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Financial credit drives urban land-use change in the United States

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ABSTRACT

Land-use change in the United States is a significant factor in environmental degradation, and occurs at a faster rate than population growth. This paper develops the hypothesis that modern financial instruments and the creation of tools that increase reliance on debt have the undesirable consequences of run-away land-use change, particularly in residential home construction. After reviewing the factors leading to increased housing development and land use change, the paper elucidates the role of modern financial instruments in driving rapid land conversion. The theory is based upon accounting of sources and uses of capital. Financial innovations, especially in credit creation and trading through global capital markets, can help explain the link between land-use change and finance. Available data from a study of modern real estate development supports the role of financial debt as the primary driver for land use change in South Florida. The mechanisms behind development financing address key policies and practices that have led to unsustainable land cover change. We encourage work on land-use change that focuses on a better understanding of the mechanisms linking land developers to financial markets, and cross-disciplinary research that recognizes linkages between financial innovations and ecological health, and that leads to the development of better policies.

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Contents

1. Introduction

Important interrelationships exist between the natural environment and modern capital markets, about which literature is scant. Available research recognizes that economic incentives, markets, and globalization have impacts on environmental change (Clarke et al., 2006; Diaz and Rosenberg, 2008; Halkos and Tzeremes, 2011; Magliocca et al., 2012; Huang et al., 2014). Numerous studies link ecological changes to variation in factors, such as income or affluence, but specifics are lacking (Lumpkin and Pearson, 2013; Nelson et al., 2006). This paper reviews one facet of this environment and finance nexus by examining the flow of money and credit through the financial real estate development. Using the example of land development, we show the mechanism and significance of financially-induced changes in land use (Lambin et al., 2000; Ye and Wu, 2014; Sleeter et al., 2013); and how researchers have standardized frameworks for investigating land use change to better understand rapid conversion of open areas to housing development. Our purpose is not to provide a comprehensive or exact model of the urban land development process, but to create awareness of the modern financial system in the picture for ecological modeling.

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Financial markets (i.e. stocks, bonds, and money markets) constitute their own complex systems, balancing the creation, use, transfer and accounting of funds to distribute the risks and rewards of lending and investment. Real estate development including the building of homes, businesses, and public infrastructure, is a critical and often government-preferred metric of the growth and robustness of an economy (Molotch, 1976; Beitel, 2000). This development activity largely depends upon external funding, so extraordinary innovations in financial markets have arisen since 1970 have greatly stimulated housing development. The result has been a "housing finance revolution" (Green and Wachter, 2007), that enabled a "great mortgaging" of increased real estate-related lending to households (Jorda et al., 2016). Mortgage securitization released a "Niagara of capital" that transformed the real estate industry (Downs, 2007). The Finance, Insurance, and Real Estate (FIRE) sector has been the largest value-added contributor to U.S. Gross Domestic Product (GDP) in every year since 1990. The U.S. has become a "financialized" economy (Krippner, 2005). The convergence of financial and real estate markets has significant effects on land use. By accessing funds beyond local financial institutions, land developers are increasingly able to undertake large real estate developments and to finance new projects when local funding is scarce. The availability of this funding has usually not been linked to, nor restricted by, the risks and rewards or long-term environmental repercussions of land-use change. Indeed, the increasing vulnerability of the built environment to future disasters related to loss of ecosystem services, carbon balance, sea level rise or climate change has brought attention to the rate of land cover change in the US (Beach, 2002; Huston, 2005; Wang et al., 2005).

This review aims to explain the need for a new interdisciplinary research that focuses on financial innovations and capital markets as "social innovations" of the Anthropocene that have changed the scale and scope of sustainability (Olsson et al., 2017). The review is not a comprehensive analysis of the banking or financial industry, but rather a call for both research and education on capital markets as an innovation with new impacts and influences on landscape ecology. Working across the disciplines of ecology, real estate financing, sociology and land-use change can mean explaining the obvious to some audience, but the end message is crucial to broader discussions of urban sustainability (Seto et al., 2017).

This paper defines the term "developers" as *real estate developers*, corporations that are engaged in the process of land development to primarily residential or commercial areas. Developers buy land, finance real estate deals, or have builders construct projects. Developers orchestrate the process of development from the project concept through permitting to marketing and sales. Developers, along with their investors and lenders, take the greatest risk in that the financing must be obtained up front, then recovered through sales and other exit strategies. Consequently, developers can also receive the greatest rewards (return on investment) converting land that is "undeveloped", either agricultural lands or vegetated natural communities, to "developed" land with substantially higher market value per unit area. Financial innovations such as Mortgage-backed Securities (MBS) have become critical to the success of the developer's business plan for selling off developed land units. Tipping the balance between real estate "paper" (securities) and actual buildings, however, can have undesirable impacts on the rate and scale of land-use change. Rapid increases in developed acreage suggest that planning, zoning, and other regulations have generally not succeeded in limiting development (Göçmen, 2014; Lynch and Geoghegan, 2011). Although developers do obtain the necessary public approval and financing, the business models to manage (and ultimately sell) a developed tract are time-sensitive, and are "disconnected" from longer term considerations for the land conversion (Schuetz and Sims, 2009). If regulations discourage development in one location, they may encourage development in other locations. In some cases, development has proceeded in violation of regulations and is then subject to fines, or mitigation (York et al., 2011). No urban development has been documented, however, without an expenditure of funds.

This review therefore focuses on the influence of finance on land development. Land-use change is the conversion of vegetated natural areas to the built environment. Land cover change is defined as the loss of natural areas, particularly loss of forests to urban or exurban development, or the loss of agricultural areas to urban or exurban development. Residential housing is the predominant purpose of urban development in the continental United States, and the amount of urban acreage increased by 60% between 1982 and 2012 (NRCS, 2015). The recent accelerated loss of natural areas has been documented through standardized and quantitative analyses to illustrate the pervasive and variable nature of land-use change (Sleeter et al., 2013). Very high rates of change occur in some regions (Northwest and Southeast US) where climate, soils and topography are suitable for intensive, resource-based land uses. According to Sleeter et al. (2013), land-use change is driven by complex interactions between socioeconomic drivers and biophysical characteristics. In the end, urban growth overall has had disastrous impacts on landscape ecology as well as increased disaster risks (e.g. flooding) to millions of residents (Göçmen, 2014; York et al.,2011),thus a new approach to understanding the role of finance should be considered.There is no documented urban development that has occurred without an expenditure of funds.

Rapid rates of land-cover change are a key concern as a driver of global environment change and loss of ecosystem services, especially with regard to stability of carbon stocks (Turner et al., 2007). Land-use change has triggered many ecological research questions over biogeochemical cycling (Defries et al., 2007; Liu et al., 2006), land-atmosphere energy exchange (Trainor et al., 2016) and loss of biological diversity (Huston, 2005). Over the past thirty years, the rate of land-use change has increased significantly faster than adult population growth, despite increased information on the need for managed natural and agricultural areas. The question arises, therefore, regarding what drives this trend, particularly in the Southeastern U.S? Over this same period,

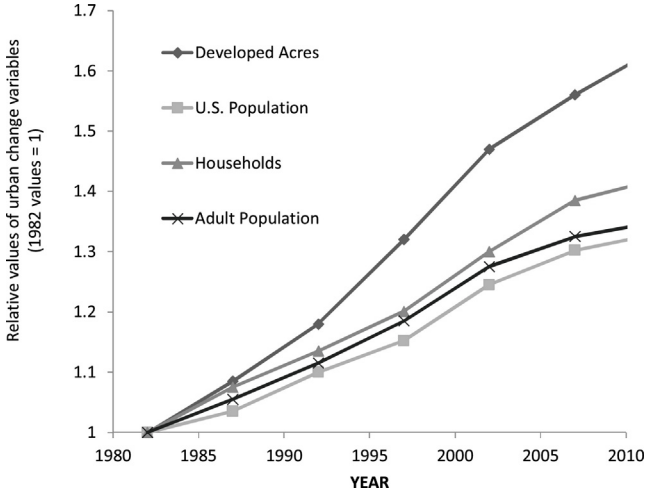

Fig. 1. Relative increase of developed land, number of households, and adult population since 1980.
Land use has changed at rates higher than population growth. (Figure adapted from US Department of Agriculture, 2012; US census data from http://www.census.gov/popest/archives/1990s/nat-agesex.txt, and http://www.census.gov/popest/archives/1990s/nat-total.txt).

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