The New Performance Index: An application to COVID-19 era

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In this study I build a performance index that is based on different human capital components, as well as differences in the distribution of these components and of their returns between different genders and ethnic groups. The index can be calculated for individual industries in an economy; it can also be calculated for global economies. It facilitates the comparison between the performance of different economies; and it can be used to study the changes in individual industries within an economy, that might be differently affected by economic, health, and social changes. As an example, I implement the index to study the US economy around the period of the COVID-19 global pandemic, to observe the different effects of the pandemic on the different industries of the economy.

1. Introduction

To gauge the performance of the whole economy, as one composed of different industries, and to facilitate comparison between the different industries and the efficacy of governmental and nongovernmental programs to revamp these industries, I provide a performance index (PI) which is based on different measures of schooling, skill distribution, earnings inequality, wage discrimination, occupational segregation, and employment inequality within the unit of analysis, such as within a particular industry in the economy, within a particular region, or within the country. The standardized, normalized PI is comparable across times, industries, and countries.

The proposed index lies in the interval [0,1], with higher values associated with better performance within the unit of analysis—in terms of skills, discrimination, inequality, and occupational distribution, among other factors. The PI also indicates the realized portion of the maximal potential compensation in the unit of analysis—so that if the average compensation in some industry is, say, 100 and the PI=0.5, then the maximal potential compensation or productivity in that industry is 200.

As an example of applying this new methodology, I apply it to US data, using the Current Population Survey, for the years 2000 to 2020. In this application the unit of analysis is industry. The estimated values of the index are reported for each of the 40 industries in the last 21 years, and a weightedaverage of these indices—called the “economy index”—is also calculated for each year, and is used to show whether any industry is cyclical, acyclical, or countercyclical over the study period. A specific case is studied, namely the comparison between the agricultural sector and the finance sector, where stark and statistically-significant, long-term differences are plotted, and estimated. The finance industry shows better performance and higher compensation, yet more room for improvement than the agricultural sector.

The reported industrial state will serve as the benchmark for future comparisons. For example, the coronavirus pandemic era is taken as an important application of this method: we can learn about the industrial adjustments during the COVID-19 pandemic, by comparing the current findings and measures with their post-pandemic counterparts (see, for example, Shin, Kim, and Koh 2020). Since the pandemic confronted the world with inevitable yet tough decisions about the tradeoff between saving lives versus saving the economy (Robalino 2020), we expect that industries which were deemed or discovered to be essential, the Achilles heels of the economy, during the pandemic will benefit from increased attention and investment from the government and the public, such that their performance index would increase substantially when measured in post-pandemic periods. Traditional industries like the health sector, agriculture, food manufacturing and services, retail trade, telecommunications, and social assistance, that are usually overlooked, would likely fall in this category. The immense importance of these industries was manifested in the mandate for these industries to continue functioning, even when the rest of the economy was under pandemic-induced lockdown.

Likewise, given the likely shift in the conditional and absolute labor demand curves in the main industries due to the pandemic, we expect an increase in the absolute wages of their employees. For the longer-term we might expect capital-saving technological changes, which furthers the importance of labor in these industries, that manifests in higher employment and wage levels.

Other dimensions of the industries can be explored through changes in the provided index, for example whether industries in which work can be done from home would be found to perform better during, and after, pandemic-hit periods or other recission-hit periods (Adams-Prassl, Boneva, Golin, and Rauh, 2020).

The rest of the paper is organized as follows. The next section outlines the methodology used to build the performance index, and the different approaches of calculating it. Section 3 describes the data used in the offered example from the US economy in the last two decades, applies the proposed methodology, and reports the main results from this application. It also discusses two industries, namely agriculture and finance, in more detail as a special case. Section 4 concludes.

2. Methodology

The overall index of the healthiness of any industry i is given by the Performance Index PI, which is a function of some sub-indices, $PI = f(I_1, I_2, I_3, I_4, I_5, I_6)$. The preferred functional form, similar to other indices in different contexts, is the geometric mean of the sub-indices. That is,

$$PI = \sqrt[6]{I_1 \times I_2 \times I_3 \times I_4 \times I_5 \times I_6}$$

which is the geometric mean of the given sub-indices, that relate to the skill, earnings, and occupational distributions across gender and ethnicity or race, within each unit of analysis (industry, region, county, district, or country, among other examples)[1]. This form of the performance index is similar to that of the Human Development Index that is devised by the UN to assess the development of countries[2]. It is also possible to use a more conservative measure of PI that relies on the harmonic mean of the sub-indices—where the harmonic mean is the reciprocal of the arithmetic mean of the reciprocals of $I_1, \ldots, I_6$. That is,

$$PI_2 = \left(\frac{\sum_{j=1}^{6} I_j^{-1}}{6}\right)^{-1}.$$

Alternatively, even a more conservative measure of PI can be calculated from a spider diagram of the individual indices. In particular, PI_3 is the share of the area enclosed by the six indices from the full area of the diagram (hexagon). It is easily shown that PI_3 can be expressed in terms of the individual indices as follows:

$$PI_3 = \frac{I_1 I_2 + I_2 I_3 + I_3 I_4 + I_4 I_5 + I_5 I_6 + I_6 I_1}{6}$$

1 Notice that the terms “minority,” “ethnicity,” and “race” are interchangeably used, to mean the same thing based on the particular context and application.

2 Explanation of the human development index and its uses is found at the UNDP page here: http://hdr.undp.org/en/content/human-development-index-hdi (last accessed Sep-1-2020).

This last measure is the least recommended, because it depends on the order of the indices (that is, if I_5, say, is listed after I_1 instead of after I_4, the value of PI will change in unpredictable directions). The six sub-indices that are used to define the PI are explained below. In what follows, I use "industry" as the unit of analysis, without loss of generality of applying the PI index to any unit of analysis—whether industry, local labor market, region, county, district, country, and the like.

I_1, mean years of schooling index:

$$I_1 = \frac{\text{average years of schooling in industry } i}{\text{highest schooling level attained}}.$$

highest schooling level attained i. The highest schooling level of the recoded schooling variable in the CPS data is 20, so I use the number 20 in the denominator of this index.

I_2, the share of skilled workers in industry i, where "skilled" is defined as having 12 or more years of schooling.

$I_3 = 1 - IS_i$, occupational segregation within industry. IS_i is the average of the gender and ethnic index of segregation (occupational segregation) in industry i. The segregation index is defined as the percentage of workers of one group (respectively, female or minority workers) who have to switch occupations in order to be equally distributed across occupations as their counterpart workers. So,

$$IS_i = \frac{IS_i(gender)+IS_i(ethnic)}{2}.$$

$$WG_i = \frac{u_{i,gender}+u_{i,ethnic}}{2},$$

$I_4 = 1 - WG_i$, wage gap.

where $u_i = U_i / G_i$ and U_i is the unexplained wage gap from an Oaxaca-Blinder decomposition of the wage gap in industry i, using a basic Mincerean log-hourly-wage equation that controls for a parsimonious set of demographic variables—in this study we control for the years of schooling, potential experience, squared experience, and union membership. For gender-gap decomposition, we also control for ethnicity; and for ethnic-gap decomposition, we control for gender. G_i is the gross (observable) wage gap between the respective groups within industry i. The measure $u_{i,J}$ (J is either gender or ethnicity) is bounded by zero from below, and by one from above.

$I_5 = 1 - GIN_i$, the unexplained earnings inequality. $GIN_i = G_i - \hat{G}_i$, where G_i is the Gini coefficient calculated over the actual (log) weekly earnings in industry i, and $\hat{G}_i$ is the Gini coefficient calculated over the predicted wages in industry i, calculated from a Mincerean logweekly-earnings equation, with all the above control variables as regressors, in addition to gender, ethnicity, and the weekly working hours.

$I_6 = if^{i+}{}_{2}{}^{imi}$, average share of female and minority workers. Where $if_i = 1 - |F - f_i|$, and $im_i =$

$1 - |M - m_i|$. The variables f_i and m_i simply stand for the share of female and minority workers, respectively, in industry i. F and M are the respective shares of female and minority workers in the whole sample (or the population).

For each industry (unit of analysis) we also define the following measures: overall hourly compensation, the "real" (working hours) weight of the industry, and the "monetary" (earnings) weight of the industry. In particular:

$$W_i = \frac{\text{total weekly earnings in industry } i}{\text{total weekly working hours in industry } i}.$$

Wi, industry hourly compensation,

$$\frac{\text{total weekly working hours in industry } i}{\text{total weekly working hours in the economy}}.$$

Likewise, the overall hourly compensation, W, is defined as the total earnings across all industries divided by the total working hours in the economy.

$$\frac{\text{total weekly earnings in industry } i}{\text{total weekly earnings in the economy}}.$$

rw_i is the "real" weight of the industry, in terms of total working hours: rw_i =

mwi is the "monetary" weight of the industry, defined as: mwi =

Note that the overall hourly compensation in the economy, W, can be calculated as:

$$W = \frac{W_i \times rw_i}{mw_i}.$$

The observed hourly compensation in each industry, W_i, is proportional to the maximal potential hourly compensation of the industry, with the proportion being the performance index. The simplest linear form of this relationship is the following:

$$W_i = PI_i \times (\text{Maximal Potential } W_i).$$

The maximal potential hourly compensation of an industry, denoted by $\bar{W}_i$, is fully realized only when the performance index, PI_i, approaches, or is equal to, one—that since the complete equality and the optimal levels of skill are necessary conditions for the economic potential to materialize (Asali and Gurashvili, 2020). If we assume that the maximal potential hourly compensation of industry i is fixed over time—that is, $\bar{W}_{i,t} = \bar{W}_i$, then we can identify it by estimating the following equation, over the whole period of analysis:

$$Wi,t = \gamma i \times PIi,t \quad + \varepsilon i,t,$$

$$p\lim_{T\to\infty} \hat{\gamma}_i = p\lim_{T\to\infty} \left(\frac{\sum_{t=1}^{T} W_{it} \times PI_{it}}{\sum_{t=1}^{T} PI_{it}^2} \right) = \bar{W}_i.$$

separately for each industry i, for t = 1,2, ... , T. The $\varepsilon_{i,t}$ being a white noise innovation, the estimated $\hat{\gamma}_i$ is the consistent measure of the potential maximal hourly compensation in industry i, Finally, the healthiness of the overall economy is summarized by the Economy Index which is a weighted average of the different performance indices across all the units of analysis (whether industries, geographical regions, counties, districts, etc.):

$$EI = \sum_{i=1}^{I} w_i \times PI_i,$$

where w_i is the weight of industry i, which can be the real weight of the industry ($w_i = rw_i$) or the monetary weight of the industry ($w_i = mw_i$).

3. Data, application, and results

Data

I provide an application of the *PI* index using Current Population Survey (CPS) US data. In particular, data about the outgoing rotation group (ORG) of the CPS, for the years 2000 to 2020, are used to estimate the industrial PI indices of the different industries, as well as the whole labor market[1]

The outgoing rotation group files, from 2000-2018, were obtained from the NBER data repository.[2] ORG data for the months Jan/2019-Jun/2020 were extracted from the raw basic monthly CPS data (the most recent of which are found at the US census bureau[3]).

Industries in which, in any specific year, there were less than 40 observations of the smallest group (non-white female workers) were dropped from the analysis. "White," for short, refers to nonHispanic white workers. While the 40-observations threshold is arbitrary, dropping small cells was necessary for the calculation of some indices, like wage gaps and inequality, which necessitated a sufficient number of observations. This resulted in a panel of 21 years and 40 industries.

The schooling variable was defined as follows: it takes the following levels (0, 2.5, 5.5, 7.5, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20) for the respective levels of the original schooling variable (31, 32, 33, 34, 35, 36, 37, 38-39, 40, 41, 42, 43, 44-45, 46). To reiterate, the NBER-provided variable for schooling (ihigrdc) was not used because it exhibited an unexplained discontinuity between the years 2014-2015, akin to a loss of one whole year of education for the average worker. Potential experience was defined as $age - schooling - 6$.

For the lack of a clear analytical/parametric alternative, standard errors of the estimated indices, and the respective confidence intervals, were obtained through a bootstrapping procedure.

Application to the Agriculture and Finance industries

The agriculture and finance industries in the year 2010 are brought as a particular illustration of the index calculation. For agriculture, the respective sub-indices calculated for this time period are: I_1 =

0.6059, I_2 = 0.7815, I_3 = 0.6369, I_4 = 0.3597, I_5 = 0.9920, I_6 = 0.8417, hence the overall performance index, which is the geometric mean of the six sub-indices, is $PI_{Agriculture}$ = 0.670. The respective figures for finance are: 0.7327, 0.9893, 0.7638, 0.512, 0.9823, 0.949, with $PI_{Finance}$ = 0.801. Had the harmonic (instead of the geometric) mean of the sub-indices been used, the performance index for each industry would have been: $PI_{2,Agriculture}$ = 0.633, and $PI2,Finance$ = 0.778.

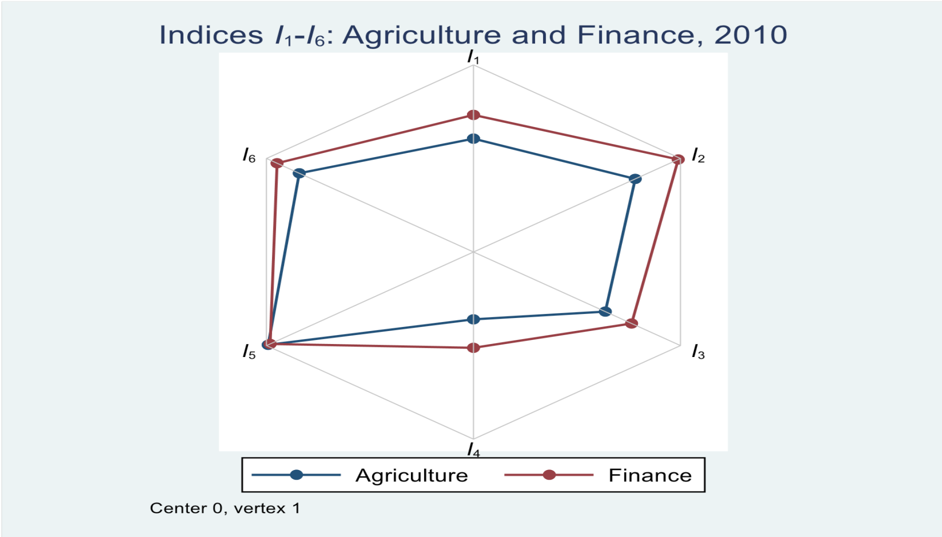
The six components (sub-indices) of the performance index can be expressed in a spider diagram, based on which a third way is suggested to calculate the overall performance index (PI_3, as defined earlier). Figure 1 below shows the spider diagram of the sub-indices for agriculture and finance in 2010.

1 Up to and including the last available data file of June 2020.

2 This is found at https://data.nber.org/morg.

3 https://www.census.gov

Figure 1: Spider diagram of component sub-indices I_1, ... , I_6, Agriculture and Finance, 2010

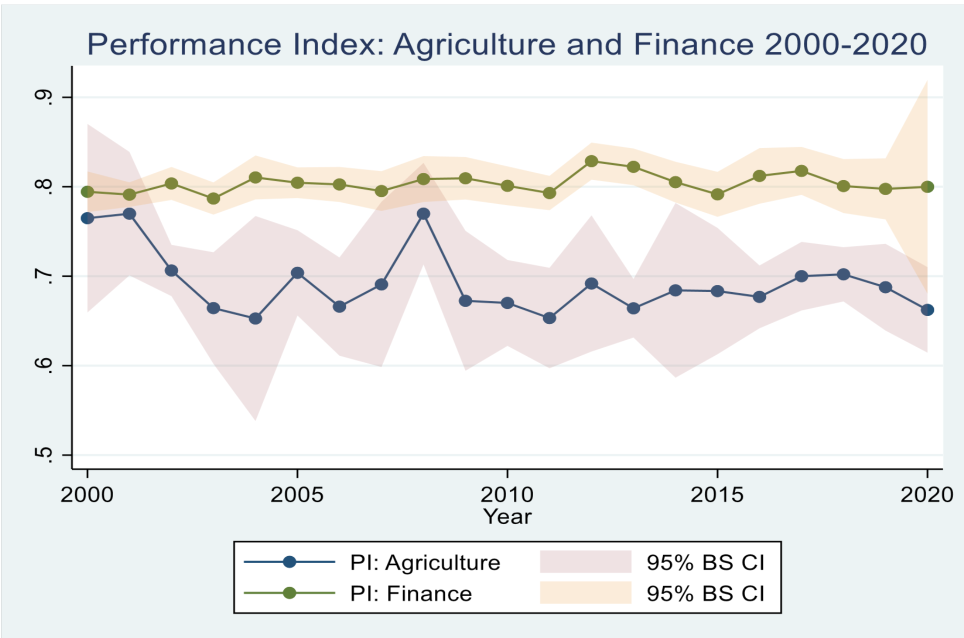


PI_3 can be calculated from the spider graph in Figure 1 by dividing the area enclosed by the indices (for agriculture it is 1.2567, and for finance it is 1.7329), over the total area of the hexagon (2.5981), which yields the estimates of: $PI_{3,Agriculture}$ = 0.4837, and $PI_{3,Finance}$ = 0.6670.

Regardless of the measure adopted for the performance index, PI or PI_2 or PI_3, the finance industry has a statistically significant higher index attesting to the fact that this industry is faring better than agriculture. The spider graph makes this point more apparent, in that the finance industry is faring better in almost all individual indices: skill level is higher and includes higher share of skilled people, the overall share of female workers and minorities (non-white workers) is higher and more equally distributed across occupations within the finance industry; moreover, there is less unexplained wage gaps in this industry.

To statistically measure the differences in the overall performance indices across industries, we calculate the performance index and its bootstrapped standard errors for each year from 2000 to 2020, for each of the 40 industries analyzed. Figure 2 below shows the case of the two industries studied above, agriculture and finance, as a special case.

Figure 2: The Performance Index (PI) for Agriculture and Finance, 2000-2020



As can be seen in the graph, the finance industry is faring better than agriculture over the past twenty years, with a whole 0.11 points gap; and the difference is statistically significant in all periods. Furthermore, the performance index of agriculture is slightly more volatile, and is more responsive to market changing conditions—for example, this industry has been hit much more by the great recession, with long-term effects and a performance index that never reverted back to its prerecession levels.

The Performance Index for All Industries and the Economy Index

We calculate the performance index for each industry for the last two decades. Data analyzed for 2020 is just up to, and including, the month of June. Likewise, we calculate the economy index (EI), which is a weighted average of the performance indices of all industries in a year—where the weight of each industry is either the 'real' (working hours) weight, that is, the share of total hours worked in that industry from the whole working hours in the economy; or the 'monetary' (earnings) weight.

The results are shown in Table 1 below.

In the last two columns we also report the linear (Pearson) correlation coefficient between the economy index and the individual performance index of each industry. For the most part, for about 70% of the industries, the correlation is positive, so that the performance index is cyclical. Also, in 90% of the cases the correlation with the economy index has the same sign whether that is the hoursweighted or the earnings-weighted economy index—and in the remaining cases the difference in the correlation coefficient sign is inconsequential, because it occurs when both co-

Table 1: The Performance Index (PI) across industries, over time; and the Economy Index (EI) weighted by hours or by earnings

Industry / Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Correlation (PI, EI)	
																						EI(earnings)	EI(hours)
Agriculture	0.765	0.770	0.706	0.664	0.653	0.704	0.666	0.691	0.770	0.673	0.670	0.653	0.692	0.664	0.684	0.683	0.677	0.700	0.702	0.688	0.662	0.064	0.009
Construction	0.637	0.641	0.639	0.644	0.640	0.642	0.638	0.635	0.637	0.641	0.650	0.645	0.647	0.646	0.640	0.641	0.649	0.636	0.641	0.627	0.645	-0.407	-0.298
Primary metals and	0.649	0.651	0.671	0.679	0.673	0.681	0.694	0.679	0.683	0.664	0.666	0.658	0.660	0.674	0.704	0.658	0.665	0.676	0.630	0.695	0.655	0.513	0.446
Machinery	0.699	0.724	0.688	0.723	0.724	0.694	0.695	0.725	0.705	0.713	0.716	0.681	0.691	0.697	0.702	0.681	0.635	0.673	0.700	0.685	0.704	-0.162	-0.274
Computer and	0.781	0.767	0.778	0.773	0.760	0.791	0.781	0.805	0.772	0.777	0.769	0.793	0.780	0.765	0.756	0.779	0.730	0.717	0.825	0.798	0.668	0.46	0.421
Electrical equipment,	0.760	0.759	0.724	0.757	0.751	0.738	0.766	0.766	0.738	0.698	0.750	0.772	0.756	0.724	0.700	0.716	0.727	0.731	0.772	0.737	0.738	-0.229	-0.26
Transportation	0.748	0.752	0.725	0.753	0.742	0.756	0.729	0.740	0.766	0.767	0.726	0.771	0.745	0.717	0.723	0.713	0.736	0.749	0.702	0.724	0.654	0.5	0.415
Miscellaneous and	0.729	0.749	0.749	0.736	0.739	0.755	0.744	0.767	0.769	0.774	0.748	0.740	0.767	0.777	0.739	0.738	0.780	0.766	0.739	0.757	0.740	0.514	0.588
Food manufacturing	0.678	0.684	0.677	0.685	0.675	0.694	0.700	0.693	0.677	0.687	0.682	0.686	0.692	0.705	0.682	0.706	0.701	0.693	0.690	0.722	0.669	0.506	0.553
Textile, apparel, and	0.655	0.662	0.637	0.669	0.690	0.662	0.680	0.681	0.715	0.725	0.696	0.655	0.684	0.720	0.736	0.690	0.713	0.718	0.703	0.701	0.697	0.096	0.219
Paper and printing	0.686	0.691	0.724	0.725	0.691	0.691	0.698	0.697	0.693	0.715	0.708	0.703	0.704	0.691	0.716	0.673	0.677	0.681	0.712	0.664	0.721	-0.378	-0.378
Chemical	0.757	0.713	0.715	0.746	0.769	0.739	0.745	0.725	0.719	0.729	0.726	0.726	0.728	0.721	0.719	0.667	0.706	0.679	0.678	0.686	0.552	0.575	0.458
Plastics and rubber	0.698	0.717	0.705	0.711	0.717	0.711	0.712	0.733	0.734	0.768	0.725	0.731	0.674	0.751	0.762	0.738	0.686	0.689	0.706	0.675	0.717	0.017	0.068
Wholesale trade	0.716	0.720	0.692	0.688	0.698	0.716	0.703	0.710	0.693	0.701	0.672	0.684	0.701	0.686	0.696	0.696	0.690	0.692	0.706	0.685	0.697	0.04	-0.057
Retail trade	0.692	0.690	0.711	0.701	0.718	0.735	0.735	0.737	0.734	0.728	0.725	0.733	0.742	0.745	0.722	0.733	0.753	0.742	0.735	0.735	0.724	0.327	0.48
Transportation and	0.613	0.608	0.645	0.618	0.665	0.632	0.650	0.623	0.628	0.610	0.595	0.640	0.650	0.655	0.639	0.666	0.654	0.633	0.629	0.641	0.631	0.435	0.507
Utilities	0.671	0.690	0.657	0.648	0.646	0.693	0.687	0.647	0.670	0.651	0.597	0.598	0.594	0.637	0.666	0.607	0.650	0.655	0.583	0.608	0.612	0.285	0.145
Publishing industries	0.766	0.779	0.755	0.743	0.765	0.694	0.791	0.719	0.749	0.750	0.678	0.708	0.824	0.631	0.804	0.806	0.801	0.720	0.626	0.815	0.874	-0.142	-0.142
Motion picture and	0.740	0.796	0.701	0.745	0.769	0.753	0.650	0.738	0.803	0.754	0.806	0.845	0.810	0.807	0.726	0.743	0.788	0.804	0.814	0.669	0.833	-0.422	-0.297
Broadcasting (except	0.788	0.718	0.753	0.772	0.774	0.702	0.751	0.784	0.697	0.778	0.734	0.738	0.638	0.611	0.677	0.641	0.782	0.721	0.765	0.785	0.543	0.281	0.162
Telecommunications	0.744	0.750	0.734	0.725	0.721	0.733	0.722	0.732	0.709	0.733	0.727	0.705	0.672	0.641	0.683	0.756	0.731	0.710	0.789	0.641	0.703	-0.389	-0.417
Other information	0.788	0.800	0.754	0.770	0.805	0.779	0.744	0.778	0.752	0.772	0.775	0.729	0.750	0.760	0.666	0.649	0.801	0.778	0.784	0.772	0.774	-0.138	-0.243
Finance	0.794	0.791	0.804	0.787	0.810	0.805	0.803	0.795	0.809	0.809	0.801	0.793	0.829	0.822	0.805	0.792	0.812	0.818	0.801	0.798	0.800	0.414	0.479
Insurance	0.769	0.767	0.773	0.761	0.775	0.779	0.786	0.808	0.785	0.790	0.789	0.787	0.821	0.807	0.795	0.773	0.762	0.781	0.772	0.802		0.575	0.624
Real Estate	0.694	0.678	0.680	0.666	0.664	0.703	0.707	0.680	0.703	0.649	0.704	0.741	0.619	0.712	0.744	0.706	0.655	0.659	0.746	0.797		-0.04	0.006
Rental and leasing	0.604	0.720	0.716	0.635	0.709	0.707	0.707	0.724	0.684	0.562	0.592	0.767	0.613	0.852	0.634	0.676	0.696	0.717	0.639	0.666	0.761	0.122	0.172
Professional and	0.790	0.767	0.825	0.777	0.799	0.786	0.774	0.756	0.761	0.771	0.743	0.765	0.753	0.763	0.770	0.776	0.762	0.840	0.764	0.834	0.672	0.628	0.496
Administrative and	0.663	0.675	0.681	0.679	0.671	0.685	0.673	0.682	0.677	0.669	0.681	0.686	0.686	0.688	0.687	0.682	0.688	0.681	0.688	0.697	0.678	0.249	0.361
Educational services	0.826	0.825	0.827	0.822	0.821	0.825	0.813	0.831	0.816	0.815	0.789	0.786	0.808	0.792	0.798	0.776	0.778	0.780	0.785	0.813	0.801	0.22	0.023
Hospitals	0.788	0.786	0.792	0.788	0.783	0.777	0.779	0.781	0.784	0.789	0.766	0.796	0.794	0.795	0.786	0.794	0.784	0.784	0.807	0.763		-0.056	0.087
Health care services	0.767	0.772	0.768	0.770	0.771	0.775	0.774	0.792	0.786	0.762	0.769	0.764	0.779	0.791	0.784	0.784	0.775	0.784	0.778	0.771	0.757	0.581	0.649
Social assistance	0.787	0.831	0.843	0.747	0.749	0.792	0.810	0.807	0.790	0.774	0.803	0.781	0.762	0.804	0.830	0.745	0.796	0.761	0.744	0.785	0.791	0.143	0.127
Arts, entertainment,	0.723	0.761	0.766	0.657	0.658	0.680	0.714	0.699	0.743	0.741	0.708	0.711	0.751	0.731	0.765	0.734	0.737	0.731	0.697	0.715	0.731	0.132	0.241
Accommodation	0.744	0.692	0.706	0.686	0.753	0.675	0.753	0.759	0.699	0.765	0.714	0.762	0.729	0.742	0.769	0.774	0.770	0.732	0.717	0.721	0.732	0.153	0.265
Food services and	0.744	0.741	0.747	0.750	0.753	0.751	0.750	0.751	0.759	0.763	0.765	0.767	0.768	0.769	0.770	0.767	0.765	0.768	0.769	0.771	0.768	-0.049	0.136
Repair and	0.620	0.629	0.583	0.587	0.626	0.626	0.629	0.661	0.635	0.636	0.655	0.627	0.615	0.645	0.598	0.598	0.628	0.609	0.590	0.557	0.583	0.166	0.187
Personal and laundry	0.449	0.485	0.532	0.620	0.569	0.367	0.635	0.541	0.573	0.546	0.444	0.638	0.610	0.602	0.521	0.655	0.638	0.482	0.621	0.552	0.410	0.368	0.501
Membership	0.829	0.862	0.809	0.843	0.831	0.813	0.822	0.846	0.808	0.846	0.813	0.747	0.853	0.850	0.840	0.802	0.774	0.747	0.787	0.770	0.823	0.062	-0.001
Private households	0.486	0.463	0.679	0.689	0.659	0.514	0.493	0.692	0.679	0.764	0.480	0.704	0.712	0.694	0.700	0.709	0.618	0.722	0.702	0.546	0.658	0.202	0.308
Public Administration	0.772	0.777	0.772	0.774	0.766	0.757	0.747	0.769	0.755	0.731	0.734	0.730	0.748	0.762	0.739	0.754	0.757	0.708	0.696	0.745	0.781	-0.038	-0.129
EI (earnings)	0.735	0.736	0.743	0.735	0.741	0.740	0.740	0.744	0.742	0.740	0.730	0.737	0.744	0.746	0.741	0.738	0.739	0.740	0.733	0.745	0.721		
EI (hours)	0.726	0.728	0.734	0.726	0.732	0.731	0.733	0.736	0.735	0.733	0.723	0.731	0.737	0.740	0.735	0.733	0.734	0.732	0.728	0.736	0.716		

efficients are not statistically different from zero. The construction and the telecommunication industries are apparent examples of counter-cyclical industries.

Hourly Compensation and Maximal Potential Compensation

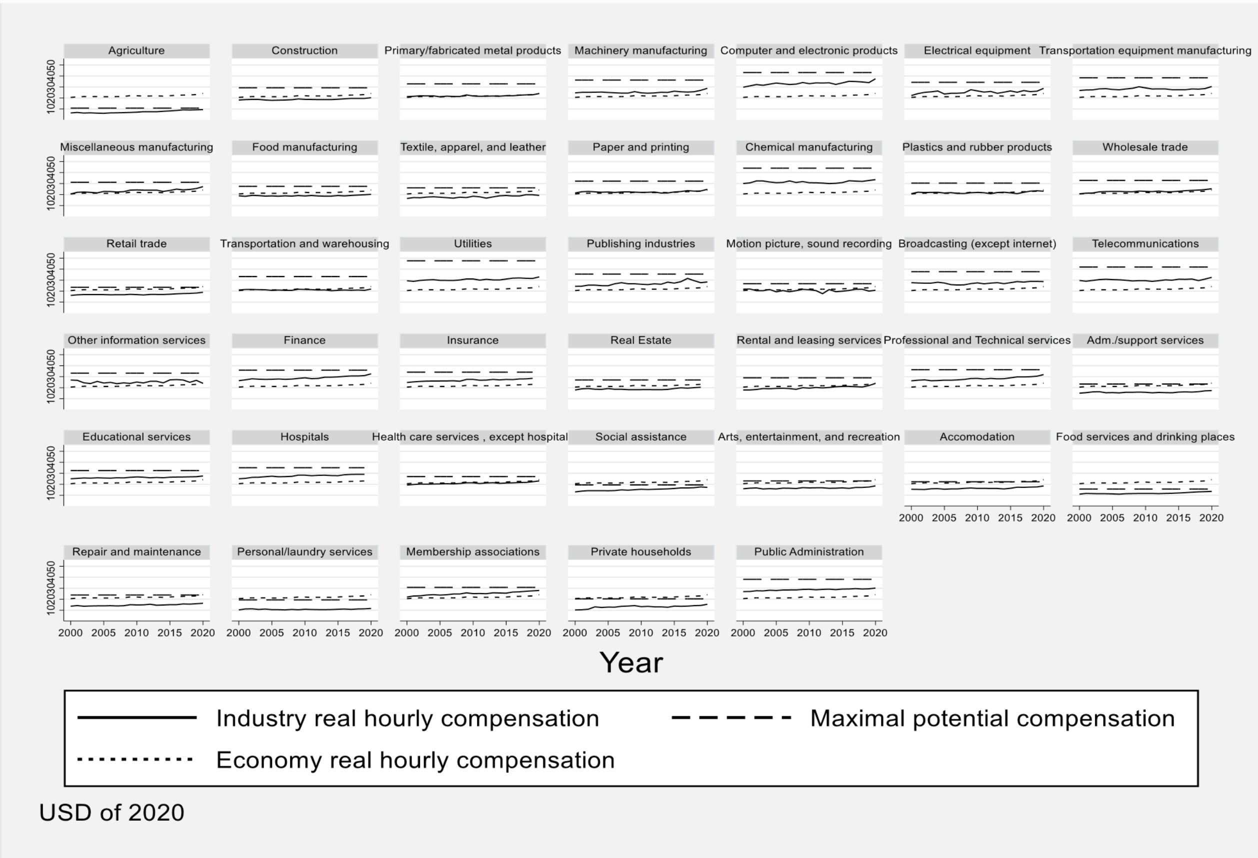
The average hourly compensation in each industry, W_i, is calculated as the ratio between the total weekly earnings in that industry and the total hours worked. We use the consumer price index to adjust the hourly compensation rate for inflation, and use a real measure of W_i which is comparable over the years (all expressed in dollars of 2020). Likewise, we calculate the economy real hourly compensation, which covers all industries combined. Finally, we also estimate the *maximal potential* hourly compensation in each industry, $\bar{W}_i$, by estimating the following regression equation, separately for each industry:

$$W_{i,t} = \gamma_i \times PI_{i,t} + \varepsilon_{i,t},$$

The estimate of the coefficient γ_i is the measured maximal potential hourly compensation for industry i. In Figure 3 below, we plot all three variables (real hourly compensation, maximal potential compensation, and the economy real compensation), for all industries over the whole period of 2000-2020.

Figure 3: Industry, Economy, and Potential Hourly Compensation, by Industry and Year

[FIGURE 3]



Some industries, like finance, insurance, and computer and electronics, among others, perform much better than the overall average, with uniformly higher average wage, that is slightly converging to its maximal potential level. Other industries, like agriculture, personal services, repair and maintenance, and social assistance, are characterized by lower hourly compensation than the whole economy, and even by lower maximal potential compensation: so, even if these industries perform better in terms of the performance index, driving the real hourly compensation to its maximum potential level, they will still exhibit lower real compensation than the whole economy.

A more important implication of the results is that, in many industries, the gap between the actual wage and the potential one is substantial. This, in turn, means that there is a room for improvement in these industries, by providing more training, increasing schooling levels, increasing equality in earnings, lowering gender and ethnic wage discrimination and occupational segregation, as well as increasing the share of minorities and females working in these industries. Industries that exhibit substantial potential increase in productivity include: utilities, chemical manufacturing, transportation, telecommunications, machinery manufacturing, primary and fabricated metal products, and the construction industry.

4. Concluding remarks

This study offers a new index, the performance index (PI), that can be used to study the industrial structure of any economy, as well as its economic spatial structure (across regions, districts, or counties), in a comparative study across countries and over longer periods of time. Changes in the index can be used to study the effect of policies and programs aimed at revamping some particular industries, local labor markets, or regions. The index lies in the interval [0,1], with higher values associated with better outcomes, and it is based on measures of schooling, skill distribution, earnings inequality, wage gaps, occupational segregation, and employment inequality within units of analysis (for example within industries). The index can also be used to estimate the maximal potential compensation in any unit of analysis (or industry), and as such to point out to units or industries with more room for improvement.

As an illustration, we explored the industrial structure in the US economy in the last two decades, using data from the Current Population Survey. The analysis showed a wide spectrum of results in different industries, from ill-performing industries (with low performance index levels) like personal services, private households, repair and maintenance, and construction, to well-performing industries like finance, insurance, and educational services. The analysis also showed that some industries like food, retail, manufacturing, and transportation are procyclical; others, like agriculture, wholesale trade, plastic and rubber, and real estate, are acyclical; yet others, like construction, paper and printing, and telecommunications, are countercyclical.

The index is universal, comparable across units of analysis and across time; within an economy, and over a cross-section of countries; and can be calculated from any standard household survey data, income survey data, labor force survey data, or any similar survey data that are usually collected by official statistical agencies in all countries.

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