biotech Center

A useful illustration is the North Carolina Biotechnology Center—a prominent industry support institution in the Research Triangle established in 1981—and more specifically its efforts to better support agricultural biotechnology in the late 1980s. This technology application emerged in response to information about the potential effects on traditional agriculture from its field experiments involving genetically modified seeds received from a large, multinational pharmaceutical firm. Admittedly, the multinational firm in question had hoped its initial interaction with the Biotech Center would result in a public relations campaign to assuage the fears of local farmers and environmental activists. Instead, the

Biotech Center responded by formalizing a new institutional channel through which local farming and environmental interests could engage with large pharmaceutical corporations and in ways that forced consensus policy around the regulation of agricultural biotechnology. The result of this exchange was our nation's first state-level field experimentation ordinance: an ordinance explicitly designed to reduce risk and uncertainty for agricultural biotechnology firms—including 'home-grown' entrepreneurial establishments—through the creation of a transparent and legally defensible regulatory apparatus. As this case and others like it from the region suggest, institutional changes initially triggered by large corporate interests can strengthen opportunities for policy development in support of regional entrepreneurship and in ways that are unanticipated by those initiating institutional action.

This example and others speak to the broader policy lessons offered by our research. Many places around the world look to North Carolina's Research Triangle as an example of successful policy-led economic development yet the precise mechanisms and policy levers are not well known. As a result, there is a tendency to downplay the influence of policy interventions and interactions on firm strategy and development. Our database and supporting documents offer a data-driven solution to this challenge by providing an essential resource for tracing the sequence of institutional interventions and facilitating policy events that contribute to and help sustain entrepreneurial development. It also helps to reveal the role of institutional actors in shaping the co-existence of multiple entrepreneurial pathways that support new firm formation. As we have discovered, entrepreneurial firms are just as likely to emerge from university-based technology transfer systems as they are from large multinational corporations that incubate and spawn entrepreneurial talent and skill. Detailed information of this kind will enable practitioners and policy makers in North Carolina to better demonstrate and defend the efficacy of economic development decisions and investments—some of which are under threat in the face of changing state politics and funding priorities. Equally, it will allow development practitioners to identify opportunities for leveraging scarce regional resources by exploring synergies with Federal, state and regional agencies.

Challenges and Considerations for Replication

Our Research Triangle study provides an initial test case for compiling and collecting spatial and temporal data at the firm, institutional and individual actor levels. In this paper, we have presented our methodology for integrating and preserving data from prior studies, incorporating archival and electronic data sources and navigating new social media. In this regard, our project creates a data-intensive loosely coupled framework and replicable methodology for broadly analyzing economic and social dynamics in other regions around the world. Still, our 6-year research effort has yielded transferable lesson, and some persistent challenges, which we continue to work through and learn from. What insights and advice might

we then offer to researchers that are seeking to compile similar comprehensive data sets in other regional economies?

First, community building is essential to our on-going data collection effort. Countless individuals and organizations have contributed to this exercise, providing essential data, historical context and interpretation. This project has benefited tremendously from partnership with UNC's Renaissance Computing Institute (RENCI), a collaborative institute between the three Triangle universities that creates software tools, visualizations, and designs data management systems. RENCi has been a technical resource and a true partner, building and maintaining a relational database, which is described in greater detail in the next section. This work has also benefitted from data sharing agreements with local organizations, including the Council on Entrepreneurial Development, First Flight Venture Center and the North Carolina Biotech Center.

We have intentionally designed this project to prioritize student involvement and education. Over the course of 6 years we have involved approximately 25 graduate and undergraduate students, three-quarters of whom are women, minorities or international students. In an effort to stimulate additional student interest in this project and data source, we also use class instruction time selectively to feature the database.⁶ We have worked with professional masters students from City and Regional Planning and the School of Library and Information Science, who have used the database for coursework, independent study or research projects and in the process made suggestions for how to improve data collection and organization. Finally, this project has benefited from a small army of undergraduates, who have worked under a variety of different compensation schemes, including additional data collection for independent studies and employment paid from a variety of sources. Undergrads have told us that experience researching companies and building a database was valuable in subsequently securing employment. We have also engaged with a number of outside researchers that have requested data access for their own research and learning purposes.

But with this extended community comes a nested set of data governance challenges. First, is the need to clearly specify rules and routines for those engaged in data entry and cleaning about what details to add, modify or delete from our evolving relational database. This has been a work-in-progress and hence a learning opportunity for us and other project participants. In particular, as a result of early missteps that risked data loss or inconsistent reporting, we have come to recognize the value of time stamping all database entries and edits to allow for greater oversight and accountability. Equally, data governance issues have arisen in relation to recent requests for data access by individuals outside our core research community. These requests required us to specify formal rules to make data available, especially to non-contributing users. In response, we developed a data sharing agreement, customized to each data request, which outlines our expectations for authorship, attribution or data sharing reciprocity. We

currently have two contracts on file, both with graduate students requesting parts of our dataset for dissertation or thesis research.

A second major goal (and thus learning opportunity) for us involves the creation of an accessible infrastructure for regional policy analysis. Our vision is a flexible cyber-enabled resource that policy makers and practitioners can utilize for identifying regional trends and challenges to technology development and entrepreneurship. Unfortunately, our present data storage system is not fully equipped to support this use, namely because it cannot selectively suppress data at the individual establishment or firm level. As noted earlier, our relational database includes information at the firm or establishment-level on annual employment, venture financing and grant awards, some of which was shared with us with an expectation or contractual requirement that we keep individual firm names and award amounts confidential. This creates the need for a layered data infrastructure that can accommodate multiple users with different levels of data access and thus at varying levels of aggregation. This problem is one that we are currently working to resolve with assistance from our partner RENCI. What we propose is a data management and integration infrastructure based upon leading edge and widely used research software systems that can support data integration, analysis and visualization capabilities. Attempts to replicate our data collective effort elsewhere would therefore benefit from a concurrent commitment to infrastructure development.

Finally, we continue to struggle with the time consuming tasks of matching data from different, independent sources that do not share a numerical firm-specific identifier. This is a common disambiguation challenge shared by numerous scholars that seek to combine multiple, large sized data sets. To paraphrase one scholar, this is essentially a million dollar computational problem. We have developed a labor-intensive strategy as a temporary work around, which essentially involves a basic SAS program that matches firm names or aliases across multiple datasets. The program generates a list of 20 potential matches for each firm in our database. Members of our team then review a subset of these lists, supplemented by address and founder data, to determine which, if any, is the best match. In some cases, they extend their search to include other sources, using a mix of internet searches and Secretary of State incorporation documents to link addresses and affiliations across a matched pair. Two overlapping data points are required to justify a match. Additionally, two members of the team are assigned identical lists of potential matches in an effort to minimize problems of subjectivity. Moving forward, our hope is that other research communities will see value in developing and openly sharing less labor-intensive solutions, with the goal of expediting data matching efforts.

Concluding Reflections

By outlining our approach in this paper, our primary objective is to create a transferable framework for analyzing regional dynamics in other locations. We offer the Research Triangle Region as a test case for compiling and collecting data at both the firm and institutional levels that would be transferable to other regions. Equally, we present this as a tool for policy making. Our database offers a data-driven resource that policy makers and practitioners alike can use to trace the sequence of interventions and facilitating events that contribute to and help sustain entrepreneurial development. It also helps to reveal the existence of multiple entrepreneurial pathways that support new firm formation. Ultimately, detailed information of this kind will enable practitioners and policy makers to better demonstrate and defend the efficacy of regional economic development decisions and investments and further enhance understanding of and coordination among multiple interventions that contribute to the region's entrepreneurial eco-system.

Sophisticated integrated analysis of social and economic processes has been hindered by the lack of meaningful and accessible data. Legacy federal economic data products do not meet data user needs because the traditional mission of federal economic statistical agencies is to support federal macroeconomic policy and guide the distribution of federal funds to political jurisdictions with particular economic characteristics, such as high unemployment. Long-standing forms of economic data also do not allow analysts to view the behavior and movement of actors over time. Furthermore, the Census Regional Data Center initiative to provide access to micro-data at the firm and individual level has been stalled due to disputes with the Internal Revenue Service and analysis is limited by Federal Section 13 privacy concerns. Moreover, there are few attempts to examine the sources of bias from using different data sources.

Additionally, traditional datasets and industrial classification schemes do not allow for consideration of the relationship among diverse organizations across space. This includes the ways established corporate anchors spawn small, entrepreneurial firms, some encouraging their formation while others enforcing non-compete agreements (Chatterji, 2009). Equally the relationship between firms and institutions are difficult to track; this includes linkages to universities, trade associations, business services, and other quasi-government entities that research has demonstrated as essential to innovative activity (Asheim and Coenen, 2005; Geels, 2004; Lowe and Gertler, 2009; Owen-Smith and Powell, 2006; Wolfe and Gertler, 2002). These institutions are often the glue that holds a regional economy together providing networks and support services that are the foundation for economic vitality.

In response to these limitations, the data we have been collecting over the past 6 years is drawn from accessible and frequently updated records, scraped from the web, pulled from voluminous documents through text analysis, found on open data platforms, purchased from third parties by our

university libraries, and integrated with other digital data sets. Furthermore, our data permit geocoding at the establishment level, thereby allowing researchers to analyze these micro-data within unique self-defined economic boundaries.

Figure 1: Structure of the Database

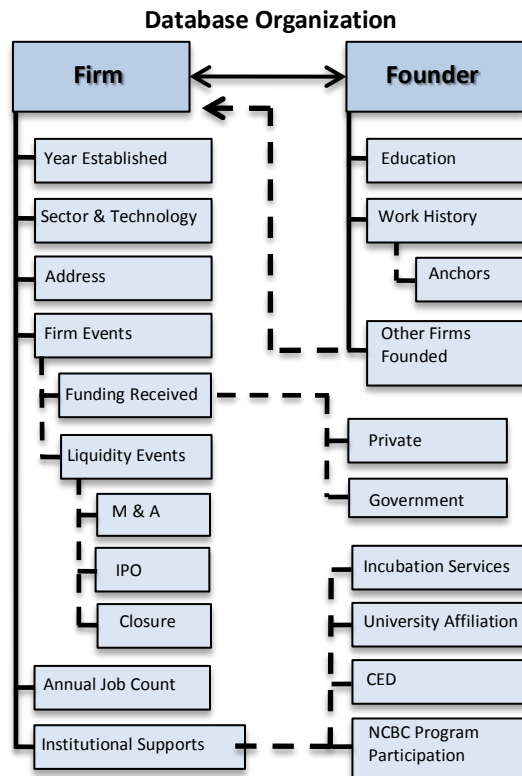


Table 1: Annual Data Sources, matched to Firm Name, listed alphabetically

Primary Data Source	Type of Information
S & P Capital IQ	Financial performance Investment
Council for Entrepreneurial Development (CED)	Program participation Institutional supports, various
Delphion Patent Data	Granted patents Patent Applications
Innovaro Medical Device Licensing	Licensing agreements
Microelectronics Center of North Carolina	Institutional support, various Archived newspaper clippings Annual reports Meeting minutes
National Establishment Time Series Database (NETS)	Firm location Employment Sales growth Parent company affiliations
National Venture Capital Association	Venture financing
North Carolina Biotechnology Center (NCBC)	Firm description Product development; clinical trials Institutional support, various
One N.C. Small Business Program	State matching institutional support
Quarterly Census of Employment and Wages, North Carolina	Establishment level employment Average wages
Small Business Association—SBIR/STTR program	Federal SBIR funding
Thomas.net	New Product Introductions
U.S. Food and Drug Administration	Status of FDA approval
U.S. Securities and Exchange Commission	Filings for IPO

Bibliography

- Asheim, B., & Coenen, L. (2005). Knowledge Bases and Regional Innovation Systems: Comparing Nordic Clusters. *Research Policy*, 34(8), 1173-90.
- Audretsch, D.B., & Keilbach, M. (2004). Entrepreneurship Capital: Determinants and Impact. *CEPR Discussion Papers 4905, C.E.P.R. Discussion Papers*.
- Burton, M. D., Sorensen, J. B., & Beckman, C. M. (2002). Coming from good stock: Career histories and new venture formation. Editor: M. Lounsbury & M. J. Ventresca. *Research in the Sociology of Organizations, Vol. 19*. Waltham, MA: Elsevier.
- Chatterji, A. (2009). Spawned with a Silver Spoon? Entrepreneurial Performance and Innovation in the Medical Device Industry. *Strategic Management Journal*, 30(2), 185-206.
- Donegan, M. 2014. Comparison of Different Data Sources. University of North Carolina, working paper.
- Feldman, M.P. and I. Lendel (2010). "Under the Lens: The Geography of Optical Science as an Emerging Industry." *Economic Geography*, 86 (2): 147-171.
- Feldman, M.P. and N. Lowe. (2011). "Restructuring for Resilience." *Innovations: Technology, Governance, Globalization*, 6 (1): 129-146.
- Feldman, M.P. and N. Lowe. (2014). "Firm Strategy and the Wealth of Regions"
- Feldman, M. P., & Lowe, N. (2011a). Industrial Genesis – Southern Style. Presentation to the Association of American Geographers (AAG), Seattle, WA, April 16.
- Feldman, M. (2012). Innovative Data Sources for Regional Economic Analysis. Washington, DC: ebook.
- Klepper, S. (2001). Employee Startups in High-Tech Industries. *Industrial and Corporate Change*, 10(3), 639-674.
- Klepper, S. (2002). The capabilities of new firms and the evolution of the U.S. automobile industry. *Industrial and Corporate Change*, 11(4), 645–666.
- Klepper, S., & Thompson, P. (2010). Disagreements and Intra-Industry Spinoffs. *International Journal of Industrial Organization*, 28(5), 526-538.
- Klepper, S., & Sleeper, S. (2005). Entry by spin-offs. *Management Science*, 51(8), 1291-1306.
- Lécuyer, C. (2008). *Making Silicon Valley: Innovation and the Growth of High Tech, 1930-1970*. Cambridge, MA: MIT Press.
- Lichtenstein, B. B., Carter, N. M, Dooley, K., & Gartner, W. B. (2007). Exploring the temporal dynamics of organizational emergence. *Journal of Business Venturing*, 22, 236–261.
- Link, A. N. (1995). A Generosity of Spirit: The Early History of the Research Triangle Park. Research Triangle Park, NC: Research Triangle Foundation of North Carolina.
- Link, A. N. (2002). From Seed to Harvest: The Growth of the Research Triangle Park. Research Triangle Park, NC: Research Triangle Foundation of North Carolina.
- Lowe, N., & Gertler, M. (2009). Building on Diversity: Institutional Foundations of Hybrid Strategies in Toronto's Life Sciences. *Regional Studies*, 43(4), 589-603.
- Markusen, A. 1994. Studying regions by studying firms. *Professional Geographer* 46: 477–90.
- Owen-Smith, J., & Powell, W. (2006). Accounting for emergence and novelty in Boston and Bay Area biotechnology. Editor: P. Braunerhjelm and M. P. Feldman. *Cluster Genesis: Technology-Based Industrial Development*. Oxford: Oxford University Press.
- Rothaermel, F.T., Agung, S.D., & Jiang, L. (2007). University Entrepreneurship: A Taxonomy of the Literature. *Industrial and Corporate Change*, 16(4), 691–791.
- Shane, S. 2004: *Academic entrepreneurship: University spinoffs and wealth creation*. Cheltenham: Edward Elgar.
- Siegel, D.S., Westhead, P., & Wright, M. (2003). Assessing the Impact of Science Parks on the Research Productivity of Firms: Exploratory Evidence from the United Kingdom. *International Journal of Industrial Organization*, 21, 135-1369.
- Wilson, J. (1999) North Carolina's Research Triangle Park: An Investment in the Future. RTP

foundation. Raleigh: RTF Video.

Wolfe, D., & Gertler, M. (2002). *Innovation and Social learning: An Introduction*. Editor: M. Gertler and D. Wolfe. *Innovation and Social Learning: Institutional Adaptation in an Era of Technological Change*. New York: Palgrave Macmillan.

Endnotes:

¹ There is a long academic tradition of studying regions by examining their constituent firms s advocated by Ann Markusen (1995).

² When asked why these firms were omitted from the original data collection Bill Little reported that he was simply more interested in firms related to chemistry and the life sciences and did not think that the software and gaming companies would have much staying power or growth potential. In consultation with the Council on Entrepreneurial Development we were able to find names and addresses for these firms. We then systematically set out to build a comprehensive data set, verifying information on firms from at least 3 different sources before including them in the database.

³ We differentiate between the firms' original address and current location – using both for different analysis. Annual updates to addresses, starting in 1991 are available through NETS, which tracks establishment location. Most entrepreneurial firms are single establishments initially and the extent to which they expand in the region is one research question currently under investigation.

⁴ While the Secretary of State data are a reliable sources for vetting firm information it has proven less useful for identifying new firms: there are more than 400,000 entities active at any time, with all business activity in the state reporting.

⁵ Data from the Quarterly Census of Employment and Wages (QCEW) were provided under special arrangements by the North Carolina Department of Commerce.

⁶ Ted Zoller and Lisa Goble have used these data in their completed doctoral dissertations and three other dissertation projects are in the works. Gil Avnemilch was a force in the beginning of the project and Max Peter Menzel worked on visualizing networks with the data.

DRAFT

Memorandum

To: Innovation and Impact Committee

From: Phil Clay

Date: May 8, 2014 (Revised June 10th to incorporate items from committee discussion)

RE: Issues for Discussion at the May Meeting of the Committee

The purpose of this memorandum is to summarize the work of the Innovation and Impact Committee of the UNC Board of Trustees, and to identify tasks and priorities in our continuing work.

The charge to the committee is to advance the goal of using research-generated discoveries by the faculty and ideas generated by members of our academic community to create economic and social impact for the campus and the state. These impacts may result from the commercialization of research output and/or the creation of enterprises and initiatives that advance ideas for solving problems. As a public university, chartered by and for the people of North Carolina, creating and supporting an ecosystem and environment on campus that supports both broad and deep engagement with the state and the world is the outcome we seek and one wholly consistent with our mission as an institution.

The University benefited greatly from the pioneering work on these issues initiated by former Chancellor Holden Thorp. The Innovation Roadmap, published in 2010, outlined a series of opportunities and goals for the University and stimulated initiatives across the campus. That initiative and the activities that followed in the past four years provide a greatly elevated starting point for the work of Innovation and Impact Committee.

This memorandum aims to foster discussion about what the university has learned and put in place in recent years and what remains to be done. Together with notes and materials from the last four meetings of the committee, this memo aims to ground the discussion at the committee meeting on May 20th. Also, it addresses several questions regarding our effort of transforming our research into innovations and impacts:

1. What is in place and capable of being a resource for our agenda?
 - a. There is broad support from all stakeholders for a larger role for the state and region in entrepreneurship and for universities to take the lead.

- b. The university has more than \$800 million in annual research and as such already has standing as a first ranked research institution.
 - c. Since 2009, the university has put a number of new programs in place, including the Carolina Express License, Carolina Kickstart, and the new services offered by the Frank Hawkins Kenan Institute for Private Enterprise. Strategic investments in the Office of Technology Development have increased its efficiency, effectiveness, and importantly, its sustainability.
 - d. A new \$2 million fund at UNC-CH to support university venture initiatives has been approved.
 - e. There is an evolving set of places and venues on campus and in Chapel Hill where entrepreneurs get together to support each other, to benefit from mentoring and trying out new ideas. Launch, incubation, and accelerator activities are numerous and include mentors, coaches, and active ventures that grew out of these venues. The business school and the Kenan Institute are actors in these activities.
 - f. There are faculty, centers, and schools that increasingly model the change the committee aims to promote.
 - g. There is the expectation on campus and across the state that UNC will play a leading role in the state.
2. What is it that we have learned to date that will help us scope, plan, and manage future efforts?
- a. Despite some initiatives triggered by the Roadmap from 2010 and examples of faculty and centers that model the change we want to see, there is considerable lack of information among faculty about resources available, about how to take the first step in moving from research to applications, and about the necessary collaboration and engagement in order to start an enterprise.
 - b. There is now a convergence of science and technology as a major trend within research universities. UNC is one of the few universities with a mega research volume but without a school of engineering in this convergence era. We have put in place a Department of Applied Sciences and invested in the Department of Biomedical Engineering that is joint with NC State that over time can partially address this shortcoming. The other part of the solution can come from collaborations.
 - c. Our funded research is heavily biomedical, and this is an area for strategic investment in commercialization of technology. We are also very strong in the public health, behavioral, and social sciences, where research is less likely to be commercialized.
 - d. Surveys show that the faculty does think about how their results can be used. The question is: what is the best activator of faculty initiative for research translation? The surveys also show the knowledge is

uneven and not “top of mind.” This includes openness to taking risks and engaging venture and corporate players.

3. What remains to be explored by the committee?
 - a. While we have a large volume of research underway on campus, our commercialization metrics fall short of those of our peer universities. This is partly due to the composition of our portfolio, which is heavily weighted toward basic research, in addition to having a substantial showing in disciplines such as behavioral and social sciences where the commercialization potential is low. There is, however, much room for improvement. Critically, results from much of our research do not translate to applications without some additional work on the part of faculty. This takes time, has some associated costs, and involves risks. What is the translation infrastructure required for this?
 - b. We need to update our exploration of best practices in other states both with respect to the research ventures and the interface between the university and the state, and between the university and industry. Specifically a number of states including California, Massachusetts, Arizona, Michigan, and Connecticut are putting in place or have put in place strategies that tie the state’s activities to the research of their universities, including state investments aimed at promoting jobs.
 - c. There are also growing collaborations on research applications with the philanthropic and nonprofit communities including critical areas of health and medicine. As federal funds are reduced, these sources become more important as does corporate research.
 - d. What does an innovation agenda in research mean for educational programs, student activities, alumni relations, town-gown relations, etc.? Over the past four or five years, UNC has developed outstanding programs for students, including the entrepreneurship minor and courses provided through the Business School. The town and region are developing new incubation and acceleration spaces. How does research connect? How does the agenda fit into the evolving Department of Applied Sciences, BME, Data Science, etc?
 - e. Design is an element of discovery, product development and commercialization. Design is typically taught in schools of architecture, engineering, business. What is the appropriate approach to addressing design for Chapel Hill?
 - f. We have only just begun to explore how to tie UNC, North Carolina State, Duke North Carolina Central, and the Research Triangle Park together with local industries to create a broad infrastructure. How do we identify and then remove, lower, or alter barriers to collaborations and insert positive incentives and support? Are there cultural or other barriers to address? Who leads this effort?

- g. Campus space for work to support innovation, is important, including research and project space, and more generally “maker space.” A committee is preparing an inventory of campus space.
- h. We need to revisit Carolina North in light of developments since the original plan and the recession. Does the enterprise model still hold up for our innovation agenda? Are there additional roles that the acreage allows?
- i. UNC has a global brand. Among our research peers, academic collaborations are increasingly international. Access to interesting problems, partners and resource opportunities beckon. What are the low hanging fruit for leveraging the UNC brand? (Water, for example, is one of our signature research areas as well as a major global topic in health, technology, law, etc.)
- j. How does an innovation agenda relate to a university campaign? What is the role of venture philanthropy? What are the synergies? Tensions? Should there be a “foundation” to support innovation related work?
- k. How can we better tell the story of impact? The growth of awareness of our work has grown recently. We need a deeper communication to those who already know the topic and UNC, and a higher-level communication to those who do not know the topic but are high-level stakeholders of the University.

4. What are the challenges to be overcome?

- a. What is the structure of the senior administration team for leading the innovation effort? What is the role of other senior officers, deans, etc.? How is the faculty mobilized for various roles? What are the eventual governance issues?
- b. How do we combine the three domains in which research and education take place – real, virtual, and connected? What are the venture opportunities in education?
- c. A thrust that highlights an innovation and entrepreneurship agenda requires a cultural shift at UNC. This is already underway. What are the opportunities, frictions, and challenges evident from the last 3-5 years’ experience?
- d. How do we engage the venture community in support of an innovation agenda? There is the special challenge of raising early stage capital and attracting firms who will seek and encourage university- enabled projects. What do we want to know from them? What are the risks and cautions?
- e. How do we engage corporate supported research? What are the lessons from the experience in recent years? How do we attract them to be partners the local ecosystem in the way early RTP did?

- f. How can we, as an institution, most effectively and seamlessly engage with corporate partners whether for technology transfer, research or workforce needs?
 - g. How do we communicate our intentions and frame value to the University community and the public?
 - h. What are the unique problems of a public university in advancing an agenda which is most elaborated in mainly private institutions or in states with an aggressive innovation agenda? How have public peers overcome the associated limitations of the public section working with private firms?
 - i. What resources are needed to kick-start and sustain an innovation agenda for at least five years? What is the source(s)?
5. What is to be done? Where do we go from here? Listed below are some options for the work of the committee and the administration. I imagine that some combination would be appropriate.
- a. A working paper that addresses selected questions above. To be prepared over the summer.
 - b. A Fall 2014 Workshop Series where the outsiders are invited in present and discuss. Meetings or time allocation to overlap BOT meetings. Invite outsiders, potential partners, etc. Examine models such as APLU's Innovation and economic Prosperity Universities Program, for organized and structured engagement with North Carolina corporate, economic development and community interests.
 - c. A more focused agenda for fall committee meetings to hear administration proposals.
 - d. A 5-year plan of action prepared by January 2015.