## Risk/Opportunity Index Report

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## Contents

1. Introduction	3
2. Procedure	3
2.1 Preliminary review	3
2.2 Assembling a preliminary version of the ROI—base economic resilience	3
2.3 Assembling a preliminary version of the ROI—the conversion factor and final economic resilience	5
2.4 Assembling a preliminary version of the ROI—exposure to Forest Service planning	6
2.5 Assembling a preliminary version of the ROI—calculating the ROI	7
2.6 Beta-testing	7
2.7 Finalizing the ROI and Ground-truthing	7
3. Results	8
3.1 Base Resilience	8
3.2 Conversion factor	11
3.4 Final Resilience Index	12
3.5 Exposure to Forest Service Planning	12
3.6 County Risk/Opportunity Index	14
4. Discussion	16
4.1 The ROI, the greater economy and marginalized populations	16
4.2 Examining the link between exposure and resilience	18
4.3 Strengths, weaknesses, and putting the ROI to work	18
References	20
Attachment 1: Sample Preliminary Risk/Opportunity Index Summary	23
Attachment 2: Notes from Ground Truthing Sessions	25

#### 1. Introduction

The "Risk/Opportunity Index" (ROI) is a measure of a county's susceptibility to economic damage or benefit resulting from a shift in planning in the national forestland of the Blue Mountains. As such it has two parts. The first part is a measure of the location's economic "resilience". For the purposes of this report resilience is the ability of a county or a community to withstand or recover from an outside shock to its economy (1). The second part of the index, "exposure", estimates a location's economic ties to the national forests of the Blue Mountains. The idea here is that a location may be deemed "resilient" but have close ties to Forest Service lands or forest-based industries, and thus still be somewhat vulnerable economically to changes in forest planning. Alternatively, a location that is resilient but not closely tied to activities in the national forests may be less vulnerable to such shifts.

The ROI addresses a need, identified by the Forest Service and counties of the region, to account for the differences between the economies of the counties that share the Wallowa-Whitman, Umatilla, and Malheur National Forests. The ROI is, therefore, a relative measure. Among the fourteen counties of the study region the ROI estimates which are the most and least economically resilient, and which are most and least exposed to Forest Service planning decisions.

#### 2. Procedure

#### 2.1 Preliminary review

Initial work on development of the ROI consisted of a review of the literature on existing indices. There is a plethora of indices in the published literature profiling various forms of economic vulnerability and resilience. Many gauge resilience or vulnerability to environmental change (2) (3), natural disasters (4) (5), while others to an economic shock (6) (7).

Of particular relevance to this study was the work of Horne and Hayes who developed a measure of socio-economic resilience for counties in the Columbia Basin (8). Their work was helpful in that is related directly to the region of the current study, and provided an example that included direct measures of reliance on forage and timber. A second index that was exceptionally useful was the Index of Economic Opportunity (9). This measure profiled county economies of the region under study, and used many of the indicators incorporated into the ROI. It is also a "relative" measure so gauges economic opportunity relative to other counties within its study area. Based on studies like these, we assembled a preliminary version of the ROI. Key issues to address in this stage involved determining what specific elements to include in the ROI, how each of these elements would be represented, and how they would be aggregated.

#### 2.2 Assembling a preliminary version of the ROI—base economic resilience

Development of the preliminary version of the ROI required settling on the general structure of the index. Based on the literature and economic intuition we opted for a two-branched structure as presented in Figure 1. One branch consisted of a measure of county-level economic resilience where economic resilience was a function of three forms of capital, human/social, monetary, and natural, as well as the county's ability to convert this capital into economic resilience. The other branch consisted of county-level exposure to Forest Service planning.

#### Figure 1: Schematic Overview of the Risk/Opportunity Index

# What are the things that a community can use to build potential resilience?

- Social/Human capital -- Qualities of a community that enable it to identify and capitalize on opportunities as well as recover from economic downturns.
- Monetary capital The financial resources of a community that it can bring to bear on opportunities and challenges.
- Natural capital The wealth embodied by a community's natural resource endowment.

# What are the things that enable a community to convert its potential resilience into actual resilience?

- Oftentimes this is infrastructure, like roads and railroads. It can also be healthcare that enables residents to stay healthy and therefore, more productive and competitive.
- They foster connections to markets and the communication of ideas and information.

#### Resilience--How well does a community resist or recover from an economic downturn?

- This depends on how much potential wealth it has at hand as well as how much of this wealth is converted to actual wealth.
- Because we want to differentiate between these counties, the yardstick this is measured against is the average of the 14 counties.

#### Exposure—Focusing on the Forest Service, is a community insulated from changes to FS planning?

- Depends partly on how much community income is related to Forest Service lands.
- A second factor is the extent of Forest Service land ownership in the area.

Risk/Opportunity index – Combines resilience and exposure. "Is this community's economy susceptible to change related to Forest Service planning?"

- A higher index indicates a county is more likely to experience significant impact either positive or negative.
- A relatively low index implies that the county is less likely to see significant impacts to its economy than its neighbors.

Selection of the measures that make up the economic resilience measure of the ROI proceeded in two stages. The initial selection of measures, for example earnings per job, and acres of farmland per person, was guided by the literature and practical economic intuition. For example, economic diversity is often cited as an important constituent of a resilient economy, and was thus included in the ROI. However, it did little to differentiate between counties because in practice nearly identical values were generated by counties with many firms and counties with few firms. Thus, the "number of firms" was introduced to the economic resilience measure as a complement to economic diversity. These two measures together performed outperformed either one taken on its own.

After the candidate measures were selected we conducted a series of sensitivity analyses and internal reviews. Ultimately, the measures put forth in the preliminary version of the ROI were as parsimonious as possible, intuitive, and generated resilience values that were reasonably stable.

Aggregation of the measures also had to be intuitive and result in stable values. Our approach to aggregation took the general form of:

(1) Sub – index 1 = county measure i/average across counties of measure i

(2) 
$$Sub - index \ 2 = (\sum_{i}^{N measures} Sub - index \ 1_i)/N$$

(3) Base Resilience Index = 
$$(\sum_{i}^{N \text{ forms of capital}} \text{Sub} - \text{index } 2_i)/N$$

Equation 1 show that each measure of base, or "potential", resilience is estimated in relative terms based on average values across all the counties. Equation 2 generates the index related to each form of capital. For human/social capital and monetary capital there are 5 measures each, while natural capital is based on 4 measures. Equation 3 indicates that base resilience is a simple average of the capital-based indices.

The nature of the measures sometimes required transformation. For example, given the goal of estimating relative resilience "poverty rate" was converted to "non-poverty rate" by simple subtraction. There were also challenges related to the magnitude of the differences between a given county's measure and the average of the counties. When necessary, some measures were converted to natural logarithms to avoid a single measure being so large that it dominated the index. These individual transformations are detailed in the description of the measures in the Results section below.

A second observation is that none of these measures or forms of capital are weighted. Oftentimes measures are weighted in an index (see for example (9)). In developing the ROI we decided against weighting to facilitate easier interpretation of the values and to maintain transparency.

# 2.3 Assembling a preliminary version of the ROI—the conversion factor and final economic resilience

After calculating a "base resilience index", each county's base resilience was conditioned on a "conversion factor". The measures that make up the conversion factor represent a sampling of attributes within a county that enable it to convert its base resilience into actual economic resilience. For example, a farm that is able to transport its produce to outside markets more easily is more economically productive than it would be if it could not do this due to isolation. To account for this, we use a "conversion factor"—a number that estimates a county's ability to "convert" its base capital into actual resilience and wealth. It takes the general form:

where each converter took a value between one and zero. For example, if a county had an Interstate highway within its borders it was given a 1, and alternatively, a 0, while Broadband access was reported as a percentage. A detailed description of the measures use in the conversion factor are provided below in the Results section.

Each county's base resilience was conditioned on its conversion factor as follows:

(5) County economic resilience =  $(0.5 \times Base Resilience Index \times County conversion factor) + (0.5 \times Base Resilience Index)$ 

In this formulation the conversion factor acts on fifty percent of the base resilience. The intuition underlying this, is that a county where the listed converters are completely absent still participates in the greater market to some degree, therefore, it would be a mistake to say the county brings zero capital to bear on its economic resilience. We adopted the rate of fifty percent because it avoids weighting the conversion factor in a way that may seem to favor a given county.

In many studies of economic resilience, the elements making up the conversion factor are defined as infrastructure or "built capital". However, authors have acknowledged that built capital seems to play a different role in economic resilience. For example, rather than being a source of wealth, built capital may enhance the development of other capitals (10). To the extent that this is a novel approach to the treatment of built capital, we conducted a series of sensitivity analyses to examine the suitability of the approach. We found that when we treated the elements of the conversion factor as a fourth form of capital the county resilience indices grew closer, or rather, low resilience counties gain a bit, while high resilience counties lost a bit. Further inquiry showed that the conversion factor was negatively correlated with the natural capital sub-index of the economic resilience. This implies that by treating built capital as a converter rather than simply another form of capital, we may avoid over-valuing natural capital's contribution to economic resilience. This tentative conclusion was supported by a second sensitivity analysis that examined the effect of different levels of exposure to the conversion factor, e.g., allowing the conversion factor to act on 25% of base resilience and 75% of base resilience. We found that as the importance of the conversion factor grew, counties with high values for natural capital saw the steepest declines in measured economic resilience.

The final measure of county economic resilience is calculated as shown in equation 6.

# (6) Relative county economic resilience = county economic resilience/average county economic resilience

Consequently, the interpretation of a given county's measure of economic resilience is as a percentage of the average.

#### 2.4 Assembling a preliminary version of the ROI—exposure to Forest Service planning

As mentioned above, the ROI depicts county relative economic resilience interacting with that county's exposure to Forest Service planning. In deciding on the elements that would make up the exposure measure we relied on the same the process employed in developing the economic resilience measure a combination of what was presented in the literature, economic intuition informed by our familiarity with the region, suggestions by outside preliminary reviewers, and sensitivity analyses. Also like the economic resilience measure, we worked to build an exposure measure that was as parsimonious as possible, intuitive, and generated values that were reasonably stable. The final measure took the form presented in equation 7.

(7) County exposure index =  $\left(\left(\sum_{i}^{N \text{ measures}} \text{ income measure } i\right)/N\right)/(\text{County average}) + (\text{Forest Service land as \% of county total/County average}) + (\text{Forest Service related Federal payments as \% of county budget/County average})$ 

Note that, like the measures of resilience, the exposure measure is a relative to the average across the 14 counties. A detailed description of the measures use in the exposure index are provided below in the Results section.

#### 2.5 Assembling a preliminary version of the ROI—calculating the ROI

Combining the measures of resilience and exposure gives us a measure of the county's "risk/opportunity" related to Forest Service planning. In evaluating alternative approaches to aggregating these measures (simple summation, arithmetic mean, geometric mean), we concluded that the summing of the two is preferred. This is based on simple correlations showing the relationship between the sum and the resilience and exposure measures is either higher or almost identical to the relationships of the alternatives to the resilience and exposure measures. All three approaches result in nearly identical ranking of risk/opportunity. It is also the simplest and easiest to interpret.

In general, the potential impact of Forest Service planning on a county's economy is an increasing function of exposure, but a decreasing function of resilience. Thus, for the purposes of calculating the ROI we use "1 minus the resilience index". The resulting number represents a county's susceptibility to an economic shock—the higher the number, the less resilient it is. With the above in mind, the final RO index is interpreted as the sum of a county's exposure and susceptibility where higher numbers represent greater risk and/or opportunity as presented in equation 8.

(8) RO Index = (1 - Economic resilience index) + (Exposure index)

#### 2.6 Beta-testing

The preliminary version of the ROI was subjected to beta testing in 4 counties. The counties were selected to be somewhat representative of the region from north to south, and with 3 in Oregon and 1 in Washington. To prepare for the sessions, each county received a preliminary ROI report that included background on the ROI and a two-page summary of the given county's ROI. This two-page summary is presented in Attachment 1 to this report. For space purposes, the remaining background info is not included.

Beta testing sessions took place over Zoom. The sessions lasted about 1.5 hours. Participation ranged from one county commissioner to multiple county commissioners and county stakeholders. Two important observations came from these sessions. Overall, the ROI did a good job of presenting the county economy and the profile of the Forest Service in that county. In addition, session participants provided excellent insights that we were able to incorporate into the final version of the ROI. This latter observation was expected given the complexity of each county's economy, and it reinforced the need to conduct a robust ground-truthing phase as part of the deployment of the ROI.

#### 2.7 Finalizing the ROI and Ground-truthing

We refined the ROI based on the feedback gained though beta testing, and composed a version of the ROI for each county in the study area. In response, five sessions were held in four counties, with

participation once again ranging from one county commissioner to multiple commissioners and stakeholders. Once again excellent insights were provided in these sessions. These insights informed the final versions of the county ROI summaries presented in this report. Notes taken during the sessions were shared with session participants, and are included in Attachment 2 of this report.

These notes highlight an important observation. Development of the ROI was closely tailored to the conditions of eastern Oregon and southeast Washington. However, county level ROI estimates are still somewhat distant from a given county's economic situation. These ground truthing sessions, as anticipated, were essential in closing the gap between the estimation provided by the ROI, and the economic constraints and opportunities facing a given county.

#### 3. Results

The discussion below provides a detailed description of the measures used to calculate the final versions of the county ROI estimates.

#### 3.1 Base Resilience

**Social/Human Capital** Looking first at the measures of capital we used, Social and human capital is the "people generated" value of a community. More specifically, social capital is based on the relationships between community members, and generally the stronger these relationships the more economically resilient a community is. Human capital is a related idea having to do with the knowledge and skills of community members. This is seen as a source of economic resilience and prosperity. We estimate this capital by:

- Marginalized households This is measured by percentage of "potentially vulnerable households", defined as households occupied by a person 65 years old or older and living alone, single female-headed households, and households without a car in 2018 (11). We assume that they represent a group of people who, given their more tenuous economic position, are less able to contribute to the community in terms of resources, energy, or ideas.
- Homeownership (12) Higher rates of home ownership are related to higher levels of social capital (13). This information is made somewhat less useful by the possibility that some homeownership is actually a second home, and these are not explicitly accounted for in the social capital literature to our knowledge.
- Education (14) This is the percentage of residents with an Associate's degree or higher in 2019. Education is positively related to both increasing competitiveness and increasing social capital (13).
- Housing cost burdened, 2018 (15) High housing costs, when mortgage payments are more than 30% of household income, can diminish a community's command over resources. When housing costs are low families have more disposable income to meet their needs and support their community. This can be an important issue for a community transitioning to a recreation economy. To convert this to a measure of resilience we calculate 1 minus "Percent Housing Cost Burdened" based on mortgage payments and 5-year estimates. Thus, the higher the number, the less burdened a county is with high housing costs.
- Population density This is measured by county population in 2019 (16) divided by the county land area in 2011 (17). The lower the density, the fewer are the relationships/exchanges between members of the community. This is also an estimate of "agglomeration" economies, or rather, the boost in economic productivity observed when interactions between people increase (18). Because the magnitude of this estimate can vary dramatically, sub-index 1 is calculated as the natural logarithm of county population density divided by the natural logarithm of the average population density. In cases of very low population density this can return a negative value, however, because

the sub-index is averaged with the remaining sub-indices the effect on resilience is consistent with the other measures.

**Monetary capital** represents the financial resources of the community. This is directly related to the command over resources that the community has. It is also linked to uncertainty since households and communities with relatively limited financial resources tend to face more uncertain futures, and adjust behaviors accordingly, e.g. decrease spending. Some of these measures are often converted to logarithmic form in the literature. This index is based on linear estimates to create additional space between the counties and to acknowledge that some county incomes are quite low. The estimate of monetary capital is based on:

- Poverty rate (19) -- The 2019 poverty rate helps to account for the important fraction of people in a community who are significantly constrained with respect to income, but may otherwise escape other measures of overall wealth, for example, where housing costs are low but incomes are also low. To be consistent with our other measures we use 1 "Percentage of People in Poverty".
- Average earnings per job (20) A direct measure of the earnings of workers in the community in 2018, reported in 2019 dollars. By using this measure of income, we focus on the wage earners in an area rather than a broader measure, e.g. per capita income, which can include incomes from retirees and other non-working members of the community. In addition, all else equal, higher pay per job can imply greater competitiveness.
- Employment (21) We estimate the fraction of the labor pool that is working in 2018 calculated as 1 unemployment. Taken together with earnings per job this can help us discern locations where the labor force may be almost fully employed, but also face low wages. To note is that these figures can differ when seasonality is considered, however, to our knowledge seasonally adjusted unemployment rates are not available for the subject counties in Washington. Therefore, we use non-seasonally adjusted figures for consistency.
- Economic diversity This is both important and difficult to interpret, for example, as the scale of ٠ the analysis increases, so can the value taken by a diversity measure (8). Also, there are locations where economic diversity is low but economic performance is high, and economic diversity has been associated with both increasing resilience and decreasing stability (22). However, research indicates that broadly speaking, more diverse economies fare better in the face of an economic shock (23). Our measure here is the Shannon-Weaver Diversity Index (24) where a value of "1" would result if each industry with an economy had an equal number of employees. While this measure is broadly used, it also has weaknesses. For example, it is a measure of how evenly jobs are spread among sectors of an economy. Consequently, an economy with 10 workers in each industry will return the same diversity score as an economy with 10,000 workers in each sector. This is a concern given the disparity in size of the county economies in the region. Our calculations are based on 2019 estimated employee numbers across the 13 main industries of a county economy: agriculture, forestry, fishing & hunting, mining; construction; manufacturing; wholesale trade; retail trade; transport, warehousing, and utilities; information; finance and insurance, and real estate; professional, scientific and management, administrative/waste management services; education, health care, and social assistance; arts, entertainment, recreation, accommodations, and food; other services, except public administration; and public administration (25).
  - Number of firms (26)– This estimates the number of single or multiple establishment firms, and is a measure of how firms have adjusted to a market (27). We assume that overall community wealth is positively related to the number of firms within that community. Informal investigation indicates that this number is closely related to the overall number of jobs in a given area. This measure also provides an important compliment to our diversity measure in that it estimates the overall size of the economy, where we assume size and resilience are positively related.

**Natural capital** is the natural resources within a county that residents can access or capitalize on. Some of the components are measured in logarithmic form to recognize the diminishing returns nature of additional resources. It is estimated here by:

- Production land per person This is composed of the acres of cropland, woodland, permanent pasture and rangeland in 2017 (28), summed and divided by the county population in 2019 (29). Because the magnitude of these estimates can vary dramatically, sub-index 1 is calculated as the natural logarithm of this acreage per person divided by the natural logarithm of the average acreage per person.
- Water resources per person This is estimated as the sum of self-supplied total groundwater and surface water irrigation resources in 2015 (30) divided by county population in 2019 (16). Because the magnitude of these estimates can vary dramatically, sub-index 1 is calculated as the natural logarithm of total irrigation water per person divided by the natural logarithm of the average total irrigation water per person.
- Forest Service land more available for commodity production This is estimated by the acres of Type C (less restrictive management protocols) Forest Service land in the county (31). For example, this classification excludes wilderness areas and wild and scenic rivers and national parks where such production is often quite limited, and consequently may have less of an economic on come counties (32). Because the magnitude of these estimates can vary dramatically, sub-index 1 is calculated as the natural logarithm of acres of Type C land in the county divided by the natural logarithm of the average acres of Type C land.
- Scenic amenities importance -- Natural resources can also generate wealth via tourism. To account for this, we use a percentage of county full and part-time jobs in tourism and travel, or rather, "Tourism sensitive" industries in 2018 (33).

Table 1 presents the final values for the sub-indices, and base resilience for each county presented below.

Measure	Asotin	Baker	Columbia	Crook	Garfield	Grant	Harney	Malheur	Morrow	Umatilla	Union	Walla Walla	Wallowa	Wheeler
Social/human capital														
1 - Percent vulnerable households	1.05	0.98	1.01	1.02	1.10	1.04	1.00	0.89	1.06	0.91	0.98	0.94	0.98	1.03
Percent home ownership	1.03	1.03	0.98	1.05	1.04	1.03	1.05	0.85	1.02	0.95	0.94	0.94	1.01	1.10
1 - Percent housing cost burdened	1.13	0.97	0.97	0.96	1.16	0.84	0.93	1.01	1.08	1.04	1.05	1.07	0.98	0.82
Education	1.06	1.03	1.37	0.97	1.24	0.83	0.91	0.73	0.56	0.89	1.11	1.37	1.16	0.76
Population density	1.70	0.79	0.73	1.00	0.54	0.22	-0.15	0.54	0.83	1.52	1.23	0.80	0.40	-0.12
Monetary capital														
1 - Poverty rate	1.02	1.02	1.03	1.01	1.05	0.95	1.04	0.91	1.00	0.96	1.00	1.00	1.01	1.00
Average annual earnings per job	1.09	0.83	1.19	1.06	1.16	0.94	0.85	0.96	1.34	1.10	1.00	1.29	0.71	0.46
Labor force employment	1.01	1.00	0.99	1.00	0.99	0.98	0.99	1.01	1.01	1.00	1.00	1.00	0.99	1.02
Number of firms	1.01	1.39	0.30	1.52	0.11	0.47	0.68	1.66	0.46	1.23	1.56	3.12	0.30	0.18
Economic diversity	0.98	1.03	1.00	1.02	1.00	0.98	0.96	1.03	1.02	1.03	0.98	0.98	1.03	0.97
Natural Capital														
Farmland per person	0.54	0.86	0.91	0.78	1.08	1.00	1.20	0.80	1.02	0.63	0.59	0.51	0.96	1.34
Irrigation water per acre of cropland	0.17	0.58	0.49	1.14	0.16	0.91	1.07	1.15	0.86	0.84	1.05	0.74	1.04	0.99
Acres of Federal land with least commercial use restrictions	0.75	0.99	0.78	0.99	0.77	1.03	1.12	1.10	0.86	0.91	0.94	0.00	0.92	0.89

#### **Table 1: Disaggregated Base Resilience Indicies**

Scenic amenities	1.05	1.38	0.84	1.14	0.25	0.77	1.57	1.14	0.64	1.15	1.10	0.89	1.03	1.06
Sub-index 2														
Social/Human	1.19	0.96	1.01	0.99	1.01	0.79	0.74	0.80	0.91	1.06	1.05	1.02	0.90	0.72
Monetary	1.02	1.05	0.90	1.12	0.86	0.86	0.90	1.11	0.96	1.06	1.11	1.47	0.80	0.72
Natural	0.62	0.95	0.75	1.01	0.56	0.92	1.23	1.04	0.84	0.88	0.91	0.53	0.98	1.07
Base Resilience Index	0.94	0.98	0.88	1.04	0.81	0.86	0.96	0.98	0.90	1.00	1.02	1.01	0.89	0.83

#### 3.2 Conversion factor

After refinements gained via the beta testing and ground truthing session, these are the elements of the final conversion factor:

- Hospital (0/1) To register as present, a county needs to have a health facility where residents can come for regular medical examinations. We assume that such a facility will help to maintain a productive workforce. These were tallied based on a simple Internet search.
- University/College (0/1) Counties with a university or community college are represented by "1" here. We assume that they are important converters of potential human capital into actual human capital. These were tallied based on an Internet search.
- Interstate (0/1) We assume that counties with an interstate highway passing through them are significantly more connected to outside markets than those that are not. This tally is based on current road maps. This is a coarse measure given that residents in a county without an interstate highway may actually be closer to such a highway than some residents in a large county with such a highway.
- Airport (0/1) -- The development status of a given location is partly related to airport access. More specifically, being within 100 miles of a major airport has been linked to additional development (34). With this in mind, where the county seat is within 100 miles of an airport as estimated by "Google Directions", and that airport is classified as "primary", or rather, boards at least 10,000 fare paying passengers per year by the Federal Aviation Administration (35) the county receives a "1", and otherwise a "0".
- Railroad (0/1) As is the case with interstate highways, we assume that counties with a freight railroad passing through them are more connected to outside markets and receive a "1". This information was gathered from the *County Transportation Profiles* put together by the Bureau of Transportation Statistics (36). Where the stated value in the table below does not match the value reported on the Bureau's website, we used more up-to-date local information.
- Metro Area proximity This measure makes use of the R*ural-Urban Continuum Codes*" developed by the USDA Economic Research Service (37). This scheme assigns values of 1 to 9 based on a county population and/or proximity to a population center, where 1 represents the most urban, and 9 the most rural. To render this consistent with our index, we use the relationship (-0.125 x continuum code)+(1.125). For example, the most rural county has a continuum code of "9", and this equation converts this to a "0" while the most urban continuum code is "1" and the equation returns a value of "1".
- Broadband (%) This accounts for the business activity that can now be conducted over the Internet. The information comes from Federal Communication Commission's "*Mapping Broadband Health in America*" (38). While this information has been updated in 2017, in general we assume broadband coverage is changing quickly, so it will be important to monitor these percentages.

Summing these measures and dividing by the maximum possible score gives us a the final "conversion" factor for each county presented below.

**Table 2: Conversion Factors** 

Factor	Asotin	Baker	Columbia	Crook	Garfield	Grant	Harney	Malheur	Morrow	Umatilla	Union	Walla Walla	Wallowa	Wheeler
Hospital (0/1)	1	1	1	1	1	1	1	1	1	1	1	1	1	0
University/College (0/1)	0	1	0	1	0	0	0	0	1	1	1	1	0	0
Interstate (0/1)	0	1	0	0	0	0	0	1	1	1	1	0	0	0
Airport Access	1	0	1	1	1	0	0	1	1	1	0	1	0	0
Railroad (0/1)	1	1	1	0	1	0	0	1	1	1	1	1	1	0
Metro area access	0.75	0.25	0.75	0.37	0.12	0	0.25	0.37	0.37	0.62	0.25	0.75	0	0
Broadband (%)	0.95	0.06	1	0.98	1	0.73	0	0.64	0.49	0.81	0.72	1	0.95	0
Conversion Factor	0.67	0.62	0.68	0.62	0.59	0.25	0.18	0.86	0.84	0.92	0.71	0.82	0.42	0

#### 3.3 Final Resilience Index

Combining the base resilience for each county with the county's conversion factor as described in the Procedure section above, gives us the final resilience indices presented below.

I upic co I mu		nence		-										
	Asotin	Baker	Columbia	Crook	Garfield	Grant	Harney	Malheur	Morrow	Umatilla	Union	Walla Walla	Wallowa	Wheeler
Unstandardized resilience index	0.79	0.80	0.75	0.85	0.65	0.54	0.57	0.92	0.83	0.96	0.88	0.92	0.64	0.42
Standardized resilience index	1.05	1.06	0.99	1.13	0.86	0.72	0.76	1.22	1.11	1.28	1.17	1.23	0.85	0.56

**Table 3: Final Resilience Index** 

#### 3.4 Exposure to Forest Service Planning

To estimate an area's exposure to Forest Service planning we use 1) labor incomes stemming from production related to forest lands, as well as labor incomes from tourism sensitive businesses, 2) the extent of Forest Service land in the county, and 3) the fraction of county government revenue most closely related to Forest Service payments. Each of these is summarized below.

• Labor income Looking at the importance of income, for each county we sum the labor incomes for the forest-linked industries listed below. We then divide this by the total labor income in the county to get that fraction of the county's labor income derived from production most likely to be related to forest lands. The incomes used for this calculation are generated using IMPLAN software. Note that this does not account for additional, or rather "induced", incomes that this income can generate in a community. It is therefore a conservative estimate of economic importance.

To estimate the importance of income from forest-related tourism to an area, we sum the labor incomes from the travel-sensitive industries listed below, and divide this by the total labor income to get the fraction of county labor income related to tourism. To account for the fact that not all tourism is related to public lands, we multiplied the tourism-related fraction of total labor income by the percent of Federal land in the county (39). This gives us a rough measure of the importance of natural resource-related tourism in an area.

#### **Forest-linked industries**

Beef cattle ranching and farming, including feedlots and dual-purpose ranching Forestry, forest products, and timber tract production Commercial logging Commercial hunting and trapping Support activities for agriculture and forestry Sawmills Wood preservation Veneer and plywood manufacturing Engineered wood member and truss manufacturing Reconstituted wood product manufacturing Wood windows and door manufacturing Cut stock, resawing lumber, and planing

Other millwork, including flooring Wood container and pallet manufacturing Manufactured home (mobile home) manufacturing Prefabricated wood building manufacturing All other miscellaneous wood product manufacturing Pulp mills Paper mills

**Travel and tourism-sensitive industries** Hotels and motels, including casino hotels Other accommodations Full-service restaurants Limited-service restaurants

- Extent of Forest Service land To complement the above income-based measure, we include the percent of Forest Service land in the county (39). This acknowledges the fact that some areas have a significant portion of public land that is not Forest Service land, and given the context of the ROI, in practical terms the extent of Forest Service land ownership in the area is closely related to the area's exposure.
- Forest Service payments To the extent that payments to county governments for Forest Service land are an important source of revenue, a county can be considered exposed to Forest Service planning decisions. We account for this by estimating the percentage of a county's budget coming from Forest Service payments, and more specifically, Payments in Lieu of Taxes (PILT), and Forest Service revenue sharing.

Because PILT is related to Federal land ownership in general, we condition county PILT payments on the percentage of total Federal land that is Forest Service land in the county. This is calculated by multiplying the total PILT payment to the county by the percentage of Federal land in the county that is Forest Service land. This dollar amount is added to the second component of Forest Service related payments, Forest Service revenue sharing. The sum of these two is then divided by the total county revenue to arrive at the percentage of each county budget that is linked to Forest Service payments.

Estimated PILT dollars are based on 2019 payments converted to 2020 dollars as reported by the US Department of Interior (40). Estimated county revenue is also presented in *A Profile of Federal Land Payments* (40). The land ownership estimates come from the US Geological Survey, Gap Analysis Program, (31).

These three measures entail an empirical challenge. Specifically, the extent of Forest Service land varies over a wider range than the other measures. This can confer an implicit weight to this part of the exposure measure. To address this challenge the exposure index has been standardized so that each county's final exposure index in row 10 is relative to the average of the

counties, and the three elements contribute equally. The final exposure index for each county is presented in the Table below.

 Table 4: Exposure Index

	Asotin	Baker	Columbia	Crook	Garfield	Grant	Harney	Malheur	Morrow	Umatilla	Union	Walla Walla	Wallowa	Wheeler	AVERAGE
1. Fraction of total labor income generated by timber and ranching	0.031	0.115	0.117	0.154	0.045	0.129	0.072	0.039	0.084	0.065	0.073	0.022	0.058	0.012	0.073
2. Fraction of total labor income from tourism sensitive incomes conditioned on public lands ownership <sup>1</sup>	0.006	0.015	0.006	0.011	0.003	0.016	0.007	0.000	0.001	0.007	0.018	0.001	0.028	0.003	600.0
3. Total income percentage (1+2)	0.037	0.130	0.124	0.165	0.048	0.145	0.079	0.039	0.086	0.072	0.091	0.023	0.086	0.016	0.081
4. FS land as a percentage of total land	0.132	0.328	0.285	0.228	0.207	0.550	0.080	0.001	0.110	0.195	0.473	0.027	0.571	0.154	0.239
5. FS-related Federal payments as percent of total county budget	0.002	0.022	0.013	0.023	0.013	0.058	0.026	0.000	0.004	0.003	0.022	0.000	0.029	0.059	0.020
6. Relative Total income percentage	0.456	1.592	1.517	2.033	0.590	1.777	0.965	0.476	1.054	0.888	1.115	0.286	1.057	0.191	1
7. Relative FS land as a percentage of total land	0.555	1.373	1.194	0.955	0.869	2.304	0.335	0.003	0.461	0.817	1.983	0.113	2.393	0.645	1
8. Relative FS-related Federal payments as percent of total county budget	0.120	1.138	0.662	1.190	0.676	2.942	1.306	0.001	0.190	0.149	1.119	0.001	1.499	3.006	1
9. Raw exposure index	1.131	4.103	3.373	4.178	2.136	7.023	2.607	0.480	1.705	1.853	4.217	0.401	4.950	3.843	3.000
10. Standardized exposure index	0.377	1.368	1.124	1.393	0.712	2.341	0.869	0.160	0.568	0.618	1.406	0.134	1.650	1.281	1

#### 3.5 County Risk/Opportunity Index

The final ROI for each county is presented below. Note that the ROI can take on a negative value when, as in the case of Walla Walla, a county has a high resilience index, and low exposure. Although a bit surprising, the interpretation of such a result is the same as for the ROI of the other counties.

Complementing the ROI presented in Table 5 is the scatter plot of resilience versus exposure for the 14 counties shown in Graph 1. On this graph the lower left-hand quadrant, Quadrant III, represents the high resilience and low exposure locations (low RO index), and the upper right-hand quadrant (Quadrant I) represents low resilience/high exposure counties—locations where the risk is highest, and where there is the greatest opportunity for current FS planning to support local livelihoods.

Table 5: Risk/Opportunity Index

Element	Asotin	Baker	Columbia	Crook	Garfield	Grant	Harney	Malheur	Morrow	Umatilla	Union	Walla Walla	Wallowa	Wheeler
Resilience	1.05	1.06	1.00	1.12	0.87	0.72	0.76	1.22	1.11	1.28	1.16	1.21	0.86	0.57
Exposure	0.38	1.37	1.12	1.39	0.71	2.34	0.87	0.16	0.57	0.62	1.41	0.13	1.65	1.28
RO index <sup>1</sup>	0.32	1.30	1.13	1.26	0.85	2.63	1.11	-0.06	0.46	0.34	1.23	-0.10	1.80	1.72

<sup>1</sup>Calculated as (1-resilience index) + exposure index

Graph 1 is helpful in that it provides information on the constraints and opportunities of counties with a similar ROI, for example Harney and Columbia Counties, but with quite different levels of exposure and resilience. This sort of interpretation has been described as vulnerability versus resilience (41) where in our case and county would be deemed vulnerable if it is highly exposed to Forest Service planning and resilience where resilience is higher than average. With this type of comparison in mind, the quadrants are interpreted in Table 6.





#### Table 6: A mapping of risks and opportunities

Quadrant	General Risk / Opportunity Profile
	Risk: Least economically resilience and therefore, most likely to suffer negative
	consequences to economy given shifts in Forest Service planning that reduce
Ι	economic benefits.
	Opportunity: Already high exposure so opportunity to generate additional benefits
	via increasing exposure is lowest. Opportunity of boosting benefits to economy
	is highest with respect to restructuring of current Forest Service activities.

	Risk: Given relatively high resilience, risk of negative consequences to economy from shifts in Forest Service planning that reduce benefits to economy is less
	than average.
IIa	Opportunity: Currently high exposure so opportunity is low with respect to
	additional benefits from an increase in exposure. Opportunity of boosting
	benefits to economy is relatively high with respect to reorienting/restructuring
	of current Forest Service planning.
	Risk: Most likely to suffer negative consequences to economy given shifts in FS
	planning that reduce benefits to economy of Forest Service activities.
IIb	Opportunity: Given low exposure, opportunity to generate important economic
110	benefits via additional exposure is high. Opportunity of boosting benefits to
	economy by restructuring of current Forest Service activities is low given
	current low exposure.
	Risk: Given relatively high economic resilience, least likely to suffer negative
	consequences to economy given shifts in Forest Service planning that reduce
	support or increase cost related to Forest Service planning activities.
III	Opportunity: Given low current exposure, there is limited opportunity with respect
	to restructuring of current Forest Service exposure to boost benefits economy.
	Conversely this allows for the greater opportunity to boost benefits to economy
	through increasing Forest Service exposure.

#### 4. Discussion

#### 4.1 The ROI, the greater economy and marginalized populations

Tables 7 and 8 put the ROI values in a broader economic context, which helps answer questions like "How do these counties compare to the larger economy?" and "Are there equity concerns that the ROI misses or highlights?" Table 7 data show that earnings per job decrease as the ROI increases, but this is expected since earnings per job is a part of the index, albeit a small part. Importantly, it also shows that changes in earnings per job and changes in population tend to decrease as the ROI increases. Where there is an exception, as in the case of intermediate ROI values and the trend in earnings and population, it can be understood by examining the data on a county-by-county basis. Crook County experienced substantial population growth despite its intermediate ROI, likely due to the expansion of the Bend and Prineville area. When population growth in Crook County is removed, the average population growth for the remaining counties falls to -0.075% which is in line with the other counties in the "intermediate RO index" group.

When a county-by-county examination does not shed light on an outlier, it points to the need for additional discussion and analysis. This is the case for the earnings per job trend. Of the five counties with an intermediate ROI two have relatively high income growth, averaging over 27%, while the remaining three counties saw income growth of about 8.5%. Unfortunately, there are too few counties to draw statistical conclusions so these data need to be interpreted carefully.

Additional context is given by comparing the earnings and population data from the counties with those of Oregon and Washington States overall. We see that for each measure the counties on average have performed well below the average of their respective States. This highlights the fact that the ROI is a relative measure discriminating between 14 counties. For example, performing well in terms resilience does not automatically mean that a given county's economy should be considered prosperous or "resilient" in a general sense, but rather, it seems more resilient than the average of the 14 counties under analysis.

#### Table 7: Risk/Opportunity Index and Economic Context

	Earnings per job,	Earnings per job change,	Population change <sup>1</sup> ,
	2018 (20)	2000-18 (20)	2000-19 (16)
High R/O index (high exposure and low resilience)	\$32,043	4.22%	-2.025
Intermediate R/O Index (high exposure or low resilience)	\$46,109	16.1%	3.14
Low R/O index (low exposure and high resilience)	\$50,520	9.62%	2.4
Benchmark 1, Oregon State	\$61,662	12.2%	10.1
Benchmark 2, Washington State	\$75,962	19.8%	13.2

<sup>1</sup> Calculated from Annual Estimates of the Resident Population for Counties in Oregon: April 1, 2010 to July 1, 2019, CO-EST2019-ANNRES-41 (and for Washington counties CO-EST2019-ANNRES-53), U.S. Census Bureau, Population Division, March 2020 release.

It is also important that the ROI consider marginalized populations. Table 8 shows two variables already included in the index—the percentage of vulnerable people, and the percentage falling below the poverty threshold. The table indicates that the high and intermediate ROI counties seems to perform well with respect to the percentage of people in these populations.

	Vulnerable Population, 2019 <sup>1</sup> (11)	Poverty rate, 2019 (19)	Non- White, 2019 (42)	Hispanic, 2019 (42)
High RO index (Quadrant I, high exposure and low resilience)	17%	15%	6.1%	4.9%
Intermediate RO Index (Quadrants IIa and IIb, high exposure or low resilience)	16%	12%	8.6%	5.4%
Low RO index (Quadrant III, low exposure and high resilience)	21%	16%	11.7%	24.4%
Benchmark 1, Oregon State	22%	13%	15.7%	13%
Benchmark 2, Washington State	20%	11%	24.6%	12.7%

 Table 8: Risk/Opportunity Index and Marginalized Populations

<sup>1</sup> The vulnerable population consists of people 65 years or older living alone, single-female headed households, and households without a car.

We also see a pattern with historically marginalized racial and ethnic groups. More specifically, these populations seem to increase in size as the ROI decreases. Once again, the limited data precludes a statistical analysis so we need to interpret this information carefully, and build a greater understanding of the relationships. An interesting working hypothesis is that the economies in counties associated with high and intermediate ROI values lack sufficient incomeearning opportunity to attract people from these demographic groups. The fact that there does seem to be a link between the RO index and marginalized populations indicates that planning changes altering the ROI of a county may impact these populations, and consequently, impacts on these populations ought to be considered.

#### 4.2 Examining the link between exposure and resilience

The scatterplot in Graph appears to show a negative relationship between relative exposure to Forest Service planning and relative county economic resilience. With this observation in mind, we ran a simple regression of county resilience estimates on the county exposure index values. The results for regression 1 presented in Table 9 show that this relationship was indeed statistically significant.

	Coefficient on independent variables <sup>1</sup>								
Regression	Exposure	Income	Land area	Forest Service Payments	$\mathbb{R}^2$				
1	-0.152**				0.31**				
2		0.074	0.003	-0.153***	0.74***				

Table 9: Exposure versus resilience, dependent variable "relative resilience"

<sup>1</sup> \*, p<0.1; \*\*, p<0.05; \*\*\*, p<0.01

To follow-up we ran a second regression, regression 2 in Table 9, this time with exposure broken down into its constituent parts (rows 6, 7, and 8 from Table 4). This regression indicates that the explanatory power of the regression flows through the variable *Forest Service Payments*. The regression also passes a visual inspection of the error terms and a test for multicollinearity. Interpreting this result; controlling for forest related income and Forest Service land area, there is a statistically significant negative relationship between the percentage of a county's budget related to the Forest Service, and that county's economic resilience.

In practical terms, a sample size of 14 counties is too small, and the regression is too simple, to establish causality with confidence. A plausible explanation for the observed relationship is that Forest Service payments are responding to the greater economic needs of low-resilience counties, thus establishing a negative relationship. Put differently, if there is any causality underlying this relationship, it is possible that low resilience leads to high payment levels. Also, to the extent that this relationship exists in its present form it suggests that Forest Service payments are falling short of closing the resilience gap. This could be an area for further research.

#### 4.3 Strengths, weaknesses, and putting the ROI to work

The ROI is designed to account for differences between counties in terms of their economic resilience and exposure to Forest Service planning. Based on feedback and informal analyses, to that end, it seems to have done so quite well. What is less clear is how it should be put to use. For example, if a given county sees an increase in the profile of Forest Service-related work, all else equal, this would generate an increase in the county's ROI estimate.

With cases like this in mind, it is important to refer to the interpretations presented in Table 6. The structure of the ROI argues that ideally, increases in, or shifts of, Forest Service inputs to a county ought to be tailored to boost economic resilience. More specifically, increasing exposure to Forest Service planning could be a "good thing" when there is a net decrease in the ROI for the county.

This brings up a second point. The specific components of resilience, and exposure are not the only levers a county and the Forest Service can focus on to boost resilience—this would be a misuse of the index. Rather, the ROI is best used as a backdrop for county-specific discussions that are more likely to unearth relevant opportunities and constraints. This was made clear

during ground-truthing sessions, where, despite our familiarity with the region and the countylevel data that was brought to bear, Commissioners and stakeholders significantly enriched the general findings of the ROI and identified shortfalls. Shortfalls that can be important in a given county include:

- Analysis at the county level can mask significant within-county differences. This is especially important in eastern Oregon and southeast Washington given the presence of very large counties, large geographic features, and a mosaic of jurisdictions.
- The ROI is linear and therefore does not do a good job of identifying economic tipping points for a county. Developing and deploying an index that could do this would be difficult at best. The ROI does flag counties with exceptionally low resilience or high exposure where such tipping points are more likely to be present, however, this currently requires additional attention at the county level.
- Measures in the ROI perform well as a gauge of relative risk and opportunity when taken as a whole. However, in a given county any of the individual measures could be misleading. An example of this is the measure "acres of farmland per person". In general, given the importance of agriculture in the region this is a good measure. However, there is a significant difference between the economic productivity of extensively managed high desert predominant in some areas, and intensively managed farmland located in other areas. The ROI does not make this distinction.

Challenges like these above highlight the idea that the ROI is a good step in the right direction, but we suggest that an important next step is to use the ROI as a vehicle to continue even more finely textured discussion.

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### Attachment 1: Sample Preliminary Risk/Opportunity Index Summary







Graph 1 indicates that Harney County's potential resilience is slightly greater than the average of the 14 counties in the study region. This seems to be driven primarily by its endowment of natural resources, and more specifically, by a high farmland per person and income from tourism. These attributes make up for challenges related to relatively high housing costs and low population density.

For additional information see Attachment section 3.2.

Graph 2 indicates that Harney County residents face high barriers to converting the county's capital into resilience. More specifically, looking at the attached detail table, Harney County is lacking nearly every piece of infrastructure that would allow it to easily capitalize on its potential wealth. This leaves residents to generate wealth without support structures like broadband Internet, the interstate highway system, freight railroad, or an airport. For additional information see Attachment section 3.3.

Based on Graph 3, the resilience base index conditioned on the conversion factor results in a resilience index for Harney County of 0.77, the third lowest of all counties in the study area. This is driven primarily by the County's low conversion factor, and it implies that the county would experience steeper economic downturns, and recover more slowly from, an economic shock.

For additional information see Attachment section 3.4.





Graph 4 indicates that across the three measures of exposure—income, land area and Federal payments—the Harney County economy is slightly less exposed to Forest Service planning decisions. Its exposure index is 0.85 against the average value of 1 across the 14 study counties. Although the County has extensive Federal land coverage, a relatively small portion of this is Forest Service land. The limited extent of Forest Service land is the primary driver of the limited exposure of Harney County.

For additional information see Attachment section 3.5.

Graph 5 shows that combining the standardized resilience and exposure indices from graphs 3 and 4 as explained in section 3.6 generates a RO index 1.10. This implies that the economy of Harney County may be slightly more susceptible to economic impacts related to changes in Forest Service policies than the average of the 14 counties. The case of Harney County is interesting in that low resilience is accompanied by low exposure, and thus an approximately average RO index value.

For additional information see Attachment section 3.6.

Graph 6 shows each county's RO index in a scatter plot of exposure versus resilience. Harney County appears in Quadrant IIb of Graph 6, reflecting the county low resilience and low exposure. Given this resilience, there is elevated risk that economic shocks imposed on the county could result in significant and/or protracted economic downturns. Because exposure is low, the Forest Service is in a position to boost resilience given appropriate planning. For additional information see Attachment section 3.6.



#### Attachment 2: Notes from Ground Truthing Sessions

#### Ground truthing session, Harney County, 9/21/21.

To be considered in the final assessment of the RO Index and Harney County

- Acres of farmland per person is not a good metric. Arid land cannot produce in the same way as farmland in other climates so it does not reflect their circumstances well. Agricultural statistics service might be a better tool for providing commodity value as opposed to acre value. Some counties can practice intensive agriculture while Harney County's is weighted more towards extensive agriculture practices on high desert. This is important with respect to the index in a number of ways. While the county is rich in farmland, much of this is less economically productive that other counties in the region. The index considers cropland per person without accounting for this lower productivity. The index value is further skewed by the low population of Harney County, which makes farmland per person seem favorable. Consequently, the portion of the index assessing natural capital paints an overly rosy picture of the county.
- Exposure factor shows Harney county with limited extent of Forest Service land. This underestimates the importance of this land by 1) ignoring the greater productivity (more AUMs...) of this land relative to the high desert land, and 2) using percentages where a small percentage is actually a large land area given Harney county's size. Were exposure conditional on productivity Harney county would show as more exposed.
- Index may underestimate the vulnerability of Harney county economy because the overall economy is small, and because cattle ranching provides a large portion of the overall income. Consequently, a small shift in AUMs would impact the largest source of income in an already small economy. The index does not account for such a non-linear impact. More generally, the RO Index does not consider non-linear effects. This could be important in the case of Harney county in that it is among the least resilient of the region. Consequently, the effects of an economic shock may be magnified in the case of Harney county.
- The way that 10-year stewardship contracts have been awarded have hurt the Harney county economy because the contracts have gone to neighboring counties. This could represent a restructuring of current activities with the aim of boosting resilience.
- The benefits of tourism may be over-estimated. Much of our tourism seems to be drivethrough resulting in limited additional economic impact in the county. The main exception to this could be hunting. This is important because the RO Index for the county shows tourism playing an important role. Thus, the RO Index may overstate the positive role that this income can play. Also, because this part of the RO Index is based on percentages, and the county economy is quite small tourism income is actually not a large stream of revenue.
- The index includes a large value for water resources. This is correct, but does not reflect the tenuous nature of the resource in the future. Therefore, the portion of the RO Index that is based on county water resources currently over-estimates the value of this important resource in the coming years.

For consideration when composing the overall final RO Index report

• Convert "baseline resilience" to something like "base capital" and make sure that labels on capital in the table match labels in the in-text descriptions.

- Clarify/emphasize that when looking at the 14 counties in a bigger economic context we see an entire region that is under stress. Therefore, even when considered relatively resilient, a county economy is still underperforming relative to the State economy. This can be addressed by moving the "context" section up front. This would clarify where the 14 counties stand relative to economies of Oregon and Washington, while allowing the RO index to function as required to discern differences between the 14 counties of the region.
- To the extent possible, consider the NEPA process in composing final report.
- Need to adjust the label for vulnerable households, and emphasize that this is an official designation that does not necessarily mean people within this group are not active members of the community. Also clarify that the link/causal factor is income--falling incomes drive social problems.
- To the extent possible, try to organize the final report to reduce the need to search for info.

Other important items to consider that are not directly part of the RO index report

• With past performance in mind, the RO index does not say where we were or where we want to be, but is more of a snapshot. Consequently, it is important to put the current economic status of the county in historical context. Note that the team is planning to add a county timeline to each county's report.

#### Ground truthing session, Umatilla County, 10/28/21.

To be considered in the final assessment of the RO Index for Umatilla County

- Native American lands exert an important influence on the access to public land in the county and this is not reflected in the RO Index. In practice, the result is often more limited access to Forest Service land for recreation and game management. Consequently, the income generating potential of these lands is diminished relative to similar land in other counties, so the RO Index needs to consider this in its analysis of Umatilla County.
- Looking at the placement of Umatilla County relative to the other counties in term of resilience and exposure, the county seems to be about where it should be. The scatter plot based on exposure and resilience is especially helpful in this respect.
- Umatilla County includes quite a lot of land that are public but with special restrictions. This includes portions along the Columbia, McNary Dam, and the Umatilla Army Depot, for example. It is important that the RO Index consider the special nature of these lands in its final analysis
- Umatilla County has very distinct boundaries related to Forest Service exposure/dependence. The Pendleton area has a significant FS personnel presence. The Ukiah region has significant FS lands. The area around Milton-Freewater is intermediate—the FS presence there is moderate. The western portion of the county has very little FS presence. Thus, portions of Umatilla County are more "exposed" to FS planning that other parts of the county. Ideally, discussion of the FS in Umatilla County should reflect this diversity of impacts.
- Looking forward, Umatilla County has forest inventory that we could take greater advantage of but we seem to be "playing it safe". Perhaps a priority should be recreation

development, for example, Ukiah cabins, downhill skiing at Spout Springs, additional cross-country skiing. Also, according to the FS recent flooding events have restricted access to portions of forestland.

• Given the inventory that we have that is not being taken advantage of more exposure could generate additional resilience--we are facing increasing returns to exposure, or rather, a dollar of additional exposure can generate more than a dollar of resilience assuming it is used properly. We can and should drive up the economic benefits to the county via additional recreation development and commercial harvest, while managing to avoid forest deterioration.

For consideration when composing the overall final RO Index report

- The conversion factor does not show actual dollars, and more specifically, private-sector dollars. It would be helpful to relate the current scatter plot of counties to a scatter plot that accounted for the importance of government versus private sector economy.
- While the RO Index shows some counties are resilient relative to other counties in the region, fact is that by many measures all of these counties have weaker economies than Oregon and Washington as a whole. Make sure to highlight the need to shift the overall average of counties in the region in a positive direction.
- To RO Index does not consider the size of the public sector relative to the private sector. This is important in that some support services like mental health draw from tax revenue. If the Federal government were to be removed completely from the RO Index calculation would there still be a county economy?

#### Ground truthing session, Union County, 8/13 and 9/22

To be considered in the final assessment of the RO Index and Union County

- The RO Index does not capture the idea that the human capital (skills/knowledge) related to logging would be at risk given even slight decrease in harvest level. Investment in new technology is also critical given the advances in logging and milling. Injecting uncertainty into these investment decisions by the possibility of shifting harvest levels makes these investments harder to justify. Thus, the importance of stable harvest levels needs to be highlighted in the case of Union County.
- Housing issues produce an odd result in the index for Union County. Despite a serious squeeze on availability and steep increases in prices, the index reports almost average rates of home ownership and slightly above average performance with respect to housing costs. Either the index is biased downward for Union County, Union county perceptions are mistaken, or the 14-county region is uniformly being squeezed with respect to these same issues.
- The conversion factor seems quite accurate, and if anything could, by weighting it equally, underestimate the importance of the goods exported (mill production and grass seed) via freight railroad.
- Recreation is rightly presented as important in Union County. It is important to note that this may provide some guidance on future beneficial Forest Service activities in the county. Specifically, an emphasis could shift towards restoration in support of recreation. Increases in other activity on Forest Service land, e.g., harvest levels, would also be desirable and can be done without compromising the recreation resource.

For consideration when composing the overall final RO Index report

• A useful descriptor for "exposure" in the report would be "leverage".

#### Ground truthing session, Wallowa County, 10/25/21.

Examining the RO Index and Wallowa County

- Overall, the RO Index seems to profile Wallowa County reasonably well—it is good to see the Wallowa County statistics put down in black and white.
- The RO Index does not account for the fact that the population is experiencing a demographic shift as aging retirees move into the area perhaps due to higher housing costs elsewhere. These retirees also boost income. This brings up a number of important issues.

First, the RO Index focuses on earnings per job, which downplays the importance of the role retiree incomes may play. A final interpretation of the RO Index for Wallowa County should consider the implications of retiree incomes on county resilience. On a related note, the RO index is sensitive to the impact that an influx of retirees can have on house prices, specifically, by including a measure of housing cost burdened and home ownership rates.

The graph below is evidence of this demographic shift. It shows that earnings per job has stayed at slightly more than \$30,000/year since 1980, while the county per capita income, which would include retiree income, has risen steadily (Source: Headwaterseconomics.com).



With a county economy that may be in transition we should note that the RO index for does not consider how resilience measures are trending. Against the backdrop of the above graph the implications of this shift on economic resilience need special attention.

• The RO Index for Wallowa County is based on a conversion factor that credits the county with a freight railroad. Interestingly, despite the official Bureau of Transportation

website saying Wallowa County has a freight railroad, during the ground-truthing session the participants said that this information is out-of-date. The railroad has not carried freight for some years, and its return to service is not anticipated. The conversion factor for Wallowa County will be adjusted to reflect this, and the change will result in a slight decrease in county resilience.

- The RO Index places Wallowa County in Quadrant 1—low resilience and high exposure. Given this position, the generic recommendation related to Forest Service planning is to consider refining on-going Forest Service activities to more effectively target economic resilience. The discussion participants provided the following specifics.
  - The Sustainable Rural Schools payment as well as Payments in Lieu of Taxes have experienced dramatic swings in recent years. Meanwhile, Wallowa County's economy is among the smallest of the 14 counties based on the number of firms, and given the extensive Forest Service land in the county, the county receives an important portion of its public budget from these payment programs. For planning purposes, it is important that the stream of payments be maintained and stabilized.
  - Similarly, income from, and investment into, the production of forest products has been hurt by low and unpredictable harvest levels. There may also be grazing allotments that are closed simply because the process for awarding them is very slow. We think that there is room to increase income and reduce income variability without a significant tradeoff in recreation, by increasing timber and beef production, and that this could lead to a more resilient economy.