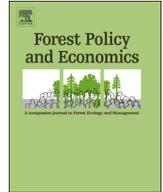




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Research trends: Forest investments as a financial asset class

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ABSTRACT

This paper serves as an introduction to a Special Issue (SI) of the *Journal of Forest Policy and Economics* dedicated to forest investment and finance. The Special Issue stemmed from an International Forest Business Conference (IFBC2018) held in Poland on 6–8 June 2018. It includes papers based on speeches at that conference, as well as others on similar topics not presented at the conference. Topics addressed in this Special Issue include timberland investments, forest finance, intensively managed plantations, risk, uncertainty and decision-making, business structures and investment strategy, timber prices and forecasts, forestry contractors, and taxes. Details papers on these subjects follow in this Special Issue.

Our finance research overview here provides a historical background and summary of forest investments and finance, focusing on forest equity investments made by institutional investors and in forestry real estate investment trusts, not including public lands or individual small private forest landowners. Forest assets as an investment class have expanded due to analytical advances, ownership changes, globalized markets, and sustainable forestry factors. Key components affecting forestry investments are expected asset returns, portfolio diversification, inflation hedge, and liquidity and natural risks.

Topics detailed in this Special Issue include timberland investments, forest finance, intensively managed plantations, risk, uncertainty and decision-making, business structures and investment strategy, timber prices and forecasts, forestry contractors, and taxes. Finally, we identify knowledge gaps regarding forest investments for future research.

1. Introduction

Forestry as an asset class has evolved substantially over the last thousand years. Forest investments cover purposeful and passive planting, regeneration, management, and harvests of forests, timberland, or woodland, as well simple exploitation, neglect, or conversion of forests. Forests generate both market commodity products, often typified by timber for forest products or fuelwood for industrial or household use. Forests also produce nontimber forest products, which may be sold in markets, or traded, or used by households and individuals. Forests have always provided ecosystem services and public goods, such as supporting (nutrient cycling, soil formation, primary production), provisioning (food, fresh water, wood and fiber, and fuel), regulating (climate, flood, disease, and water purification), and cultural (aesthetic, spiritual, educational, and recreational) services (Millennium Ecosystem Assessment, 2005).

2. Investment science history

A large sector of forest and timberland investments as an asset class has developed over the last three to four decades, which is the focus of this Special Issue. There were many investments by forest products companies historically, as well active investing or passive management by public and private forest owners. In addition, public and private owners have always provided ecosystem services, nonmarket public goods, that benefit society in general. As these ecosystem services have slowly begun to be monetized, forest investors and governments are beginning to make investments to capture profits from those previously nonmarket goods and services. A brief history provides context for the current status of forest investments. In this overview, we focus on forest investments made by industrial forest products manufacturing firms and as an asset class for equity investors, not including public lands or individual small private forest landowners.

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2.1. The first industrial timberland

Forests were treated as a security and national strategic resource for countries in providing different products and services. Probably the first large scale forest operations were carried out in Falun (Sweden) where the copper mine was operating for nearly millennium from the 10th century to 1992. The principal method for extracting copper was heating the rock via large fires, known as fire-setting. Abundant and cheap wood was used until it was found that the regeneration of the forest stands must take place in order to avoid costly transport of wood from distant locations to the mine. A more professional operation began to take place in the mine from 1275 to 1290 when nobles and merchants from Lübeck (Germany) had taken over from farmers and started to transport and sold copper in Europe.

The first written document about the mine is from 1288 and it includes the oldest preserved share in the Swedish copper mining company Stora Kopparberg (“great copper mountain”), which granted the Bishop of Västerås 12.5% ownership. This event by many is considered as the oldest known preserved share in any company in the world and makes Stora and its successor Stora Enso—a manufacturer of pulp, paper and other forest products—the oldest existing corporation or limited liability company globally. Since the beginning, the company was vertically integrated; however, the situation has changed during last years and now Stora Enso owns forest lands in various countries through subsidiaries, joint operations and indirectly through equity-accounted investments. Currently, only about 30% of Stora Enso's wood raw material is covered from its own sources or long-term supply agreements globally (Stora Enso, 2020).

Since these early industrial forestry roots, companies bought lands to supply forest products mills, especially pulp and paper mills, throughout much of Europe and North America. Scandinavia evolved into having major pulp and paper companies with timberlands, and forest landowners and their associations, that supplied wood to forest products mills. The U.S. developed into the largest pulp and paper producer in the world in the 1950s to 1960s and expanded into saw-timber and panel boards in the 1960s and since (Carter et al., 2015). These pulp and paper firms came to be referred to as vertically integrated forest products companies (VIFPCs)—extending from the timberlands through the manufacturing process—and have eventually extended their business model of timberland purchase and management to supply some or all of their own pulp mills throughout most of the world. Sawmill supply has generally not relied on vertical integration, but rather a mix of timber from individual private landowners and public lands.

This premise of VIFPCs for pulp mills has remained dominant in newly developing countries in Latin American and Asia. However, as discussed shortly, the U.S. and some other countries have largely or completely divested their timberlands, and forest products mills rely on purchase agreements from major landowners, or open market or dealer/broker wood purchases from small landowners to supply their mills.

2.2. Five factors facilitating timberland investments

Between these first documented timberland investment origins in 1288, through 2020, we can identify five important events that have helped shape the present forest investments environment.

The first event was the advancement of economic theory about land rents and forest returns. This included the fundamentals of land rent theory posited by Adam Smith (Smith, 1776), followed by its translation into forestry by Johann Hossfeld in 1805 (Viitala, 2016). This was followed by other German forest economists including Martin Faustmann (1849) who published his calculations on the net present value of an infinite series of identical forest rotations, which was developed later into a mathematical formula now termed the soil expectation value (SEV), land expectation value (LEV), or bare land value

(BLV). The application of land rent theory in forestry prompted a considerable change in forest management practice due to the reduction of usual rotations and stocking density (Möhring, 2001). Also, forests started to be treated as an investment with a strong focus on optimal rotation length, thinning strategies, and intensity of intermediate harvests.

At first, even-aged stands oriented for timber production dominated the research and practical business applications. Then, thanks to the extension of Faustmann formula by Richard Hartman, it was found that the presence of recreational and other services provided by standing forest may well have an important impact on when or whether to harvest (Hartman, 1976). Usually, the presence of recreational or ecosystem service cash flows throughout a timber rotation will extend that rotation, in order to capture the additional future present values associated with older forest stands. This trend has become highly important in recent decades thanks to additional cashflows that forest may provide, including but not limited to carbon payments, conservation easements, hunting licenses or other non-wood forest products.

The second major factor affecting forest investments as an asset was the transition from completely vertically integrated company to companies based on outsourcing, subsidiaries, joint operations or through equity-accounted investments. This process in forest sector was well observed in last four decades in the U.S., when virtually all major VIFPCs have sold their timberland assets of almost 15 million hectares to other institutional or individual owners, in lands managed by Timber Investment Management Organizations (TIMOs), or spun off their corporate lands into Real Estate Investment Trusts (REITs) (Korhonen et al., 2016). The early TIMOs generally evolved from bank trust departments and agricultural/timber lending groups. For instance, first National Bank of Atlanta closed the first TIMO-type commingled fund in 1982, while John Hancock Timber Resource Group launched its first commingled fund in 1984. At the end of that decade, total TIMO assets barely exceeded \$1 billion (Zinkhan, 2008; Binkley, 2019).

The third major factor encouraging the development of timberland assets was the change of ownership many major of state-owned forest resources. This happened either by (a) privatization process in countries such as New Zealand, Australia, and South Africa, where government-developed timberlands were sold to TIMOs or other private investors (Cabbage et al., 2020) or (b) forest land restitution (i.e., giving nationalized forest lands back to their owners) in former socialist countries such as Bulgaria, Latvia, Lithuania, Estonia or Slovenia (Nichiforel et al., 2020).

Fourth, economic globalization and competition from imports have accelerated structural change in forest product markets, favoring the survival of forest product enterprises that are more capital-intensive, less labor-intensive, and generally larger, more productive, and globally connected. Demand for roundwood is predicted to reach six billion m³ by 2050 (Barua et al. 2014). This demand is expected to be the main driver for the expansion of industrial plantations, with large scale establishment only began in the 1960s (Szulecka et al., 2014). The role of plantations as only being a source of roundwood for global markets has started changing. The future demand for forest products will most likely be met by plantations that have good conservation and biodiversity standards, as well as respecting the needs and livelihoods of local communities (Innes 2013; McEwan et al., 2020; Szulecka et al., 2014).

Fifth, sustainable forest management has become a widely accepted paradigm across the globe in recent years (Siry et al., 2005, 2018), and its evolution required the development of conservation finance and ecosystem service payments as investors and the public seek to maintain economic growth and protect public values that have been historically difficult to monetize. Higher-level needs, including environmental protection, global climate change, carbon storage, aesthetics, and biodiversity have been increasingly recognized as important contributors to people's quality of life and survival with high demands to increase protection and provision of these services (Cabbage et al., 2007). The individual and societal goals with respect to forests changed

as values, economic conditions, political situations, and natural resource stocks have changed.

The diversity of value of forests for humans has been increasing, especially when it was recognized that forests are important in providing a wide array of ecosystem services, amenity values, recreation and tourism, biodiversity or forest products and services. This recognition of the importance of sustainable forests and ecosystem values also resulted in higher interests from investors who found forestry strategies as immediately investable and scalable to help enhance ecosystem services, including climate change mitigation (e.g., [Canadell and Raupach, 2008](#); [Moomaw et al., 2020](#)), biodiversity protection, and support for rural development and in effect receive additional revenues from selling carbon credits, hunting and tourism permits, water quality protection easements and more. Such change offered forest assets additional benefits to investors, who look to enhance returns from alternative asset classes, meanwhile diversifying their traditional portfolios.

This trend has led to forest investments as being considered an important and viable option for investors seeking benefits that are desirable from a financial and environmental, social, and governance (ESG) perspective. Now there are many third-party ESG reports and rating providers including (i) Bloomberg ESG Data Service; (ii) Corporate Knights Global 100; (iii) DowJones Sustainability Index (DJSI); (iv) Institutional Shareholder Services (ISS); (v) MSCI ESG Research; (vi) RepRisk; (vii) Sustainalytics Company ESG Reports; and (viii) Thomson Reuters ESG Research Data ([Huber and Comstock, 2017](#)).

2.3. Forest land ownership patterns

Forests may be owned by the public sector by governments at various levels, or by private firms, or by a private individual. As of 2020, about 73% of the world's 3.9 million ha of forests are publicly owned, which is a marked decrease from 80% in 2010 ([FAO, 2010, 2020](#)). Public ownership represents forests owned by federal, state, and public administration units as well as publicly owned institutions and corporations. Although the amount varies from one country to the next, about one-quarter of world forests are privately owned. Private ownership is a diverse category which comprises individuals, families, communities, business entities (private firms, corporations, and investment funds), private religious and educational entities, non-governmental organizations (NGOs), nature conservation societies and other private entities ([Siry et al., 2015](#)).

Public ownership is predominant in all regions and most subregions. Of the regions, Oceania, North and Central America and South America have the highest proportions of private forests ([FAO, 2020](#)). Africa, Asia, and Europe have the highest percentage of public forestland by continent at 90% or higher ([Chambers et al., 2020](#)). This fact is driven by Russia, which has 100% of forests that are government owned, but also public ownership dominates in the other 11 states in the Commonwealth of the Independent States and several other former communist states ([Detter and Folster, 2015](#)). Public ownership also dominates in Canada, Indonesia, India, Brazil, Australia or China ([Pulla et al., 2013](#)). Thus, out of the top ten countries with the largest forest cover in the world, seven public forest ownership dominates.

On the other hand, private ownership describes the situation in which individuals, firms, businesses, corporations, and even non-governmental organizations possess ownership rights to forests. Most timberland is directly owned and privately traded by institutional investors, wood industry and individual forest owners. For instance, more forest land is under private ownership in the U.S., with private owners together accounting for 57% of forest ownership ([Detter and Folster, 2015](#)). While all forests in the Russian Federation are publicly owned, public ownership in nearby Western Europe is less than 50% of the total; France, Norway, and Sweden, for example, have more than 70% of their forests privately owned. North and Central America (particularly the United States, Nicaragua, Costa Rica), South America

(Columbia, Paraguay, Chile), and Oceania (New Zealand, Papua New Guinea) have a higher proportion of private forests than other world regions ([Siry et al., 2015](#)).

These land ownership patterns by country affect the possible universe of timberland investments that may occur. In countries with largely public lands, investors must choose to invest in timber leases, concessions, or contracts for public sales (e.g., Canada, Russia, Indonesia, Brazil, Eastern Europe) on public lands. In some cases, they also may be given usufructuary rights to public land for fixed time periods from a community (e.g., red book rights in China or Vietnam, land leases in Africa) or from a state (e.g., in Australia) in order to manage timberland for extended time periods. In most other cases, which are preferred by TIMOs and forest industry, investors will be able to buy land outright, or in partnership with local managers and owners, and manage it through reforestation, management, and harvest for as long as they choose to own the land—e.g., private land in the United States, Brazil, Uruguay, Paraguay, Colombia, Central America, about half of Western Europe, and Oceania. Nonetheless, finding and buying adequate industrial-grade forest investment land with adequate biophysical characteristics, acceptable market conditions, adequate infrastructure, and good political conditions is a challenge.

3. Forestry as an alternative asset class

While extensive private ownership of forests occurred for centuries, it was dominated by small private and family forest landowners, some large estates, and forest products companies. Since the emergence of TIMOs and REITs in the 1980s, a separate class of forest investments for institutional investors has occurred. TIMOs are organizations that invest in forest land on behalf of other institutional or wealthy investors, either funds purchased by single investors and owners, or through commingled funds with many a few to many investors contributing to a large fund pool. A TIMO then buys and manages a set of properties jointly for those investors, and divides the costs, service fees, and profits proportionally among the investors.

The four established means that provide investment exposure to forestry asset class are ([Chambers et al., 2020](#); [Fu, 2012a](#)):

1. Direct (solo) investments that include self-purchase and management of timberland by an individual, partnership, company, or other business entity;
2. Private-equity investing including pooled fund investing (commingled timber fund of a chosen strategy and investment term) and co-investing (dedicated separate account with a timberland investment manager). Pooled funds and separate accounts are managed by TIMOs;
3. Purchase of shares in publicly traded timber-related firms (e.g., REITs, timber companies) or timber ETFs (exchange-traded funds in the United States, with ticker symbols WOOD and CUT) that have been developed to track timber firm values;
4. Purchase of futures contract (Random Length Lumber contracts) that trades on the Chicago Mercantile Exchange (CME) and offers exposure to timber prices.

It should be noted that investment opportunities related to point 3 and 4 tend to offer some exposure to timberland but they are often heavily weighted toward forest products firms.

Together with the development of forestry as a separate asset class, a number of published scientific articles on its economic and financial characteristics significantly increased. This section summarizes key characteristics of forest investments, such as expected returns, portfolio diversification, inflation hedge, and illiquidity.

3.1. Global forest investments and returns

Institutional timberland investments began in North America and

have grown significantly from virtually zero in the early 1980s to more than 100 billion U.S. dollars today (RISI, 2015). During the last decades, we observed that forest products companies have been divesting their timberlands and outsourcing the business of growing and harvesting timber (Mei, 2019). This conversion was prompted by (1) the shift in production from diversification to specialization and in consequence, rising demand from TIMOs and REITs; (2) declining incentive to own and produce a company's own wood supply due to relatively poor corporate financial performance; (3) reduced insurance value of timberland due to expanding and reliable timber supplies; (4) significant undervaluation of timberland under the U.S. generally accepted accounting principles, where book values reflect historical acquisition costs rather than fair market values; (5) expensive federal tax treatment for C-Corporations, and the opportunity to structure forestland holdings as a pass-through tax entity and avoid corporate taxes; (6) opportunities to cash out on significantly appreciated land values and (7) changes in regulations of private pension plans in the U.S. (The Employee Retirement Income Security Act, 1974) requiring them to diversify beyond stocks and bonds (Zhang et al., 2012; Mendell, 2016; Mei, 2019).

As the U.S. timberland market has matured, increased competition for assets and a decline in returns have occurred. Investors, especially non-USD denominated investors, have increasingly sought new investment opportunities in non-U.S. markets, especially Latin America, Australia, and New Zealand, as well as modest interest in Asia, Africa and Europe. Initially, about 91% of the investment by institutions was in the U.S., 2% in South America, 5% in Australia and New Zealand, and 2% in other areas (Hagler, 2006). The most recent statistics suggest that these proportions have changed and are now: U.S. (66%), Australia and New Zealand (19%), Latin America (9%), Canada (3%) and Asia, Africa and Europe is 1% (TimberLink, 2018).

Currently, most of the investment markets (i.e., pension plans, endowment and private equity funds, insurance companies, and foundations) rely on TIMOs to advise them about their investments in timberlands and to manage those timberlands on their behalf. REITs and wood industry continue to manage their timberlands and are mostly organized as publicly traded forest products companies.

Based on a comprehensive review of current literature, we summarize the range of forest investments returns—usually excluding land costs—estimated by different studies that were published from 2015 to 2020 (Table 1).

Based on the studies of investment returns at the stand level as summarized in Table 1—not including land, administration, overhead, purchase, legal, and corporate costs—forest investments generate internal rates of return (IRRs) between zero and 30% and are likely the most influenced by biological growth and timber prices (e.g., Chudy et al., 2020; Mei et al., 2013). However, other factors may have a significant impact as well, such as planting costs, management costs (Chudy et al., 2020), land value appreciation, higher and better use (HBU) sales on parts of large timberland properties or country political stability (Cabbage et al., 2020). Overall, the published research has shown that timber stand investments can offer reasonable returns. However, potential investors must examine all facets of forest investing in order to assess its merit with respect to other alternatives (Hiegel et al., 2020).

The preceding rates of return represent typical IRR values for different species and site classes, not including land costs as a factor of production. Rates of return would be substantially less if the costs of land were included. Cabbage et al. (2020) found that IRRs ranged from three percentage points less for loblolly pine in the U.S. South to eight percentage points less for Brazil eucalyptus if the land were included as a purchase cost and a final sale. In this study, land value appreciation or depreciation was not included, which would increase or decrease the magnitude of the realized IRR accordingly.

It also is of interest to compare the timberland investment returns with those from other assets. There is not a universal global benchmark for all assets, but the S&P 500 provides a frequent standard that many

Table 1
Timber investment returns from available studies, 2015–2020, without land prices.

Country	Species	IRR
Argentina	<i>Pinus taeda</i> - Misiones	6.5
Argentina	<i>Eucalyptus grandis</i> - Corrientes	7.5
Australia	<i>Pinus radiata</i> high growth	7.5
Australia	<i>Pinus radiata</i> low growth	5.7
Brazil	<i>Pinus taeda</i> sawtimber	14.3
Brazil	<i>Eucalyptus urophylla</i> pulpwood	8.1
Brazil	<i>Eucalyptus grandis</i> sawtimber	10.7
Chile	<i>Pinus radiata</i> sawtimber - good site	13.0
Chile	<i>Pinus radiata</i> - pulpwood - poor site	11.2
Chile	<i>Eucalyptus globulus</i> pulpwood	14.3
Chile	<i>Eucalyptus nitens</i> pulpwood	12.2
China	<i>Pinus massoniana</i>	7.9
China	<i>Eucalyptus</i> spp.	31.5
Colombia	<i>Pinus tecunumanii</i>	8.7
Colombia	<i>Pinus patula</i>	6.6
Costa Rica	<i>Gmelina arborea</i>	24.5
Finland	<i>Picea abies</i>	4.3
Finland	<i>Pinus sylvestris</i>	4.3
France	<i>Quercus petraea</i>	2.0
Laos	<i>Eucalyptus</i> spp. Industry	21.7
Laos	<i>Eucalyptus</i> spp. Outgrower	11.8
Laos	<i>Tectona grandis</i>	13.0
Mexico	<i>Pinus gregii</i>	11.3
Mexico	<i>Eucalyptus grandis</i>	20.1
Mexico	<i>Gmelina</i> spp.	19.7
Mexico	<i>Tectona grandis</i> / Teak	18.6
New Zealand	<i>Pinus radiata</i>	8.8
Paraguay	<i>Eucalyptus grandis</i> /urograndi clones	21.8
Peru	<i>Pinus patula</i>	3.6
Poland	<i>Quercus</i> Sp. State forest	2.4
Poland	<i>Pinus sylvestris</i> State forest	2.4
Poland	<i>Pinus sylvestris</i> Private forest	4.5
Scotland	Sitka spruce	13.6
South Africa	<i>Pinus</i> spp.	3.1
South Africa	<i>Eucalyptus</i> spp.	24.8
Spain	<i>Populus</i> spp.	9.9
Spain	<i>Eucalyptus globulus</i>	9.6
Uruguay	<i>Eucalyptus globulus</i>	13.2
Uruguay	<i>Eucalyptus grandis</i> pulp	10.4
Uruguay	<i>Eucalyptus grandis</i> sawtimber	11.8
Uruguay	<i>Pinus taeda</i>	8.0
USA	<i>Pinus taeda</i> / low yield & intensity	0.0
USA	<i>Pinus taeda</i> / medium yield - North Carolina	5.9
USA	<i>Pinus taeda</i> / medium yield - South	7.1
USA	<i>Pinus taeda</i> / high yield & intensity	7.6
USA	Mixed Hardwoods, even age, plant	3.2
USA	Mixed Hardwoods, uneven age, selection	10.0
USA	<i>Pseudotsuga menziesii</i> Site I	7.9
USA	<i>Pseudotsuga menziesii</i> Site III	5.9
USA	Hybrid exotic larch, Northeast / Central	5.2
Venezuela	<i>Eucalyptus urophylla</i>	12.4
Vietnam	Acacia smallholder	22.7
Vietnam	Acacia state forest	7.7
Vietnam	<i>Eucalyptus urophylla</i> high growth	23.1
Croatia	Oak/Beech/Fir	5.8
New Zealand	Pine spp.	8.3
Vietnam	Acacia spp.	30.0
Laos	Teak spp.	17.5
Vietnam	Acacia spp., <i>Eucalyptus</i> spp.	20.0
China	<i>Pinus</i> spp., <i>Cunninghamia</i> spp., <i>Castanopsis</i> spp. and mixes, <i>Eucalyptus</i> spp.	9 to 28
Italy	Poplar spp.	8.8
Spain	Poplar spp.	8.4
Portugal	<i>Eucalyptus</i> spp.	9.0
Portugal	Pine spp.	5.6
Latvia	Scots pine, Norway spruce, Birch spp.	3.6
Estonia	Scots pine, Norway spruce, Birch spp.	2.5
Colombia	Pine spp.	4.1
New Zealand	<i>Pinus radiata</i>	8.5

Sources: Beljan et al., 2020; Cabbage et al., 2020; Evison, 2018; Frey et al., 2018; Maraseni et al., 2018, 2017; Pra et al., 2019; Ramírez et al., 2020; Watt et al., 2017; Zhang et al., 2019; NORSKOG, 2020.

investments in the United States and elsewhere are compared with. Similarly, U.S. bond rates also serve as a useful comparison. Accordingly, Fig. 1 shows the historical annual S&P 500 returns and U.S. bond rates from 2005 to 2018, drawn from Damodaran (2012). The average annual return for stocks from 2005 to 2018 was 9.9%, with a standard deviation of 16.7%. The return for long-term (10-year) bonds was 4.5%, with a standard deviation of 8.8%. Assuming inflation was about 2% per year during this period average annual real returns would be about 8% per year for stocks and 2.5% for bonds. Stocks performed better in 2019 with a 31.2% return but have fluctuated wildly in 2020 and were - 4% for 2020 as of late June, with COVID-19 and major U.S. economic problems.

Commercial real estate also has been adopted widely in institutional investment portfolios and REITs, with reported values of \$12 trillion in the U.S and \$32 trillion in the world. Global real estate investment internal rates of return have averaged 3% in 2007 to 15% in 2011 to 10% in 2017. However, massive vacancies and rent payment delinquencies have occurred since COVID-19 struck, with a 10% average delinquency rate in June 2020, and 15% to 25% for office and lodging sectors. Empty offices and retail establishments have little other recourse, since bad loans cannot be replaced with minimal other demand, so commercial property faces low return for years to come (The Economist, 2020).

Compared to farmland forest investments offer a flexible harvest timing option. In most cases, a harvest schedule can be accelerated or postponed by several years, which gives the owner the opportunity to time a harvest to coincide with personal income needs or to wait for a more favorable price situation (Chambers et al., 2020). This is reassuring, but timber prices have been quite low for more than a decade, which is an inordinate wait and will not be improved with depressed forest product demand with COVID-19. Nonetheless, timber markets have not fallen as far as commercial property and forest products business has proceeded, so forest assets still are achieving the sought after moderate but stable returns.

Overall, the apparent risks of thin timberland markets and price risks are generally smaller for forest land markets than for many equity investments. Timberland investments returns are moderate, but appear larger than bonds, and less than stocks. The risks of timberland investments appear smaller than stocks, but that is based on relatively stable but low timber prices in the last decade.

3.2. Forest investments as portfolio diversifiers

Like financial securities, the prices of forest assets are directly related to changes in forecasted cash flows and changes in the market discount rate. However, what differs forest assets is that cash flows and especially returns are predominantly driven by wood prices and biological growth (Caulfield, 1998; Chudy et al., 2020, 2020). Wood prices, like other commodity prices, are a result of wood supply and demand interaction. Biological growth that affects yield is completely independent of financial markets. Thus, given that returns in forestry are driven by different economic fundamentals than are stocks and bonds, forest assets have little correlation, or even negative correlation, with the prices of financial assets, providing a diversification potential in the mixed portfolio and could improve investment performance (e.g., Binkley, 2019; Chambers et al., 2020; Lutz, 2018; Martinez-Oviedo and Medda, 2017; Rubbiani et al., 2018; Wan et al., 2015).

As a long-term investment, timberland has shown significant risk mitigation potential in pure forest portfolio through spatial, product and market selection (Busby et al., 2020). Timber can be used for a variety of purposes (e.g., building and construction materials, pulp and paper products, bioenergy or other wood biomass derived bio-products like vanillin), offering the option to put the timber into a variety of products that add considerable value. The prices of these associated timber products are often characterized by a lack of cointegration (Chudy and Hagler, 2020).

Forest investments offer four broad approaches to diversifying a portfolio and mitigating risk through spatial, temporal, product and market, and investment structure and strategy (Fu, 2012). The spatial portfolio diversification includes the selection of different countries, regions or local markets. The size and distribution pattern of investment properties are important features of spatial diversification. The temporal portfolio diversification focuses on the age class distribution of forest assets and supports holding invested capital in different stand age classes. The diversification through product and market considers investments in different commercial tree species, focus on different wood assortments, but also pursues a range of non-timber income sources. Finally, the portfolio diversification through investment structure and strategy recommends a careful selection of investment vehicle (e.g., fund, co-investment, direct investment (Mei and Clutter 2020); manager, investment strategy (e.g., pure timber vs. timber + carbon vs. timber + agriculture (Busby et al., 2020); and investment model based on different timber assets (e.g., fee simple, cutting rights, timber leases).

3.3. Forest investments as a hedge against inflation

Timberland is often described as an investment that offers a hedge against inflation (Lundgren, 2005; Lutz, 2008; Parajuli and Chang, 2015; Redmond and Cabbage, 1988; Rubbiani et al., 2018; Wan et al., 2013; Washburn and Binkley, 1993) but also against oil price risk (Martinez-Oviedo and Medda, 2017). This characteristic does not always apply to public-equity assets (Parajuli and Chang, 2015). Inflation hedging has not seemed so important in the 21st century as inflation and interest rates have remained quite low, but there are notable exceptions in some countries, and the risk remains germane.

In the past, Washburn and Binkley (1993) found that forests in the U.S. West and South have been superior hedges against higher-than-anticipated inflation, while forests in the Northeast have been less effective inflation hedges. Lundgren (2005) evaluated the investment performance of Swedish timberland and found that timberland investments in Sweden can serve as a hedge against inflation. Lutz (2008) described that that U.S. timberland returns, as measured by the NCREIF¹ Timberland Index, appear to lead the U.S. Consumer Price Index by a year and those returns are highly positively correlated with inflation. On the other hand, timber prices, which are a major driver of timberland returns, are not always highly correlated with inflation (Lutz, 2008; Zhang et al., 2011). It was also shown that a geographically diversified timberland portfolio is required if investors want timberland returns to be positively correlated with inflation over the long term and that many international investors may find that U.S. timberland returns outpace inflation in their countries (Lutz, 2008).

3.4. Liquidity and natural risks

Forest assets are often described as a relatively illiquid investments, with potential exposures to natural disasters. The problem with illiquidity has been reduced through REITs that provide liquid access to this illiquid asset class, i.e., investors can add to or trim their exposure to real estate quickly and easily through purchase and sale of shares in REITs. Even in relatively recent bear markets for timber sales, timberland prices in the U.S. have retained their values at about \$1700 per acre for the combined land and timber components from 2005 to 2017 (Cabbage et al. 2019). There still is a quite active market for TIMOs and other investors seeking to buy and sell forest land, and large timberland tracts are scarce.

In general, illiquidity protects forests as an asset class from financial crises and inflation. However, due to a large span of investment

¹ NCREIF stands for the National Council of Real Estate Investment Fiduciaries.

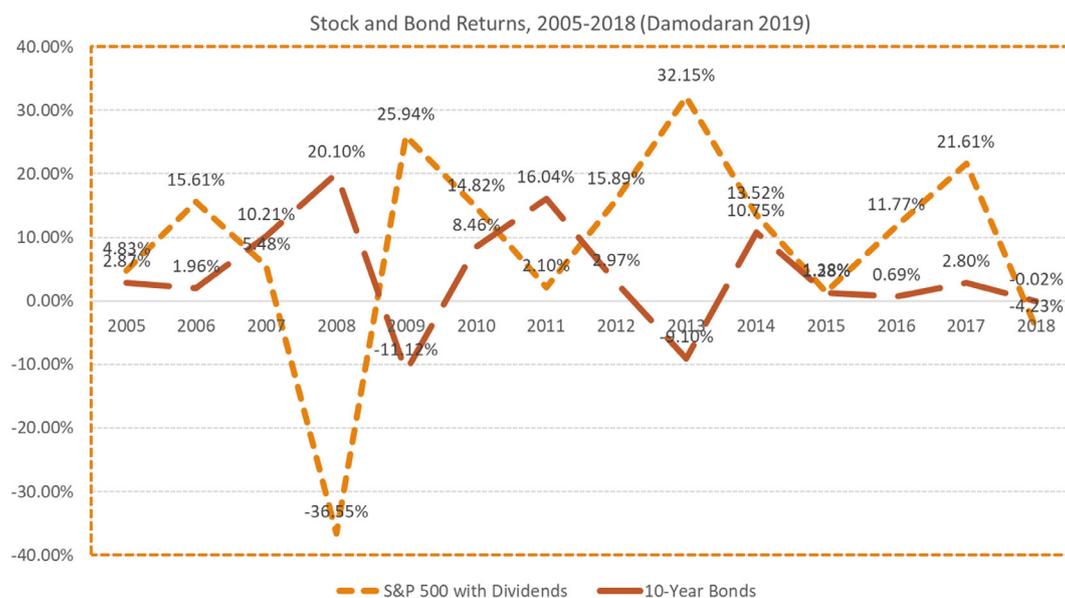


Fig. 1. U.S. S&P 500 and Bond Average Returns Per Year, 2005–2019.

possibilities in forest assets, this feature seems to be closely dependent to investment vehicle being used in each investment. For instance, REITs hold illiquid private investments, which generate returns that are passed through public REIT structures to form ownership units (shares) that are liquid (Chambers et al., 2020). The question arises whether owners of publicly traded REITs receive an expected return that includes a risk premium for illiquidity. From one perspective, it is possible that forest properties are acquired at prices that are discounted for their illiquidity. On the other hand, competition by investors to receive a positive illiquidity premium while holding a liquid REIT would appear to drive property values up to the point that they no longer offer a risk premium for illiquidity. The literature indicates that REITs have higher than TIMOs systematic risk (Mei and Clutter, 2020) which may make them more vulnerable to financial crises, but also REITs may not have the same inflation hedging attributes as direct ownership vehicles (Hoyt, 2015).

Biotic (insect, disease) and abiotic (fire, storms, floods) threats to forest investments are perceived as issues, but not that prevalent. The impacts of insects and diseases on forests vary from natural thinning to extraordinary levels of tree mortality. Regarding random events such as wildfire, insects, diseases. A study done by Hancock Timber Resource Group (HTRG) showed that historically annual percent of timberland asset value lost to natural disasters are quite low, at less than about 0.5% per year (HTRG, 2013). Siry et al. (2018) found that tree mortality in the United States from insect and diseases amounted to only about 0.3% of all land area in the country, and the brunt of this would occur on older stands on public lands or overmature stands on private lands. In the U.S. about seven to eight million acres of forest are burned by fires in recent years. Based on a base of 750 million acres, this would represent less than 1% of the country's forests. Again, much of this is focused on public lands and the West, but private (investable) lands still bear some risk.

Hurricanes, tornadoes, and storms also present a low percentage risk but can create a total loss in hard-hit areas. For example, in one of the worst cases in a decade, in 2018 Hurricane Michael struck Florida, Alabama, and Georgia, damaging an estimated three to five million acres of timberland and 1.2 million acres (2.8%) of all planted pine stands in the U.S. South. But only 0.5% of all planted pine stands in the South were more than 50% damaged, and only 0.2% were severely (90%) damaged (Cabbage et al. 2019). However, little of the damaged stands could be salvaged and sold at any reasonable timber price, so the financial losses on individual stands affected were huge. In some

countries, forest owners do have a possibility to insure their forest assets.

In sum, biotic and abiotic risks can affect forests, but they are much less than presumed. Insects and diseases are less likely to attack managed forest stands, with a likelihood of mortality of less than 0.2% per year. Fire is the greatest threat, but also less common on managed investment forestlands, at less than 1.0% per year for all forests in the U.S. with the vast majority on western, mostly public lands. Hurricanes and storms do affect productive forests, but major ones such as Hugo and Michael are uncommon, so the net effect is probably less than 0.2% to 0.5% per year. Storm damage is at least as likely to affect business, commercial, residential, or agricultural property, with much greater losses. Urban real estate property damage also is possible from fires and even social protests. And major recessions will affect all sectors; perhaps much more than timberland.

4. Contributions in the special issue

4.1. Global investments in forest assets

This Special Issue of FPE presents 13 papers on timberland finance and investments from around the world. Articles in this Special Issue demonstrate that optimal portfolios of institutional investors include significant allocations to both the U.S. and Latin America, with the allocation to Latin America (and Asia) increasing as the risk budget increases (Busby et al., 2020). A return boost of just 10 to 20 basis points resulted when Australia and New Zealand entered optimal global timberland investment portfolio. This result is in line with Timberlink statistics, which suggest that majority of investments by institutional investors are in U.S. (66%), Australia and New Zealand (19%) and Latin America (9%).

Cabbage et al. (2020) estimated timber investment returns around the globe and explained why various regions are attractive for investors. South American plantation growth rates and their concomitant returns are generally greater, at more than 12% IRRs, as were those in China, Vietnam, and Laos. Then these IRRs are followed by those for plantations in southern hemisphere countries of Australia and New Zealand and Mexico, with IRRs around 8%. Temperate forest plantations in the U.S. and Europe returned less, from 4% to 8%, but those countries have less financial risk, better timber markets, and more infrastructure.

Pra et al. (2019) focused on forest plantation investments in

Southwestern Europe and found that there are some opportunities for reasonably attractive investment returns ($IRR > 5\%$) for current landowners and forest products industry, and to a less extent for financial investors. However, these new emerging markets are still hampered by timber market, biotic and abiotic risks and forest holdings structure. Therefore, each forestry investment should be treated with caution and on a case by case basis. Factors such as biological growth and timber prices (Chudy et al., 2020), bioenergy market and contractual rights and obligations on the properties (Mei, 2019), tax structure (Li et al., 2020), availability and characteristics of forest service contractors (Štěrbová and Kovalčík, 2020) or even other forest merchantability limitations in given regions (Pokharel and Latta, 2020) may vary and may significantly impact IRRs of specific timberland investments.

Further, Mei (2019) confirmed that that timberland serves as risk diversifier in institutional investors' portfolios. Timber REITs have some risk-reduction ability but at the same time track the stock market closely, so have higher systematic risk than TIMOs, which have unique advantages as land management investments (Mei and Clutter, 2020). Thus, REITs may not offer excess returns. Overall, REITs and TIMOs both exhibit positive abnormal returns (Mei and Clutter, 2020). Risk reduction can occur through careful due diligence (Hiegel et al., 2020) and selection of investment vehicle and manager, together with spatial market diversification that is supported by the lack of integration between global roundwood markets (Chudy and Hagler, 2020).

Tran et al. (2020) found that in addition to financial benefits, large forest landowners derived nonfinancial benefits from the land, such as a sense of identity and its history and the value of passing it on to future generations. Li et al. (2020) found that the U.S. Tax Cuts and Jobs Act of 2017 would make landowners holding timber as investments moderately worse off due to the changes in itemized deductions, and that timber would become less beneficial in terms of tax savings for forest landowners with moderate and high non-timber income compared to the prior law.

4.2. Forest products markets

Another important subject in this Special Issue was related to forest products markets. For instance, Schlosser (2020) developed a tool to forecast real price appreciation that timberland managers may find helpful during market disruption and recovery events. Chudy and Hagler (2020) found that in general non-coniferous and coniferous wood markets are not integrated due to a lack of perfect substitutability of roundwood products and significant transaction costs among trading regions. Kanieski da Silva et al. (2020) investigated market linkages between stumpage prices and forest products and found that wood market is efficient among product classes with respect to external market shocks in Brazil, with limited opportunities for arbitrage profits. However, timberland investors in Brazil tend to be more affected by the lack of infrastructure and market inefficiency (often caused by government policies such as cross-state taxes) than in developed countries. Pokharel and Latta (2020) used network analysis to identify hotspots in which merchantability may limit forest management across the United States.

5. Conclusion and outlook on future research

This Special Issue contains a comprehensive summary of forestry as an alternative asset class. Given massive changes in the global forest sector, as well as business and economic considerations within the timberland investment environment, we think that there are still substantial knowledge gaps in the refereed literature regarding forestry investments.

First, there is a need to better understand the conservation impact forestry (CIF) and environment, social, and governance (ESG) investments, which focus on the joint production of ecosystem services and

wood products. Busby et al. (2020) found that CIF does enter the set of risk-efficient timberland portfolios. More research certainly needs to be done, including but not limited to, providing more information for investors regarding the benefits of CIF strategy, both in financial and sustainable terms. Lessons learned from forest certification show that the financial viability of such investment strategies is one of the most important criteria that may help to attract more financial capital and consequently help to achieve sustainable goals in forestry. This subject area could include research about climate-smart solutions in forestry investments (economics of natural regeneration, multilayer forestry, agroforestry, flood reduction and mitigation, etc.).

Second, it seems that research on forestry as an asset class has advanced, but mostly in the U.S., which is the largest timberland investment market. More research should be done in other regions as well. More information about the characteristics of other markets may help to make the market more transparent and consequently attract new investors interested in forestry, who want to diversify their portfolios; find niche strategies; buy undervalued assets; and identify preferred land, market, institutional, and political locations.

Third, although timberland investments done by institutional investors started in the 1980s, there is still a knowledge gap regarding excess returns compared to market index/benchmark (alpha) or systematic risk (beta) that forestry investments generate. For instance, Mei (2019) suggested that classic asset pricing models have difficulty in pricing private-equity timberland assets. Thus, more research on private equity markets, companies that purely invest in forestry (not only on vertically integrated forest industry companies) should be done.

Fourth, there is a widespread need for both better knowledge and better data about timber and forest land prices, costs, markets, and returns. While a few investment returns data sources and timber price data series exist, they are limited. Systematic data on stand-level forest management costs are even less available, and information about total costs including overhead, administration, legal, tax, and policy components of investments are almost nonexistent. Identification and "rationalization" of data on best forest markets, for timber or ecosystem services, are almost nonexistent.

So, while purposeful timber growing and forest assets are centuries old, as are the principles and practice of most business investments, systematic institutional investing in forests as an asset class is less than four decades old. This remains a new alternative investment class, and there are a quite modest number of researchers dedicated to full- or part-time to the subject. As an old adage suggests, the field of forest investments and forestry investment research remains quite open for action. More research, adoption, and application can help improve the use of forest assets as an investment class; presumably help attract more capital to the asset; and improve sustainable forest management and provision of ecosystem services.

Declaration of Competing Interest

We have no conflicts of interest to disclose.

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