The Value and Configuration of Coastal Natural Capital

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Physical accounts of non-produced capital assets often serve as proxies for monetary balance sheets in the absence of market prices. Recording the physical stocks and flows of services over time is fundamental to assessing the state of the environment (Jorgenson 2018; Power, Lawson, and Vardon 2014). However, physical stocks alone are not enough; quality and condition matter (Fenichel et al. 2020). Specifically, the configuration of natural capital assets can fundamentally alter the quantity and types of services they provide, shifting the asset price and widening the information gap between physical and monetary accounts for natural capital assets. Therefore, understanding how and when the configuration of natural capital will impact asset service flows can bridge the gap between non-market valuation of ecosystem services and monetary accounts of non-produced assets. Asset configuration is highlighted in Section 4 of the 2021 SEEA-EA revision; however, guidance is sparse for operationalizing the role of asset configuration in national accounts. Linking values to asset configuration can help improve the allocative efficiency of coastal management strategies in the face of sea-level rise and global change.

This paper aims to connect non-market valuation methods for ecosystem services with detailed geospatial data describing beach sand configuration along the US east coast to develop a tool for valuing coastal natural capital assets. Coastal areas provide a dynamic setting for thinking about the configuration of non-produced capital assets. Natural processes in coastal zones, and the services they generate, vary non-linearly across time and space (Koch et al. 2009). Winds, tides, currents, waves, and eddies arrange and rearrange produced and non-produced assets in the coastal zone from ocean plastic and seaweed to nutrients and grains of sand. Sand, in particular, can reside above or below water and contribute to the provision of spatially dependent services, like coastal protection and recreation, or disservices, like impeding coastal navigation in the form of a sand bar or shoal.

Using a quasi-experimental setting and property transactions in North Carolina, my current research shows that the configuration of a marginal cubic foot of beach sand—allocated to making coastal dunes taller, making them wider, or to making beaches wider—can significantly change its value and even change the sign of its value. I also find that the value of dune height, as capitalized in North Carolina property values between 2008 and 2017, is sensitive to its relationship with the produced capital (the structures) on the property. Specifically, for homes with viewsheds that are not entirely blocked by dune height, I find the marginal capitalization of dune height to be -$14,519/ft, whereas, for homes with viewsheds that are already entirely blocked, the marginal capitalization of dune height is $7,203/ft. I posit that the marginal capitalization of an additional foot of dune height for homes with fully obstructed viewsheds represents the coastal protection value of an additional foot of dune height in the sample.

Complementarities between natural capital asset stocks can also be important. In my North Carolina study area, when accounting for interactions between coastal dune attributes in an ecosystem service production function I find that the marginal capitalization of dune height for fully-blocked homes climbs by almost three-fold to $24,808/ft. The estimate of the marginal capitalization of dune height for fully-blocked homes for the restricted sample of homes that are beach-adjacent, as opposed to the entire sample of homes up to 8 blocks away from the ocean, is about $5,000/ft lower, at $19,884/ft. I also

estimate the marginal capitalization of coastal dune vegetation using high-resolution 4-Band orthoimagery from NC OneMap and find that, on average, an additional square foot of vegetation is associated with property values that are between $45 and $75 greater.

The study area for this project does not encapsulate the many forms and shapes beach sand can take in coastal areas or the arrangements of users of the public amenities from beach sand in coastal areas. Pocket beaches, for example, represent a different configuration of sand than the contiguous stretches of barrier island along the Florida coastline, and may be enjoyed differently due to their structure.

Using Connecticut beaches as an empirical example, I can translate my hedonic workflow from the study area in North Carolina to value beach sand along the Connecticut coastline and ultimately the US East coast. I have property transactions data on hand from Zillow ZTRAX as well as remotely-sensed data acquired through USGS and UConn. With the richer set of geophysical configurations of sand the Connecticut setting combined with the North Carolina work can better detail how heterogeneity in coastal form connects to natural capital values. Ultimately, this work will generate policy tools to develop balance sheets for coastal natural capital assets that can be disaggregated down to the spatial arrangement of sand at a coastal profile.

References

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Conflict of Interest Statement

I have no financial or other conflicts of interest for the proposed work. I have no financial ties to any firms that may be affected by the valuation of environmental public goods.