Final Project

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## Introduction

In today’s world, you can’t turn on the tv or log onto social media with seeing a story about someone who wants to exercise their “freedom” to do something. Freedom is an incredibly complex topic, but the Heritage Foundation aims to measure a particular type of freedom, economic freedom (“2020 Index of Economic Freedom”). They try to measure economic freedom through twelve individual freedoms from expert opinions, survey data, and algorithms. They combine two very complex ideas, freedom and economic theory, to create a measure that the everyday person can understand which limits the amount of background information one needs to understand it.

This is important to study with the help of SEM for many reasons. First, each of the measures should be measuring separated things. The individual freedoms should be correlated, but they shouldn’t be so correlated that they’re measuring the same underlying freedom, otherwise what is the point of them being included. Second, the underlying structure of the data should be measuring the same freedom(s) with every wave of the data. If there is a new structure every year, then are they truly measuring freedom or something else? Ideally the definition of freedom wouldn’t change after a single year, so their work would be much more credible if that same structure exists over time. The Heritage Foundation, the creators of this index, are an independent organization, so it’s important that the general public is able to check their work and make sure that what they’re producing is accurate to make sure they’re a credible and truthful organization. It’s also important to realize that our understanding and responses to surveys change, but that shouldn’t change your results and if it does then it is time to tweak the overall methodology. This paper will look to define the underlying structure as well as confirm that the same structure exists for multiple years of data.

## The Data

The data consists of twelve different measures of freedom for every country for three years of data creating an initial sample size of 558. Each of these scores are between 0 and 100. These scores are derived from survey data (survey questions not provided), a combined measure of other economic features, professional opinion, or a combination of them. According to the “Methodology” document provided by the Heritage Foundation, the measures are split into four different categories: Rule of Law, Government Size, Regulatory Efficiency, and Market Openness. Each of these are summarized from the “Methodology” document in the following paragraphs. The same measures exist in each of the three years’ data.

Rule of Law consists of Property Rights, Judicial Effectiveness, and Government Integrity. Property Rights is defined as the existence of laws that allow citizens to purchase, rent/own, and use property. Judicial Effectiveness is a measure of how fair and how well a particular country’s judicial system works. Government Integrity is a measure of how corrupt a government’s institutions are. These are calculated from results from other reports from an assortment of organizations.

Government size consists of Tax Burden, Government Spending, and Fiscal Health. Tax Burden is defined as the measure of overall tax rate, derived from personal and corporate tax rates as well as how much the country’s GDP comes directly from taxes. Government spending is simply a measure of how much a country spends. From their wording, this appears to be the least precise measure since there is no “right” or “wrong” way for a country to spend money. Fiscal Health is a measure of debt and deficit and is calculated from previous deficits, debts, and GDP.

Regulatory Efficiency consists of Business Freedom, Labor Freedom, and Monetary Freedom. Business Freedom is defined as the amount laws and regulations allow for businesses to operate. Labor Freedom is a measure of the regulations protecting laborers and the amount of citizens who are a part of the labor force. Monetary Freedom is a measure of inflation and market price fluctuations. Business and Labor Freedom are both derived from other reports by the World Bank. Monetary Freedom is derived from inflation as well as other measures of government interference in pricing, such as subsidies.

Open Markets, the final grouping, consists of Trade Freedom, Investment Freedom, and Financial Freedom. Trade Freedom is a measure of tariffs, a tax on imports or exports, which is directly used in its derivation. Investment Freedom is a measure of how easy it is for a person or company to invest in companies, including foreign and domestic investments. This is calculated from various qualitative measures that are given point values. Financial Freedom measures how separate the banks are from government control. This is also measured qualitatively and given a point value.

## The Model

There are multiple parts to this analysis. First, is to find the underlying structure. The data is measuring Economic Freedom, so ideally there would be one factor. The Heritage Foundation grouped the variables into four groups of three, so there may be four underlying factors. Exploratory analysis will show there are other solutions as well. The second part of the analysis is MGCFA. The data consists of three years, 2020 (the most recent), 2019 (the second most recent), and 2017 (the furthest back the data goes). The first model compares 2020 to 2019 to see if the structure holds between the most recent years. The second model compares 2020 to 2017 to see if the same structure holds as time goes on.

## The Analysis

### Data Screening

The first step is to read in the data. All missing observations are then dropped. In this case, values that are missing are not missing at random and are missing for a reason. Imputation would not be accurate for this set.

library(lavaan)

## This is lavaan 0.6-7

## lavaan is BETA software! Please report any bugs.

library(corrplot)

## corrplot 0.84 loaded

library(semPlot)

## Registered S3 methods overwritten by 'huge':  
## method from   
## plot.sim BDgraph  
## print.sim BDgraph

library(MOTE)

## Registered S3 methods overwritten by 'car':  
## method from  
## influence.merMod lme4  
## cooks.distance.influence.merMod lme4  
## dfbeta.influence.merMod lme4  
## dfbetas.influence.merMod lme4

library(readxl)  
library(car)

## Loading required package: carData

library(psych)

##   
## Attaching package: 'psych'

## The following object is masked from 'package:car':  
##   
## logit

## The following object is masked from 'package:lavaan':  
##   
## cor2cov

library(knitr)  
setwd("C:\\Users\\cboyk\\OneDrive\\Desktop\\HU Analytics\\580 Structural Equation Modeling\\Final Project")  
data <- read\_excel("Combined Data.xlsx")  
data2 <- na.omit(data)

Next, is to check for outliers. The twelve scores are the set of continuous variables used to calculate outliers. The countries that were listed as outliers were checked as well to see which ones were dismissed. This leaves a sample size of 527.

mahal <- mahalanobis(data2[, 4:15],  
 colMeans(data2[, 4:15]),  
 cov(data2[, 4:15], use = 'pairwise.complete.obs'))  
cutoff <- qchisq(p = 1- 0.001, df = ncol(data2[, 4:15]))  
cutoff

## [1] 32.90949

summary(mahal < cutoff)

## Mode FALSE TRUE   
## logical 13 527

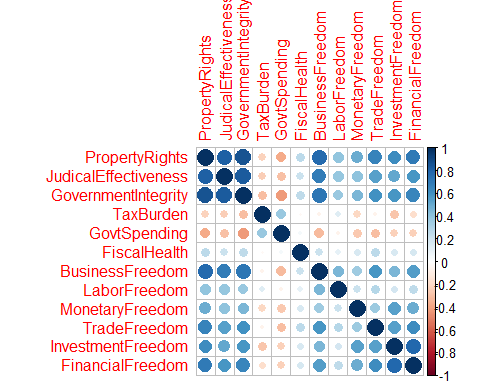
data2[mahal > cutoff, ]

## # A tibble: 13 x 16  
## CountryID CountryName Region PropertyRights JudicalEffectiv~ GovernmentInteg~  
## <dbl> <chr> <chr> <dbl> <dbl> <dbl>  
## 1 42 Cuba Ameri~ 20.1 10 38.7  
## 2 86 Kiribati Asia-~ 47.5 34.2 24.3  
## 3 87 Korea, Nor~ Asia-~ 20.1 5 15.1  
## 4 179 Venezuela Ameri~ 10.1 12.6 14.6  
## 5 53 Eritrea Sub-S~ 35.5 18.1 19.7  
## 6 87 Korea, Nor~ Asia-~ 31.6 5 24.4  
## 7 111 Micronesia Asia-~ 7.6 26.6 36.6  
## 8 179 Venezuela Ameri~ 7.6 13.1 7.9  
## 9 42 Cuba Ameri~ 32.4 10 41.8  
## 10 87 Korea, Nor~ Asia-~ 32.4 5 11.6  
## 11 164 Timor-Leste Asia-~ 6.8 10.3 29.2  
## 12 170 Turkmenist~ Asia-~ 32.4 5 29.6  
## 13 179 Venezuela Ameri~ 6.76 10.3 11.6  
## # ... with 10 more variables: TaxBurden <dbl>, GovtSpending <dbl>,  
## # FiscalHealth <dbl>, BusinessFreedom <dbl>, LaborFreedom <dbl>,  
## # MonetaryFreedom <dbl>, TradeFreedom <dbl>, InvestmentFreedom <dbl>,  
## # FinancialFreedom <dbl>, Year <dbl>

data3 <- data2[ mahal < cutoff, ]

Now that the data is cleaned, it can be screened for the assumptions, starting with additivity (correlations).

corrplot(cor(data3[,4:15]))

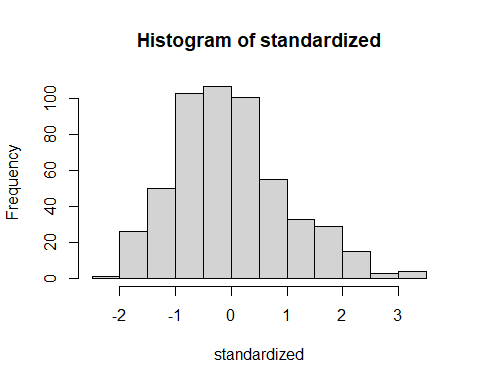


vif(lm(rchisq(nrow(data3[,4:15]), 5) ~ ., data3[,4:15]))

## PropertyRights JudicalEffectiveness GovernmentIntegrity   
## 6.466217 3.977070 5.838760   
## TaxBurden GovtSpending FiscalHealth   
## 1.434956 1.475279 1.151746   
## BusinessFreedom LaborFreedom MonetaryFreedom   
## 2.891812 1.358402 1.549453   
## TradeFreedom InvestmentFreedom FinancialFreedom   
## 2.152100 3.009907 3.425452

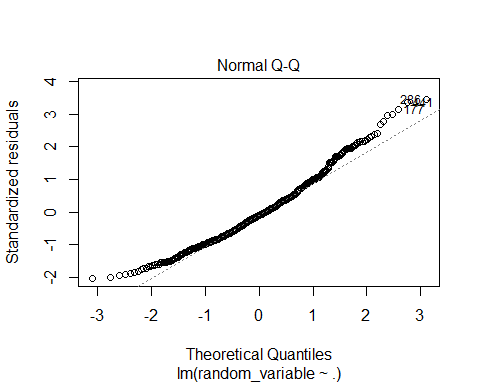
There are correlations that are high, like Government Integrity for example, but overall the data appears to pass additivity. VIF is low across the variables as well, showing that there are no signs of multicollinearity. Next is to check Normality.

set.seed(52)  
random\_variable <- rchisq(nrow(data3[, 4:15]), 13)  
fake\_model <- lm(random\_variable ~ . , data = data3[, 4:15])  
standardized <- rstudent(fake\_model)  
fitvalues <- scale(fake\_model$fitted.values)  
hist(standardized)

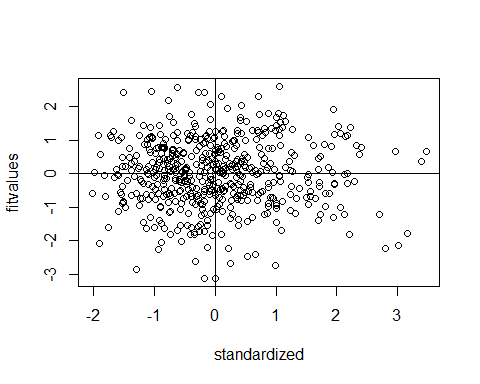


The data appears to be normal with the center slightly to the left of 0, but most of the values are between -2 and 2 with a slight right skew. Next, is linearity.

plot(fake\_model, 2)

 The data appears to be mostly linear, but it veers off before 2, so it can be considered questionable. To be conservative, this passes linearity. Next is homogeneity and homoskedasticity.

{plot(standardized, fitvalues)   
 abline(v = 0)  
 abline(h = 0)}

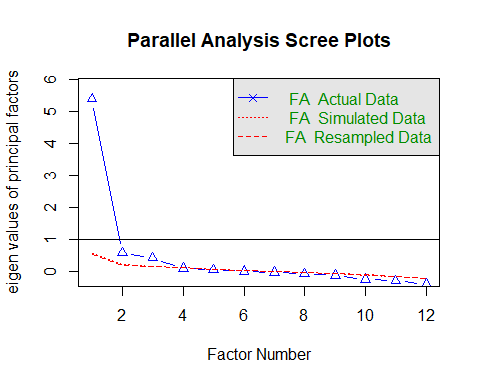


Most of the values are between -2 and 2 along both axes with no clear pattern, so both of these are passed. Now that the data is cleaned and screened, the models can be built.

### Build the Model - EFA/CFA

The first step of of modeling is to try EFA to see what the math believes the best number of factors is. Theory suggests that it can be one factor (because it is measuring overall economic freedom) or four factors (the four subgroups that they used to bucket the variables).

number\_factors <- fa.parallel(data3[, 4:15], fm = 'ml', fa = 'fa') # 3



## Parallel analysis suggests that the number of factors = 3 and the number of components = NA

number\_factors$fa.values

## [1] 5.38598159 0.57677829 0.41651032 0.09149780 0.05364373 -0.00426399  
## [7] -0.02866428 -0.06945500 -0.12099319 -0.24491771 -0.29402178 -0.40205529

sum(number\_factors$fa.values > 1) # 1

## [1] 1

sum(number\_factors$fa.values > 0.7)

## [1] 1

Parallel analysis suggests 3 factors while the eigenvalues suggest 1. For sake of being thorough, a 2 factor solution was checked as well.

Starting with a 1 factor model, Fiscal Health and Tax Burden were removed due to loadings being below 0.3.

fa1.model <- fa(data3[, c(4, 5, 6, 8, 10, 11, 12, 13, 14, 15)], fm = 'ml', nfactors = 1, rotate = 'oblimin')  
fa1.model

## Factor Analysis using method = ml  
## Call: fa(r = data3[, c(4, 5, 6, 8, 10, 11, 12, 13, 14, 15)], nfactors = 1,   
## rotate = "oblimin", fm = "ml")  
## Standardized loadings (pattern matrix) based upon correlation matrix  
## ML1 h2 u2 com  
## PropertyRights 0.95 0.90 0.097 1  
## JudicalEffectiveness 0.86 0.74 0.259 1  
## GovernmentIntegrity 0.92 0.84 0.159 1  
## GovtSpending -0.40 0.16 0.841 1  
## BusinessFreedom 0.80 0.64 0.362 1  
## LaborFreedom 0.42 0.18 0.825 1  
## MonetaryFreedom 0.52 0.27 0.727 1  
## TradeFreedom 0.70 0.49 0.513 1  
## InvestmentFreedom 0.67 0.45 0.553 1  
## FinancialFreedom 0.75 0.56 0.442 1  
##   
## ML1  
## SS loadings 5.22  
## Proportion Var 0.52  
##   
## Mean item complexity = 1  
## Test of the hypothesis that 1 factor is sufficient.  
##   
## The degrees of freedom for the null model are 45 and the objective function was 7.01 with Chi Square of 3655.77  
## The degrees of freedom for the model are 35 and the objective function was 0.88   
##   
## The root mean square of the residuals (RMSR) is 0.07   
## The df corrected root mean square of the residuals is 0.08   
##   
## The harmonic number of observations is 527 with the empirical chi square 240.95 with prob < 1.4e-32   
## The total number of observations was 527 with Likelihood Chi Square = 460.51 with prob < 1.2e-75   
##   
## Tucker Lewis Index of factoring reliability = 0.848  
## RMSEA index = 0.152 and the 90 % confidence intervals are 0.14 0.165  
## BIC = 241.16  
## Fit based upon off diagonal values = 0.98  
## Measures of factor score adequacy   
## ML1  
## Correlation of (regression) scores with factors 0.98  
## Multiple R square of scores with factors 0.96  
## Minimum correlation of possible factor scores 0.92

Next is the 2 factor model. Tax Burden and Fiscal Health were again dropped due to low loadings. Trade Freedom was also dropped due to cross loading. Factor 1 is made up of Property Rights, Judicial Effectiveness, Government Integrity, Government Spending, Business Freedom, and Labor Freedom. Factor 2 is made up of Monetary Freedom, Investment Freedom, and Financial Freedom. I am calling Factor 1 “Legal” and Factor 2 “Market”.

fa2.model <- fa(data3[, c(4, 5, 6, 8, 10, 11, 12, 14, 15)], fm = 'ml', nfactors = 2, rotate = 'oblimin')

## Loading required namespace: GPArotation

fa2.model

## Factor Analysis using method = ml  
## Call: fa(r = data3[, c(4, 5, 6, 8, 10, 11, 12, 14, 15)], nfactors = 2,   
## rotate = "oblimin", fm = "ml")  
## Standardized loadings (pattern matrix) based upon correlation matrix  
## ML1 ML2 h2 u2 com  
## PropertyRights 0.87 0.11 0.89 0.11 1.0  
## JudicalEffectiveness 0.91 -0.04 0.78 0.22 1.0  
## GovernmentIntegrity 0.89 0.05 0.86 0.14 1.0  
## GovtSpending -0.41 0.01 0.16 0.84 1.0  
## BusinessFreedom 0.84 -0.05 0.65 0.35 1.0  
## LaborFreedom 0.52 -0.13 0.20 0.80 1.1  
## MonetaryFreedom 0.17 0.47 0.35 0.65 1.3  
## InvestmentFreedom -0.06 0.98 0.89 0.11 1.0  
## FinancialFreedom 0.25 0.67 0.73 0.27 1.3  
##   
## ML1 ML2  
## SS loadings 3.73 1.79  
## Proportion Var 0.41 0.20  
## Cumulative Var 0.41 0.61  
## Proportion Explained 0.68 0.32  
## Cumulative Proportion 0.68 1.00  
##   
## With factor correlations of   
## ML1 ML2  
## ML1 1.00 0.67  
## ML2 0.67 1.00  
##   
## Mean item complexity = 1.1  
## Test of the hypothesis that 2 factors are sufficient.  
##   
## The degrees of freedom for the null model are 36 and the objective function was 6.29 with Chi Square of 3283.29  
## The degrees of freedom for the model are 19 and the objective function was 0.18   
##   
## The root mean square of the residuals (RMSR) is 0.03   
## The df corrected root mean square of the residuals is 0.05   
##   
## The harmonic number of observations is 527 with the empirical chi square 41.05 with prob < 0.0024   
## The total number of observations was 527 with Likelihood Chi Square = 93.59 with prob < 7.6e-12   
##   
## Tucker Lewis Index of factoring reliability = 0.956  
## RMSEA index = 0.086 and the 90 % confidence intervals are 0.069 0.104  
## BIC = -25.48  
## Fit based upon off diagonal values = 1  
## Measures of factor score adequacy   
## ML1 ML2  
## Correlation of (regression) scores with factors 0.98 0.96  
## Multiple R square of scores with factors 0.95 0.92  
## Minimum correlation of possible factor scores 0.90 0.85

Next is the 3 factor model. Government Spending and Labor Freedom was removed due to cross loading. Fiscal Health was removed due to low loadings. However, this leaves with only 1 variable in Factor 3, which makes this a bad model (should have at least 3 variables)

fa3.model <- fa(data3[, c(4, 5, 6, 7, 10, 12, 14, 15)], fm = 'ml', nfactors = 3, rotate = 'oblimin')  
fa3.model

## Factor Analysis using method = ml  
## Call: fa(r = data3[, c(4, 5, 6, 7, 10, 12, 14, 15)], nfactors = 3,   
## rotate = "oblimin", fm = "ml")  
## Standardized loadings (pattern matrix) based upon correlation matrix  
## ML1 ML2 ML3 h2 u2 com  
## PropertyRights 0.85 0.14 0.04 0.89 0.11 1.1  
## JudicalEffectiveness 0.91 -0.05 -0.10 0.79 0.21 1.0  
## GovernmentIntegrity 0.90 0.03 -0.14 0.89 0.11 1.1  
## TaxBurden -0.13 -0.09 0.57 0.40 0.60 1.2  
## BusinessFreedom 0.84 -0.01 0.22 0.71 0.29 1.1  
## MonetaryFreedom 0.15 0.48 -0.05 0.36 0.64 1.2  
## InvestmentFreedom -0.07 0.97 -0.05 0.88 0.12 1.0  
## FinancialFreedom 0.21 0.72 0.10 0.76 0.24 1.2  
##   
## ML1 ML2 ML3  
## SS loadings 3.32 1.91 0.43  
## Proportion Var 0.42 0.24 0.05  
## Cumulative Var 0.42 0.65 0.71  
## Proportion Explained 0.59 0.34 0.08  
## Cumulative Proportion 0.59 0.92 1.00  
##   
## With factor correlations of   
## ML1 ML2 ML3  
## ML1 1.00 0.68 -0.09  
## ML2 0.68 1.00 -0.15  
## ML3 -0.09 -0.15 1.00  
##   
## Mean item complexity = 1.1  
## Test of the hypothesis that 3 factors are sufficient.  
##   
## The degrees of freedom for the null model are 28 and the objective function was 5.99 with Chi Square of 3131.73  
## The degrees of freedom for the model are 7 and the objective function was 0.02   
##   
## The root mean square of the residuals (RMSR) is 0.01   
## The df corrected root mean square of the residuals is 0.02   
##   
## The harmonic number of observations is 527 with the empirical chi square 1.89 with prob < 0.97   
## The total number of observations was 527 with Likelihood Chi Square = 11.8 with prob < 0.11   
##   
## Tucker Lewis Index of factoring reliability = 0.994  
## RMSEA index = 0.036 and the 90 % confidence intervals are 0 0.071  
## BIC = -32.07  
## Fit based upon off diagonal values = 1  
## Measures of factor score adequacy   
## ML1 ML2 ML3  
## Correlation of (regression) scores with factors 0.98 0.96 0.71  
## Multiple R square of scores with factors 0.95 0.92 0.50  
## Minimum correlation of possible factor scores 0.91 0.84 0.01

The 4 factor model based on the subgroups provided in the methodology leads to the Government Size latent variable having a negative variance. If any variables are dropped then a factor will have less than 3 variables, making this a non-viable option.

fa4.model <- "  
GovernmentSize =~ TaxBurden + GovtSpending + FiscalHealth  
RuleofLaw =~ PropertyRights + JudicalEffectiveness + GovernmentIntegrity  
RegulatoryEffeciency =~ BusinessFreedom + LaborFreedom + MonetaryFreedom  
OpenMarkets =~ TradeFreedom + InvestmentFreedom + FinancialFreedom  
"  
fa4.fit <- cfa(fa4.model, data = data3)

## Warning in lav\_model\_estimate(lavmodel = lavmodel, lavpartable = lavpartable, :  
## lavaan WARNING: the optimizer warns that a solution has NOT been found!

## Warning in lav\_object\_post\_check(object): lavaan WARNING: some estimated lv  
## variances are negative

summary(fa4.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 366 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 30  
##   
## Number of observations 527  
##   
## Model Test User Model:  
##   
## Test statistic 468.224  
## Degrees of freedom 48  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 3955.892  
## Degrees of freedom 66  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.892  
## Tucker-Lewis Index (TLI) 0.851  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -24813.681  
## Loglikelihood unrestricted model (H1) -24579.569  
##   
## Akaike (AIC) 49687.363  
## Bayesian (BIC) 49815.379  
## Sample-size adjusted Bayesian (BIC) 49720.151  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.129  
## 90 Percent confidence interval - lower 0.118  
## 90 Percent confidence interval - upper 0.140  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.097  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## GovernmentSize =~   
## TaxBurden 1.000 NA NA  
## GovtSpending -216.627 2142.254 -0.101 0.919 NA NA  
## FiscalHealth 192.509 1903.783 0.101 0.919 NA NA  
## RuleofLaw =~   
## PropertyRights 1.000 17.649 0.948  
## JudclEffctvnss 0.912 0.027 33.399 0.000 16.093 0.870  
## GvrnmntIntgrty 1.028 0.025 40.713 0.000 18.138 0.926  
## RegulatoryEffeciency =~   
## BusinessFreedm 1.000 11.709 0.820  
## LaborFreedom 0.515 0.050 10.258 0.000 6.025 0.443  
## MonetaryFreedm 0.324 0.027 12.129 0.000 3.799 0.515  
## OpenMarkets =~   
## TradeFreedom 1.000 7.634 0.705  
## InvestmentFrdm 2.284 0.128 17.776 0.000 17.433 0.832  
## FinancialFredm 2.226 0.117 18.953 0.000 16.994 0.915  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## GovernmentSize ~~   
## RuleofLaw 0.724 7.161 0.101 0.919 1.476 1.476  
## RegltryEffcncy 0.454 4.487 0.101 0.919 1.394 1.394  
## OpenMarkets 0.230 2.278 0.101 0.919 1.086 1.086  
## RuleofLaw ~~   
## RegltryEffcncy 201.339 14.455 13.928 0.000 0.974 0.974  
## OpenMarkets 108.004 9.346 11.556 0.000 0.802 0.802  
## RegulatoryEffeciency ~~   
## OpenMarkets 70.362 6.611 10.643 0.000 0.787 0.787  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .TaxBurden 138.235 8.516 16.233 0.000 138.235 1.000  
## .GovtSpending 513.573 47.827 10.738 0.000 513.573 1.076  
## .FiscalHealth 905.479 62.561 14.474 0.000 905.479 1.033  
## .PropertyRights 34.759 3.786 9.182 0.000 34.759 0.100  
## .JudclEffctvnss 83.130 6.007 13.838 0.000 83.130 0.243  
## .GvrnmntIntgrty 55.094 4.823 11.424 0.000 55.094 0.143  
## .BusinessFreedm 66.780 7.265 9.192 0.000 66.780 0.328  
## .LaborFreedom 148.391 9.381 15.819 0.000 148.391 0.803  
## .MonetaryFreedm 40.014 2.571 15.563 0.000 40.014 0.735  
## .TradeFreedom 59.055 4.067 14.520 0.000 59.055 0.503  
## .InvestmentFrdm 135.306 11.327 11.945 0.000 135.306 0.308  
## .FinancialFredm 56.453 7.732 7.301 0.000 56.453 0.164  
## GovernmentSize -0.001 0.015 -0.051 0.960 NA NA  
## RuleofLaw 311.480 21.450 14.521 0.000 1.000 1.000  
## RegltryEffcncy 137.101 13.292 10.315 0.000 1.000 1.000  
## OpenMarkets 58.275 6.505 8.959 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## TaxBurden -0.000  
## GovtSpending -0.076  
## FiscalHealth -0.033  
## PropertyRights 0.900  
## JudclEffctvnss 0.757  
## GvrnmntIntgrty 0.857  
## BusinessFreedm 0.672  
## LaborFreedom 0.197  
## MonetaryFreedm 0.265  
## TradeFreedom 0.497  
## InvestmentFrdm 0.692  
## FinancialFredm 0.836

After this step of modeling, the 1 factor and 3 factor model will be compared to see which one is the better model to continue on to MGCFA.

### Examine the Fit/Summary - Which model is better?

Now that there are two viable models, they will be checked to see which one is better to be used for MGCFA, starting with the fit statistics for the 1 factor model

Factor1.model <- "  
Freedom =~ PropertyRights + JudicalEffectiveness + GovernmentIntegrity + GovtSpending + FiscalHealth + BusinessFreedom + LaborFreedom + MonetaryFreedom + TradeFreedom + InvestmentFreedom + FinancialFreedom  
"  
Factor1.fit <- cfa(Factor1.model, data = data3)  
summary(Factor1.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 93 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 22  
##   
## Number of observations 527  
##   
## Model Test User Model:  
##   
## Test statistic 500.720  
## Degrees of freedom 44  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 3765.574  
## Degrees of freedom 55  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.877  
## Tucker-Lewis Index (TLI) 0.846  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -22878.630  
## Loglikelihood unrestricted model (H1) -22628.270  
##   
## Akaike (AIC) 45801.261  
## Bayesian (BIC) 45895.139  
## Sample-size adjusted Bayesian (BIC) 45825.305  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.140  
## 90 Percent confidence interval - lower 0.129  
## 90 Percent confidence interval - upper 0.152  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.063  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Freedom =~   
## PropertyRights 1.000 17.688 0.951  
## JudclEffctvnss 0.900 0.028 32.652 0.000 15.913 0.860  
## GvrnmntIntgrty 1.016 0.025 39.994 0.000 17.970 0.917  
## GovtSpending -0.490 0.051 -9.612 0.000 -8.674 -0.397  
## FiscalHealth 0.454 0.072 6.307 0.000 8.034 0.271  
## BusinessFreedm 0.645 0.024 27.058 0.000 11.402 0.799  
## LaborFreedom 0.322 0.031 10.228 0.000 5.688 0.419  
## MonetaryFreedm 0.218 0.016 13.476 0.000 3.856 0.523  
## TradeFreedom 0.428 0.021 20.810 0.000 7.574 0.699  
## InvestmentFrdm 0.792 0.041 19.264 0.000 14.002 0.668  
## FinancialFredm 0.784 0.033 23.487 0.000 13.871 0.747  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 33.307 3.547 9.390 0.000 33.307 0.096  
## .JudclEffctvnss 88.828 6.271 14.166 0.000 88.828 0.260  
## .GvrnmntIntgrty 61.105 4.981 12.267 0.000 61.105 0.159  
## .GovtSpending 402.318 24.987 16.101 0.000 402.318 0.842  
## .FiscalHealth 812.063 50.199 16.177 0.000 812.063 0.926  
## .BusinessFreedm 73.843 4.931 14.974 0.000 73.843 0.362  
## .LaborFreedom 152.336 9.472 16.084 0.000 152.336 0.825  
## .MonetaryFreedm 39.569 2.478 15.968 0.000 39.569 0.727  
## .TradeFreedom 59.957 3.854 15.555 0.000 59.957 0.511  
## .InvestmentFrdm 243.127 15.523 15.663 0.000 243.127 0.554  
## .FinancialFredm 152.801 9.962 15.338 0.000 152.801 0.443  
## Freedom 312.873 21.423 14.604 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.904  
## JudclEffctvnss 0.740  
## GvrnmntIntgrty 0.841  
## GovtSpending 0.158  
## FiscalHealth 0.074  
## BusinessFreedm 0.638  
## LaborFreedom 0.175  
## MonetaryFreedm 0.273  
## TradeFreedom 0.489  
## InvestmentFrdm 0.446  
## FinancialFredm 0.557

The fit statistics are ok, but not great. Loadings are all above 0.3 and there are no heywood cases. Next is the 2 factor model

factor2.model <- "  
Legal =~ PropertyRights + JudicalEffectiveness + GovernmentIntegrity + GovtSpending + BusinessFreedom + LaborFreedom  
Market =~ MonetaryFreedom + InvestmentFreedom + FinancialFreedom  
"  
Factor2.fit <- cfa(factor2.model, data = data3)  
summary(Factor2.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 129 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 19  
##   
## Number of observations 527  
##   
## Model Test User Model:  
##   
## Test statistic 148.795  
## Degrees of freedom 26  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 3313.682  
## Degrees of freedom 36  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.963  
## Tucker-Lewis Index (TLI) 0.948  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -18392.009  
## Loglikelihood unrestricted model (H1) -18317.612  
##   
## Akaike (AIC) 36822.019  
## Bayesian (BIC) 36903.096  
## Sample-size adjusted Bayesian (BIC) 36842.785  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.095  
## 90 Percent confidence interval - lower 0.080  
## 90 Percent confidence interval - upper 0.110  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.040  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 17.579 0.945  
## JudclEffctvnss 0.921 0.027 33.577 0.000 16.187 0.875  
## GvrnmntIntgrty 1.035 0.026 40.361 0.000 18.188 0.928  
## GovtSpending -0.497 0.051 -9.664 0.000 -8.741 -0.400  
## BusinessFreedm 0.651 0.024 26.863 0.000 11.437 0.801  
## LaborFreedom 0.328 0.032 10.339 0.000 5.758 0.424  
## Market =~   
## MonetaryFreedm 1.000 4.345 0.589  
## InvestmentFrdm 4.138 0.289 14.315 0.000 17.979 0.858  
## FinancialFredm 3.876 0.266 14.578 0.000 16.838 0.906  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal ~~   
## Market 58.904 5.781 10.189 0.000 0.771 0.771  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 37.162 3.950 9.409 0.000 37.162 0.107  
## .JudclEffctvnss 80.032 5.883 13.604 0.000 80.032 0.234  
## .GvrnmntIntgrty 53.222 4.833 11.013 0.000 53.222 0.139  
## .GovtSpending 401.155 24.938 16.086 0.000 401.155 0.840  
## .BusinessFreedm 73.037 4.927 14.825 0.000 73.037 0.358  
## .LaborFreedom 151.530 9.433 16.064 0.000 151.530 0.820  
## .MonetaryFreedm 35.564 2.329 15.270 0.000 35.564 0.653  
## .InvestmentFrdm 115.947 11.342 10.222 0.000 115.947 0.264  
## .FinancialFredm 61.668 8.499 7.256 0.000 61.668 0.179  
## Legal 309.020 21.446 14.409 0.000 1.000 1.000  
## Market 18.876 2.659 7.098 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.893  
## JudclEffctvnss 0.766  
## GvrnmntIntgrty 0.861  
## GovtSpending 0.160  
## BusinessFreedm 0.642  
## LaborFreedom 0.180  
## MonetaryFreedm 0.347  
## InvestmentFrdm 0.736  
## FinancialFredm 0.821

The fit statistics are all very good here, loadings are still above 0.3, and no heywood cases. As an added check ANOVA was used, though the results should be interpeted carefully, because they don’t have the same number of variables. More attention should be paid to the fit statistics

anova(Factor1.fit, Factor2.fit)

## Warning in lavTestLRT(object = new("lavaan", version = "0.6.7", call =  
## lavaan::lavaan(model = Factor1.model, : lavaan WARNING: some models are based on  
## a different set of observed variables

## Chi-Squared Difference Test  
##   
## Df AIC BIC Chisq Chisq diff Df diff Pr(>Chisq)   
## Factor2.fit 26 36822 36903 148.80   
## Factor1.fit 44 45801 45895 500.72 351.92 18 < 2.2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

fitmeasures(Factor1.fit, c("aic", "ecvi"))

## aic ecvi   
## 45801.261 1.034

fitmeasures(Factor2.fit, c("aic", "ecvi"))

## aic ecvi   
## 36822.019 0.354

Overall, it is clear that the 2 factor model is the better model based off of, most importantly, the fit indices.

### Examine Modification Indices

Next, is to check if there’s any indices that should be added.

modindices(Factor2.fit, sort. = TRUE, minimum.value = 30.00000)

## lhs op rhs mi epc sepc.lv sepc.all  
## 39 JudicalEffectiveness ~~ GovernmentIntegrity 30.327 25.746 25.746 0.394  
## sepc.nox  
## 39 0.394

This shows that JudicialEffectiveness ~~ GovernmentIntegrity should be added. Both of these are on the same latent variable and it seems reasonable, so it will be added

factor2.model2 <- "  
Legal =~ PropertyRights + JudicalEffectiveness + GovernmentIntegrity + GovtSpending + BusinessFreedom + LaborFreedom  
Market =~ MonetaryFreedom + InvestmentFreedom + FinancialFreedom  
JudicalEffectiveness ~~ GovernmentIntegrity  
"  
Factor2.fit2 <- cfa(factor2.model2, data = data3)  
summary(Factor2.fit2, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 143 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 20  
##   
## Number of observations 527  
##   
## Model Test User Model:  
##   
## Test statistic 119.831  
## Degrees of freedom 25  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 3313.682  
## Degrees of freedom 36  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.971  
## Tucker-Lewis Index (TLI) 0.958  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -18377.527  
## Loglikelihood unrestricted model (H1) -18317.612  
##   
## Akaike (AIC) 36795.054  
## Bayesian (BIC) 36880.398  
## Sample-size adjusted Bayesian (BIC) 36816.913  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.085  
## 90 Percent confidence interval - lower 0.070  
## 90 Percent confidence interval - upper 0.100  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.039  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 17.936 0.964  
## JudclEffctvnss 0.874 0.028 30.818 0.000 15.675 0.848  
## GvrnmntIntgrty 0.988 0.026 37.452 0.000 17.719 0.904  
## GovtSpending -0.483 0.050 -9.584 0.000 -8.656 -0.396  
## BusinessFreedm 0.639 0.023 27.448 0.000 11.463 0.803  
## LaborFreedom 0.320 0.031 10.348 0.000 5.746 0.423  
## Market =~   
## MonetaryFreedm 1.000 4.344 0.589  
## InvestmentFrdm 4.130 0.288 14.317 0.000 17.942 0.856  
## FinancialFredm 3.882 0.266 14.608 0.000 16.866 0.908  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 26.181 5.279 4.959 0.000 26.181 0.319  
## Legal ~~   
## Market 60.751 5.908 10.284 0.000 0.780 0.780  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 24.470 4.364 5.608 0.000 24.470 0.071  
## .JudclEffctvnss 96.342 7.162 13.452 0.000 96.342 0.282  
## .GvrnmntIntgrty 70.059 6.100 11.485 0.000 70.059 0.182  
## .GovtSpending 402.636 25.018 16.094 0.000 402.636 0.843  
## .BusinessFreedm 72.458 4.914 14.745 0.000 72.458 0.355  
## .LaborFreedom 151.672 9.438 16.070 0.000 151.672 0.821  
## .MonetaryFreedm 35.566 2.327 15.282 0.000 35.566 0.653  
## .InvestmentFrdm 117.280 11.267 10.409 0.000 117.280 0.267  
## .FinancialFredm 60.736 8.384 7.245 0.000 60.736 0.176  
## Legal 321.712 21.663 14.850 0.000 1.000 1.000  
## Market 18.873 2.658 7.102 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.929  
## JudclEffctvnss 0.718  
## GvrnmntIntgrty 0.818  
## GovtSpending 0.157  
## BusinessFreedm 0.645  
## LaborFreedom 0.179  
## MonetaryFreedm 0.347  
## InvestmentFrdm 0.733  
## FinancialFredm 0.824

### MGCFA 2020-2019 Data

The first model to be tested is to see if the structure from above is the same for the 2020 and the 2019 data. The modeling is started with this, because it is the shortest period of time between waves and if this model fails then any other year would most likely fail as well. The multiple steps are the overall model, the 2020 model, the 2019 model, the configural model, the metric model, the scalar model, and the strict model. First is the overall model with the 2019 and 2020 data.

data20202019 <- data3[data3$Year == 2019 | data3$Year == 2020,]  
Model <- "  
Legal =~ PropertyRights + JudicalEffectiveness + GovernmentIntegrity + GovtSpending + BusinessFreedom + LaborFreedom  
Market =~ MonetaryFreedom + InvestmentFreedom + FinancialFreedom  
JudicalEffectiveness ~~ GovernmentIntegrity  
"  
Overall.fit <- cfa(Model, data = data20202019, meanstructure = T)  
summary(Overall.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 143 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 29  
##   
## Number of observations 352  
##   
## Model Test User Model:  
##   
## Test statistic 91.682  
## Degrees of freedom 25  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2292.960  
## Degrees of freedom 36  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.970  
## Tucker-Lewis Index (TLI) 0.957  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12212.973  
## Loglikelihood unrestricted model (H1) -12167.132  
##   
## Akaike (AIC) 24483.945  
## Bayesian (BIC) 24595.991  
## Sample-size adjusted Bayesian (BIC) 24503.991  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.087  
## 90 Percent confidence interval - lower 0.068  
## 90 Percent confidence interval - upper 0.107  
## P-value RMSEA <= 0.05 0.001  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.037  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 17.739 0.971  
## JudclEffctvnss 0.843 0.033 25.664 0.000 14.956 0.847  
## GvrnmntIntgrty 1.034 0.033 31.497 0.000 18.334 0.904  
## GovtSpending -0.481 0.061 -7.917 0.000 -8.525 -0.398  
## BusinessFreedm 0.655 0.029 22.845 0.000 11.624 0.805  
## LaborFreedom 0.334 0.038 8.801 0.000 5.932 0.436  
## Market =~   
## MonetaryFreedm 1.000 4.050 0.564  
## InvestmentFrdm 4.411 0.394 11.204 0.000 17.866 0.868  
## FinancialFredm 4.187 0.368 11.365 0.000 16.957 0.910  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 31.830 6.343 5.019 0.000 31.830 0.392  
## Legal ~~   
## Market 56.205 6.841 8.216 0.000 0.782 0.782  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 55.916 0.974 57.410 0.000 55.916 3.060  
## .JudclEffctvnss 46.336 0.941 49.237 0.000 46.336 2.624  
## .GvrnmntIntgrty 43.762 1.081 40.500 0.000 43.762 2.159  
## .GovtSpending 66.299 1.141 58.131 0.000 66.299 3.098  
## .BusinessFreedm 64.799 0.770 84.157 0.000 64.799 4.486  
## .LaborFreedom 60.097 0.726 82.798 0.000 60.097 4.413  
## .MonetaryFreedm 76.081 0.383 198.802 0.000 76.081 10.596  
## .InvestmentFrdm 58.835 1.097 53.612 0.000 58.835 2.858  
## .FinancialFredm 49.489 0.994 49.810 0.000 49.489 2.655  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 19.258 4.919 3.915 0.000 19.258 0.058  
## .JudclEffctvnss 88.048 7.852 11.213 0.000 88.048 0.282  
## .GvrnmntIntgrty 74.836 7.778 9.621 0.000 74.836 0.182  
## .GovtSpending 385.201 29.260 13.165 0.000 385.201 0.841  
## .BusinessFreedm 73.576 6.067 12.128 0.000 73.576 0.353  
## .LaborFreedom 150.248 11.435 13.140 0.000 150.248 0.810  
## .MonetaryFreedm 35.151 2.786 12.616 0.000 35.151 0.682  
## .InvestmentFrdm 104.738 12.817 8.172 0.000 104.738 0.247  
## .FinancialFredm 59.918 10.052 5.961 0.000 59.918 0.172  
## Legal 314.657 25.564 12.309 0.000 1.000 1.000  
## Market 16.402 2.970 5.522 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.942  
## JudclEffctvnss 0.718  
## GvrnmntIntgrty 0.818  
## GovtSpending 0.159  
## BusinessFreedm 0.647  
## LaborFreedom 0.190  
## MonetaryFreedm 0.318  
## InvestmentFrdm 0.753  
## FinancialFredm 0.828

table\_fit <- matrix(NA, nrow = 7, ncol = 6)  
colnames(table\_fit) = c("Model", "X2", "df", "CFI", "RMSEA", "SRMR")  
table\_fit[1, ] <- c("Overall Model", round(fitmeasures(Overall.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 91.682 | 25 | 0.97 | 0.087 | 0.037 |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |

Next, is the individual 2019 and 2020 models

model2020.fit <- cfa(Model, data = data20202019[data20202019$Year == 2020,], meanstructure = T)  
summary(model2020.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 163 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 29  
##   
## Number of observations 176  
##   
## Model Test User Model:  
##   
## Test statistic 58.117  
## Degrees of freedom 25  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 1180.401  
## Degrees of freedom 36  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.971  
## Tucker-Lewis Index (TLI) 0.958  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -6079.308  
## Loglikelihood unrestricted model (H1) -6050.249  
##   
## Akaike (AIC) 12216.615  
## Bayesian (BIC) 12308.559  
## Sample-size adjusted Bayesian (BIC) 12216.723  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.087  
## 90 Percent confidence interval - lower 0.058  
## 90 Percent confidence interval - upper 0.116  
## P-value RMSEA <= 0.05 0.021  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.041  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 17.024 0.971  
## JudclEffctvnss 0.905 0.047 19.348 0.000 15.398 0.862  
## GvrnmntIntgrty 1.144 0.045 25.342 0.000 19.483 0.929  
## GovtSpending -0.551 0.085 -6.495 0.000 -9.375 -0.450  
## BusinessFreedm 0.677 0.042 16.208 0.000 11.529 0.801  
## LaborFreedom 0.330 0.056 5.910 0.000 5.611 0.416  
## Market =~   
## MonetaryFreedm 1.000 3.654 0.530  
## InvestmentFrdm 4.835 0.660 7.325 0.000 17.666 0.864  
## FinancialFredm 4.589 0.618 7.421 0.000 16.767 0.908  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 13.470 7.904 1.704 0.088 13.470 0.192  
## Legal ~~   
## Market 49.181 8.802 5.588 0.000 0.791 0.791  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 58.062 1.322 43.920 0.000 58.062 3.311  
## .JudclEffctvnss 46.458 1.346 34.512 0.000 46.458 2.601  
## .GvrnmntIntgrty 44.917 1.581 28.418 0.000 44.917 2.142  
## .GovtSpending 67.367 1.571 42.890 0.000 67.367 3.233  
## .BusinessFreedm 64.739 1.085 59.678 0.000 64.739 4.498  
## .LaborFreedom 60.250 1.017 59.262 0.000 60.250 4.467  
## .MonetaryFreedm 75.896 0.519 146.156 0.000 75.896 11.017  
## .InvestmentFrdm 58.807 1.541 38.151 0.000 58.807 2.876  
## .FinancialFredm 49.602 1.393 35.619 0.000 49.602 2.685  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 17.786 5.656 3.145 0.002 17.786 0.058  
## .JudclEffctvnss 81.810 10.473 7.812 0.000 81.810 0.257  
## .GvrnmntIntgrty 60.111 9.816 6.124 0.000 60.111 0.137  
## .GovtSpending 346.309 37.262 9.294 0.000 346.309 0.798  
## .BusinessFreedm 74.198 8.505 8.724 0.000 74.198 0.358  
## .LaborFreedom 150.431 16.159 9.309 0.000 150.431 0.827  
## .MonetaryFreedm 34.110 3.795 8.987 0.000 34.110 0.719  
## .InvestmentFrdm 106.092 18.139 5.849 0.000 106.092 0.254  
## .FinancialFredm 60.200 14.157 4.252 0.000 60.200 0.176  
## Legal 289.813 33.166 8.738 0.000 1.000 1.000  
## Market 13.349 3.682 3.626 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.942  
## JudclEffctvnss 0.743  
## GvrnmntIntgrty 0.863  
## GovtSpending 0.202  
## BusinessFreedm 0.642  
## LaborFreedom 0.173  
## MonetaryFreedm 0.281  
## InvestmentFrdm 0.746  
## FinancialFredm 0.824

table\_fit[2, ] <- c("2020 Model", round(fitmeasures(model2020.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 91.682 | 25 | 0.97 | 0.087 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |

model2019.fit <- cfa(Model, data = data20202019[data20202019$Year == 2019,], meanstructure = T)  
summary(model2019.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 142 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 29  
##   
## Number of observations 176  
##   
## Model Test User Model:  
##   
## Test statistic 52.055  
## Degrees of freedom 25  
## P-value (Chi-square) 0.001  
##   
## Model Test Baseline Model:  
##   
## Test statistic 1173.997  
## Degrees of freedom 36  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.976  
## Tucker-Lewis Index (TLI) 0.966  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -6106.830  
## Loglikelihood unrestricted model (H1) -6080.803  
##   
## Akaike (AIC) 12271.661  
## Bayesian (BIC) 12363.605  
## Sample-size adjusted Bayesian (BIC) 12271.769  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.078  
## 90 Percent confidence interval - lower 0.048  
## 90 Percent confidence interval - upper 0.108  
## P-value RMSEA <= 0.05 0.061  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.039  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 18.359 0.980  
## JudclEffctvnss 0.794 0.045 17.740 0.000 14.569 0.835  
## GvrnmntIntgrty 0.932 0.045 20.539 0.000 17.103 0.878  
## GovtSpending -0.437 0.086 -5.109 0.000 -8.025 -0.367  
## BusinessFreedm 0.639 0.039 16.519 0.000 11.738 0.810  
## LaborFreedom 0.336 0.052 6.474 0.000 6.162 0.448  
## Market =~   
## MonetaryFreedm 1.000 4.455 0.598  
## InvestmentFrdm 4.055 0.474 8.561 0.000 18.067 0.872  
## FinancialFredm 3.845 0.442 8.700 0.000 17.132 0.911  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 49.170 9.613 5.115 0.000 49.170 0.548  
## Legal ~~   
## Market 63.920 10.553 6.057 0.000 0.781 0.781  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 53.769 1.412 38.074 0.000 53.769 2.870  
## .JudclEffctvnss 46.214 1.315 35.133 0.000 46.214 2.648  
## .GvrnmntIntgrty 42.607 1.469 29.011 0.000 42.607 2.187  
## .GovtSpending 65.232 1.650 39.530 0.000 65.232 2.980  
## .BusinessFreedm 64.859 1.093 59.342 0.000 64.859 4.473  
## .LaborFreedom 59.944 1.036 57.858 0.000 59.944 4.361  
## .MonetaryFreedm 76.266 0.562 135.717 0.000 76.266 10.230  
## .InvestmentFrdm 58.864 1.562 37.673 0.000 58.864 2.840  
## .FinancialFredm 49.375 1.417 34.835 0.000 49.375 2.626  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 13.946 7.514 1.856 0.063 13.946 0.040  
## .JudclEffctvnss 92.291 11.243 8.209 0.000 92.291 0.303  
## .GvrnmntIntgrty 87.093 11.524 7.557 0.000 87.093 0.229  
## .GovtSpending 414.869 44.453 9.333 0.000 414.869 0.866  
## .BusinessFreedm 72.471 8.467 8.559 0.000 72.471 0.345  
## .LaborFreedom 150.946 16.228 9.301 0.000 150.946 0.799  
## .MonetaryFreedm 35.729 4.038 8.848 0.000 35.729 0.643  
## .InvestmentFrdm 103.243 17.831 5.790 0.000 103.243 0.240  
## .FinancialFredm 60.089 13.993 4.294 0.000 60.089 0.170  
## Legal 337.069 38.107 8.845 0.000 1.000 1.000  
## Market 19.850 4.732 4.195 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.960  
## JudclEffctvnss 0.697  
## GvrnmntIntgrty 0.771  
## GovtSpending 0.134  
## BusinessFreedm 0.655  
## LaborFreedom 0.201  
## MonetaryFreedm 0.357  
## InvestmentFrdm 0.760  
## FinancialFredm 0.830

table\_fit[3, ] <- c("2019 Model", round(fitmeasures(model2019.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 91.682 | 25 | 0.97 | 0.087 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2019 Model | 52.055 | 25 | 0.976 | 0.078 | 0.039 |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |

Next is the configural model where it is stated that there are separate groups

configural.fit <- cfa(Model, data = data20202019, meanstructure = T, group = "Year")  
summary(configural.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 267 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 58  
##   
## Number of observations per group:   
## 2020 176  
## 2019 176  
##   
## Model Test User Model:  
##   
## Test statistic 110.172  
## Degrees of freedom 50  
## P-value (Chi-square) 0.000  
## Test statistic for each group:  
## 2020 58.117  
## 2019 52.055  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2354.398  
## Degrees of freedom 72  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.974  
## Tucker-Lewis Index (TLI) 0.962  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12186.138  
## Loglikelihood unrestricted model (H1) -12131.052  
##   
## Akaike (AIC) 24488.276  
## Bayesian (BIC) 24712.367  
## Sample-size adjusted Bayesian (BIC) 24528.368  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.083  
## 90 Percent confidence interval - lower 0.062  
## 90 Percent confidence interval - upper 0.104  
## P-value RMSEA <= 0.05 0.007  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.040  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
##   
## Group 1 [2020]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 17.024 0.971  
## JudclEffctvnss 0.905 0.047 19.348 0.000 15.398 0.862  
## GvrnmntIntgrty 1.144 0.045 25.342 0.000 19.483 0.929  
## GovtSpending -0.551 0.085 -6.495 0.000 -9.375 -0.450  
## BusinessFreedm 0.677 0.042 16.208 0.000 11.529 0.801  
## LaborFreedom 0.330 0.056 5.910 0.000 5.611 0.416  
## Market =~   
## MonetaryFreedm 1.000 3.654 0.530  
## InvestmentFrdm 4.835 0.660 7.325 0.000 17.666 0.864  
## FinancialFredm 4.589 0.618 7.421 0.000 16.767 0.908  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 13.470 7.904 1.704 0.088 13.470 0.192  
## Legal ~~   
## Market 49.181 8.802 5.588 0.000 0.791 0.791  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 58.062 1.322 43.920 0.000 58.062 3.311  
## .JudclEffctvnss 46.458 1.346 34.512 0.000 46.458 2.601  
## .GvrnmntIntgrty 44.917 1.581 28.418 0.000 44.917 2.142  
## .GovtSpending 67.367 1.571 42.890 0.000 67.367 3.233  
## .BusinessFreedm 64.739 1.085 59.678 0.000 64.739 4.498  
## .LaborFreedom 60.250 1.017 59.262 0.000 60.250 4.467  
## .MonetaryFreedm 75.896 0.519 146.156 0.000 75.896 11.017  
## .InvestmentFrdm 58.807 1.541 38.151 0.000 58.807 2.876  
## .FinancialFredm 49.602 1.393 35.619 0.000 49.602 2.685  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 17.786 5.656 3.145 0.002 17.786 0.058  
## .JudclEffctvnss 81.810 10.473 7.812 0.000 81.810 0.257  
## .GvrnmntIntgrty 60.111 9.816 6.124 0.000 60.111 0.137  
## .GovtSpending 346.309 37.262 9.294 0.000 346.309 0.798  
## .BusinessFreedm 74.198 8.505 8.724 0.000 74.198 0.358  
## .LaborFreedom 150.431 16.159 9.309 0.000 150.431 0.827  
## .MonetaryFreedm 34.110 3.795 8.987 0.000 34.110 0.719  
## .InvestmentFrdm 106.092 18.139 5.849 0.000 106.092 0.254  
## .FinancialFredm 60.200 14.157 4.252 0.000 60.200 0.176  
## Legal 289.813 33.166 8.738 0.000 1.000 1.000  
## Market 13.349 3.682 3.626 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.942  
## JudclEffctvnss 0.743  
## GvrnmntIntgrty 0.863  
## GovtSpending 0.202  
## BusinessFreedm 0.642  
## LaborFreedom 0.173  
## MonetaryFreedm 0.281  
## InvestmentFrdm 0.746  
## FinancialFredm 0.824  
##   
##   
## Group 2 [2019]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 18.359 0.980  
## JudclEffctvnss 0.794 0.045 17.740 0.000 14.569 0.835  
## GvrnmntIntgrty 0.932 0.045 20.539 0.000 17.103 0.878  
## GovtSpending -0.437 0.086 -5.109 0.000 -8.025 -0.367  
## BusinessFreedm 0.639 0.039 16.519 0.000 11.738 0.810  
## LaborFreedom 0.336 0.052 6.474 0.000 6.162 0.448  
## Market =~   
## MonetaryFreedm 1.000 4.455 0.598  
## InvestmentFrdm 4.055 0.474 8.561 0.000 18.067 0.872  
## FinancialFredm 3.845 0.442 8.700 0.000 17.132 0.911  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 49.170 9.613 5.115 0.000 49.170 0.548  
## Legal ~~   
## Market 63.920 10.553 6.057 0.000 0.781 0.781  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 53.769 1.412 38.074 0.000 53.769 2.870  
## .JudclEffctvnss 46.214 1.315 35.133 0.000 46.214 2.648  
## .GvrnmntIntgrty 42.607 1.469 29.011 0.000 42.607 2.187  
## .GovtSpending 65.232 1.650 39.530 0.000 65.232 2.980  
## .BusinessFreedm 64.859 1.093 59.342 0.000 64.859 4.473  
## .LaborFreedom 59.944 1.036 57.858 0.000 59.944 4.361  
## .MonetaryFreedm 76.266 0.562 135.717 0.000 76.266 10.230  
## .InvestmentFrdm 58.864 1.562 37.673 0.000 58.864 2.840  
## .FinancialFredm 49.375 1.417 34.835 0.000 49.375 2.626  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 13.946 7.514 1.856 0.063 13.946 0.040  
## .JudclEffctvnss 92.291 11.243 8.209 0.000 92.291 0.303  
## .GvrnmntIntgrty 87.093 11.524 7.557 0.000 87.093 0.229  
## .GovtSpending 414.869 44.453 9.333 0.000 414.869 0.866  
## .BusinessFreedm 72.471 8.467 8.559 0.000 72.471 0.345  
## .LaborFreedom 150.946 16.228 9.301 0.000 150.946 0.799  
## .MonetaryFreedm 35.729 4.038 8.848 0.000 35.729 0.643  
## .InvestmentFrdm 103.243 17.831 5.790 0.000 103.243 0.240  
## .FinancialFredm 60.088 13.993 4.294 0.000 60.088 0.170  
## Legal 337.069 38.107 8.845 0.000 1.000 1.000  
## Market 19.850 4.732 4.195 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.960  
## JudclEffctvnss 0.697  
## GvrnmntIntgrty 0.771  
## GovtSpending 0.134  
## BusinessFreedm 0.655  
## LaborFreedom 0.201  
## MonetaryFreedm 0.357  
## InvestmentFrdm 0.760  
## FinancialFredm 0.830

table\_fit[4, ] <- c("Configural Model", round(fitmeasures(configural.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 91.682 | 25 | 0.97 | 0.087 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2019 Model | 52.055 | 25 | 0.976 | 0.078 | 0.039 |
| Configural Model | 110.172 | 50 | 0.974 | 0.083 | 0.04 |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |

There is no drop in CFI (change of 0.01 is the cutoff), so the next model is the metric model where the loadings are set to equal.

metric.fit <- cfa(Model, data = data20202019, meanstructure = T, group = "Year",  
 group.equal = c("loadings"))  
summary(metric.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 240 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 58  
## Number of equality constraints 7  
##   
## Number of observations per group:   
## 2020 176  
## 2019 176  
##   
## Model Test User Model:  
##   
## Test statistic 122.309  
## Degrees of freedom 57  
## P-value (Chi-square) 0.000  
## Test statistic for each group:  
## 2020 63.882  
## 2019 58.427  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2354.398  
## Degrees of freedom 72  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.971  
## Tucker-Lewis Index (TLI) 0.964  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12192.207  
## Loglikelihood unrestricted model (H1) -12131.052  
##   
## Akaike (AIC) 24486.414  
## Bayesian (BIC) 24683.459  
## Sample-size adjusted Bayesian (BIC) 24521.667  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.081  
## 90 Percent confidence interval - lower 0.061  
## 90 Percent confidence interval - upper 0.100  
## P-value RMSEA <= 0.05 0.007  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.052  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
##   
## Group 1 [2020]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.389 0.981  
## JdclEff (.p2.) 0.864 0.032 26.803 0.000 15.017 0.852  
## GvrnmnI (.p3.) 1.043 0.032 32.249 0.000 18.131 0.908  
## GvtSpnd (.p4.) -0.492 0.061 -8.103 0.000 -8.552 -0.415  
## BsnssFr (.p5.) 0.663 0.029 23.214 0.000 11.523 0.799  
## LbrFrdm (.p6.) 0.337 0.038 8.824 0.000 5.861 0.431  
## Market =~   
## MntryFr 1.000 3.982 0.565  
## InvstmF (.p8.) 4.410 0.393 11.225 0.000 17.562 0.863  
## FnnclFr (.p9.) 4.181 0.367 11.386 0.000 16.649 0.904  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 19.436 7.875 2.468 0.014 19.436 0.251  
## Legal ~~   
## Market 54.665 8.240 6.634 0.000 0.789 0.789  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 58.062 1.337 43.435 0.000 58.062 3.274  
## .JudclEffctvnss 46.458 1.329 34.965 0.000 46.458 2.636  
## .GvrnmntIntgrty 44.917 1.506 29.829 0.000 44.917 2.248  
## .GovtSpending 67.367 1.552 43.417 0.000 67.367 3.273  
## .BusinessFreedm 64.739 1.087 59.574 0.000 64.739 4.491  
## .LaborFreedom 60.250 1.025 58.780 0.000 60.250 4.431  
## .MonetaryFreedm 75.896 0.531 142.815 0.000 75.896 10.765  
## .InvestmentFrdm 58.807 1.534 38.334 0.000 58.807 2.890  
## .FinancialFredm 49.602 1.389 35.712 0.000 49.602 2.692  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 12.138 5.546 2.189 0.029 12.138 0.039  
## .JudclEffctvnss 85.215 10.392 8.200 0.000 85.215 0.274  
## .GvrnmntIntgrty 70.351 9.818 7.165 0.000 70.351 0.176  
## .GovtSpending 350.601 37.606 9.323 0.000 350.601 0.827  
## .BusinessFreedm 75.058 8.535 8.794 0.000 75.058 0.361  
## .LaborFreedom 150.559 16.159 9.318 0.000 150.559 0.814  
## .MonetaryFreedm 33.848 3.792 8.926 0.000 33.848 0.681  
## .InvestmentFrdm 105.763 17.183 6.155 0.000 105.763 0.255  
## .FinancialFredm 62.336 13.259 4.701 0.000 62.336 0.184  
## Legal 302.364 33.696 8.973 0.000 1.000 1.000  
## Market 15.857 3.168 5.005 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.961  
## JudclEffctvnss 0.726  
## GvrnmntIntgrty 0.824  
## GovtSpending 0.173  
## BusinessFreedm 0.639  
## LaborFreedom 0.186  
## MonetaryFreedm 0.319  
## InvestmentFrdm 0.745  
## FinancialFredm 0.816  
##   
##   
## Group 2 [2019]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.804 0.967  
## JdclEff (.p2.) 0.864 0.032 26.803 0.000 15.376 0.853  
## GvrnmnI (.p3.) 1.043 0.032 32.249 0.000 18.564 0.899  
## GvtSpnd (.p4.) -0.492 0.061 -8.103 0.000 -8.756 -0.395  
## BsnssFr (.p5.) 0.663 0.029 23.214 0.000 11.799 0.815  
## LbrFrdm (.p6.) 0.337 0.038 8.824 0.000 6.001 0.440  
## Market =~   
## MntryFr 1.000 4.120 0.565  
## InvstmF (.p8.) 4.410 0.393 11.225 0.000 18.169 0.873  
## FnnclFr (.p9.) 4.181 0.367 11.386 0.000 17.225 0.914  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 44.605 9.594 4.649 0.000 44.605 0.524  
## Legal ~~   
## Market 57.240 8.705 6.576 0.000 0.780 0.780  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 53.769 1.387 38.761 0.000 53.769 2.922  
## .JudclEffctvnss 46.214 1.359 34.018 0.000 46.214 2.564  
## .GvrnmntIntgrty 42.607 1.557 27.367 0.000 42.607 2.063  
## .GovtSpending 65.232 1.671 39.029 0.000 65.232 2.942  
## .BusinessFreedm 64.859 1.091 59.437 0.000 64.859 4.480  
## .LaborFreedom 59.944 1.028 58.320 0.000 59.944 4.396  
## .MonetaryFreedm 76.266 0.550 138.749 0.000 76.266 10.459  
## .InvestmentFrdm 58.864 1.570 37.503 0.000 58.864 2.827  
## .FinancialFredm 49.375 1.421 34.753 0.000 49.375 2.620  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 21.692 6.941 3.125 0.002 21.692 0.064  
## .JudclEffctvnss 88.408 11.211 7.886 0.000 88.408 0.272  
## .GvrnmntIntgrty 81.968 11.622 7.053 0.000 81.968 0.192  
## .GovtSpending 414.993 44.595 9.306 0.000 414.993 0.844  
## .BusinessFreedm 70.366 8.307 8.471 0.000 70.366 0.336  
## .LaborFreedom 149.918 16.150 9.283 0.000 149.918 0.806  
## .MonetaryFreedm 36.203 4.042 8.957 0.000 36.203 0.681  
## .InvestmentFrdm 103.461 17.356 5.961 0.000 103.461 0.239  
## .FinancialFredm 58.545 13.418 4.363 0.000 58.545 0.165  
## Legal 316.988 36.012 8.802 0.000 1.000 1.000  
## Market 16.973 3.391 5.005 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.936  
## JudclEffctvnss 0.728  
## GvrnmntIntgrty 0.808  
## GovtSpending 0.156  
## BusinessFreedm 0.664  
## LaborFreedom 0.194  
## MonetaryFreedm 0.319  
## InvestmentFrdm 0.761  
## FinancialFredm 0.835

table\_fit[5, ] <- c("Metric Model", round(fitmeasures(metric.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 91.682 | 25 | 0.97 | 0.087 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2019 Model | 52.055 | 25 | 0.976 | 0.078 | 0.039 |
| Configural Model | 110.172 | 50 | 0.974 | 0.083 | 0.04 |
| Metric Model | 122.309 | 57 | 0.971 | 0.081 | 0.052 |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |

CFI still looks good, so the next model is the scalar model where the intercepts are set to be equal in addition to the loadings.

scalar.fit <- cfa(Model, data = data20202019, meanstructure = T, group = "Year",  
 group.equal = c("loadings", "intercepts"))  
summary(scalar.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 299 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 60  
## Number of equality constraints 16  
##   
## Number of observations per group:   
## 2020 176  
## 2019 176  
##   
## Model Test User Model:  
##   
## Test statistic 144.353  
## Degrees of freedom 64  
## P-value (Chi-square) 0.000  
## Test statistic for each group:  
## 2020 74.292  
## 2019 70.061  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2354.398  
## Degrees of freedom 72  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.965  
## Tucker-Lewis Index (TLI) 0.960  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12203.229  
## Loglikelihood unrestricted model (H1) -12131.052  
##   
## Akaike (AIC) 24494.457  
## Bayesian (BIC) 24664.457  
## Sample-size adjusted Bayesian (BIC) 24524.872  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.084  
## 90 Percent confidence interval - lower 0.066  
## 90 Percent confidence interval - upper 0.103  
## P-value RMSEA <= 0.05 0.002  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.055  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
##   
## Group 1 [2020]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.410 0.979  
## JdclEff (.p2.) 0.857 0.032 26.367 0.000 14.914 0.848  
## GvrnmnI (.p3.) 1.040 0.032 32.073 0.000 18.114 0.908  
## GvtSpnd (.p4.) -0.482 0.061 -7.942 0.000 -8.397 -0.408  
## BsnssFr (.p5.) 0.656 0.029 22.844 0.000 11.427 0.794  
## LbrFrdm (.p6.) 0.335 0.038 8.799 0.000 5.835 0.429  
## Market =~   
## MntryFr 1.000 3.981 0.565  
## InvstmF (.p8.) 4.411 0.393 11.217 0.000 17.562 0.863  
## FnnclFr (.p9.) 4.182 0.368 11.378 0.000 16.650 0.904  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 19.759 7.972 2.479 0.013 19.759 0.254  
## Legal ~~   
## Market 54.783 8.260 6.632 0.000 0.790 0.790  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR (.23.) 57.708 1.338 43.143 0.000 57.708 3.245  
## .JdclEff (.24.) 47.712 1.236 38.590 0.000 47.712 2.713  
## .GvrnmnI (.25.) 45.294 1.451 31.215 0.000 45.294 2.271  
## .GvtSpnd (.26.) 65.661 1.227 53.522 0.000 65.661 3.189  
## .BsnssFr (.27.) 65.920 0.985 66.907 0.000 65.920 4.582  
## .LbrFrdm (.28.) 60.651 0.793 76.506 0.000 60.651 4.463  
## .MntryFr (.29.) 76.077 0.441 172.354 0.000 76.077 10.787  
## .InvstmF (.30.) 58.848 1.470 40.023 0.000 58.848 2.891  
## .FnnclFr (.31.) 49.497 1.361 36.377 0.000 49.497 2.686  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 13.190 5.718 2.307 0.021 13.190 0.042  
## .JudclEffctvnss 86.883 10.606 8.192 0.000 86.883 0.281  
## .GvrnmntIntgrty 69.831 9.865 7.079 0.000 69.831 0.175  
## .GovtSpending 353.405 37.910 9.322 0.000 353.405 0.834  
## .BusinessFreedm 76.427 8.692 8.792 0.000 76.427 0.369  
## .LaborFreedom 150.672 16.176 9.314 0.000 150.672 0.816  
## .MonetaryFreedm 33.888 3.796 8.927 0.000 33.888 0.681  
## .InvestmentFrdm 105.812 17.187 6.156 0.000 105.812 0.255  
## .FinancialFredm 62.299 13.257 4.699 0.000 62.299 0.183  
## Legal 303.121 33.877 8.948 0.000 1.000 1.000  
## Market 15.851 3.169 5.002 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.958  
## JudclEffctvnss 0.719  
## GvrnmntIntgrty 0.825  
## GovtSpending 0.166  
## BusinessFreedm 0.631  
## LaborFreedom 0.184  
## MonetaryFreedm 0.319  
## InvestmentFrdm 0.745  
## FinancialFredm 0.817  
##   
##   
## Group 2 [2019]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.796 0.965  
## JdclEff (.p2.) 0.857 0.032 26.367 0.000 15.245 0.849  
## GvrnmnI (.p3.) 1.040 0.032 32.073 0.000 18.515 0.899  
## GvtSpnd (.p4.) -0.482 0.061 -7.942 0.000 -8.583 -0.387  
## BsnssFr (.p5.) 0.656 0.029 22.844 0.000 11.681 0.810  
## LbrFrdm (.p6.) 0.335 0.038 8.799 0.000 5.964 0.438  
## Market =~   
## MntryFr 1.000 4.119 0.565  
## InvstmF (.p8.) 4.411 0.393 11.217 0.000 18.169 0.873  
## FnnclFr (.p9.) 4.182 0.368 11.378 0.000 17.225 0.914  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 45.091 9.733 4.633 0.000 45.091 0.526  
## Legal ~~   
## Market 57.221 8.710 6.570 0.000 0.781 0.781  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR (.23.) 57.708 1.338 43.143 0.000 57.708 3.128  
## .JdclEff (.24.) 47.712 1.236 38.590 0.000 47.712 2.657  
## .GvrnmnI (.25.) 45.294 1.451 31.215 0.000 45.294 2.198  
## .GvtSpnd (.26.) 65.661 1.227 53.522 0.000 65.661 2.959  
## .BsnssFr (.27.) 65.920 0.985 66.907 0.000 65.920 4.570  
## .LbrFrdm (.28.) 60.651 0.793 76.506 0.000 60.651 4.452  
## .MntryFr (.29.) 76.077 0.441 172.354 0.000 76.077 10.429  
## .InvstmF (.30.) 58.848 1.470 40.023 0.000 58.848 2.826  
## .FnnclFr (.31.) 49.497 1.361 36.377 0.000 49.497 2.626  
## Legal -3.304 1.915 -1.725 0.084 -0.186 -0.186  
## Market -0.006 0.457 -0.012 0.990 -0.001 -0.001  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 23.566 7.199 3.274 0.001 23.566 0.069  
## .JudclEffctvnss 89.981 11.433 7.870 0.000 89.981 0.279  
## .GvrnmntIntgrty 81.697 11.719 6.971 0.000 81.697 0.192  
## .GovtSpending 418.905 45.018 9.305 0.000 418.905 0.850  
## .BusinessFreedm 71.642 8.461 8.467 0.000 71.642 0.344  
## .LaborFreedom 150.001 16.167 9.278 0.000 150.001 0.808  
## .MonetaryFreedm 36.245 4.046 8.957 0.000 36.245 0.681  
## .InvestmentFrdm 103.394 17.366 5.954 0.000 103.394 0.239  
## .FinancialFredm 58.610 13.437 4.362 0.000 58.610 0.165  
## Legal 316.701 36.127 8.766 0.000 1.000 1.000  
## Market 16.965 3.392 5.002 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.931  
## JudclEffctvnss 0.721  
## GvrnmntIntgrty 0.808  
## GovtSpending 0.150  
## BusinessFreedm 0.656  
## LaborFreedom 0.192  
## MonetaryFreedm 0.319  
## InvestmentFrdm 0.761  
## FinancialFredm 0.835

table\_fit[6, ] <- c("Scalar Model", round(fitmeasures(scalar.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 91.682 | 25 | 0.97 | 0.087 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2019 Model | 52.055 | 25 | 0.976 | 0.078 | 0.039 |
| Configural Model | 110.172 | 50 | 0.974 | 0.083 | 0.04 |
| Metric Model | 122.309 | 57 | 0.971 | 0.081 | 0.052 |
| Scalar Model | 144.353 | 64 | 0.965 | 0.084 | 0.055 |
| NA | NA | NA | NA | NA | NA |

There is a drop in CFI, but not more than the threshold of 0.01. The strict model can now be run which sets the residuals equal in addition to the loadings and intercepts.

strict.fit <- cfa(Model, data = data20202019, meanstructure = T, group = "Year",  
 group.equal = c("loadings", "intercepts", "residuals"))  
summary(strict.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 196 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 60  
## Number of equality constraints 25  
##   
## Number of observations per group:   
## 2020 176  
## 2019 176  
##   
## Model Test User Model:  
##   
## Test statistic 149.010  
## Degrees of freedom 73  
## P-value (Chi-square) 0.000  
## Test statistic for each group:  
## 2020 79.639  
## 2019 69.371  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2354.398  
## Degrees of freedom 72  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.967  
## Tucker-Lewis Index (TLI) 0.967  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12205.557  
## Loglikelihood unrestricted model (H1) -12131.052  
##   
## Akaike (AIC) 24481.114  
## Bayesian (BIC) 24616.341  
## Sample-size adjusted Bayesian (BIC) 24505.307  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.077  
## 90 Percent confidence interval - lower 0.059  
## 90 Percent confidence interval - upper 0.095  
## P-value RMSEA <= 0.05 0.008  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.056  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
##   
## Group 1 [2020]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.440 0.974  
## JdclEff (.p2.) 0.847 0.032 26.239 0.000 14.776 0.843  
## GvrnmnI (.p3.) 1.026 0.032 31.797 0.000 17.894 0.898  
## GvtSpnd (.p4.) -0.477 0.060 -7.895 0.000 -8.311 -0.390  
## BsnssFr (.p5.) 0.650 0.028 22.838 0.000 11.344 0.796  
## LbrFrdm (.p6.) 0.331 0.038 8.771 0.000 5.781 0.426  
## Market =~   
## MntryFr 1.000 3.996 0.559  
## InvstmF (.p8.) 4.401 0.391 11.244 0.000 17.587 0.864  
## FnnclFr (.p9.) 4.173 0.366 11.407 0.000 16.675 0.906  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 22.282 7.482 2.978 0.003 22.282 0.270  
## Legal ~~   
## Market 55.077 8.316 6.623 0.000 0.790 0.790  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR (.23.) 57.610 1.345 42.818 0.000 57.610 3.216  
## .JdclEff (.24.) 47.755 1.228 38.883 0.000 47.755 2.726  
## .GvrnmnI (.25.) 45.353 1.438 31.534 0.000 45.353 2.275  
## .GvtSpnd (.26.) 65.492 1.227 53.355 0.000 65.492 3.071  
## .BsnssFr (.27.) 65.901 0.979 67.284 0.000 65.901 4.623  
## .LbrFrdm (.28.) 60.658 0.791 76.699 0.000 60.658 4.472  
## .MntryFr (.29.) 76.084 0.443 171.851 0.000 76.084 10.650  
## .InvstmF (.30.) 58.847 1.471 40.003 0.000 58.847 2.893  
## .FnnclFr (.31.) 49.500 1.360 36.394 0.000 49.500 2.691  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR (.11.) 16.755 4.792 3.496 0.000 16.755 0.052  
## .JdclEff (.12.) 88.581 7.794 11.366 0.000 88.581 0.289  
## .GvrnmnI (.13.) 77.061 7.768 9.920 0.000 77.061 0.194  
## .GvtSpnd (.14.) 385.849 29.287 13.175 0.000 385.849 0.848  
## .BsnssFr (.15.) 74.486 6.099 12.213 0.000 74.486 0.367  
## .LbrFrdm (.16.) 150.599 11.451 13.152 0.000 150.599 0.818  
## .MntryFr (.17.) 35.063 2.780 12.612 0.000 35.063 0.687  
## .InvstmF (.18.) 104.583 12.746 8.205 0.000 104.583 0.253  
## .FnnclFr (.19.) 60.365 9.986 6.045 0.000 60.365 0.178  
## Legal 304.155 34.229 8.886 0.000 1.000 1.000  
## Market 15.970 3.187 5.012 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.948  
## JudclEffctvnss 0.711  
## GvrnmntIntgrty 0.806  
## GovtSpending 0.152  
## BusinessFreedm 0.633  
## LaborFreedom 0.182  
## MonetaryFreedm 0.313  
## InvestmentFrdm 0.747  
## FinancialFredm 0.822  
##   
##   
## Group 2 [2019]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 18.012 0.975  
## JdclEff (.p2.) 0.847 0.032 26.239 0.000 15.261 0.851  
## GvrnmnI (.p3.) 1.026 0.032 31.797 0.000 18.481 0.903  
## GvtSpnd (.p4.) -0.477 0.060 -7.895 0.000 -8.584 -0.400  
## BsnssFr (.p5.) 0.650 0.028 22.838 0.000 11.716 0.805  
## LbrFrdm (.p6.) 0.331 0.038 8.771 0.000 5.970 0.437  
## Market =~   
## MntryFr 1.000 4.124 0.572  
## InvstmF (.p8.) 4.401 0.391 11.244 0.000 18.149 0.871  
## FnnclFr (.p9.) 4.173 0.366 11.407 0.000 17.209 0.911  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 42.842 7.043 6.083 0.000 42.842 0.519  
## Legal ~~   
## Market 58.013 8.790 6.600 0.000 0.781 0.781  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR (.23.) 57.610 1.345 42.818 0.000 57.610 3.119  
## .JdclEff (.24.) 47.755 1.228 38.883 0.000 47.755 2.664  
## .GvrnmnI (.25.) 45.353 1.438 31.534 0.000 45.353 2.217  
## .GvtSpnd (.26.) 65.492 1.227 53.355 0.000 65.492 3.055  
## .BsnssFr (.27.) 65.901 0.979 67.284 0.000 65.901 4.529  
## .LbrFrdm (.28.) 60.658 0.791 76.699 0.000 60.658 4.445  
## .MntryFr (.29.) 76.084 0.443 171.851 0.000 76.084 10.544  
## .InvstmF (.30.) 58.847 1.471 40.003 0.000 58.847 2.825  
## .FnnclFr (.31.) 49.500 1.360 36.394 0.000 49.500 2.622  
## Legal -3.388 1.926 -1.759 0.079 -0.188 -0.188  
## Market -0.006 0.458 -0.012 0.990 -0.001 -0.001  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR (.11.) 16.755 4.792 3.496 0.000 16.755 0.049  
## .JdclEff (.12.) 88.581 7.794 11.366 0.000 88.581 0.276  
## .GvrnmnI (.13.) 77.061 7.768 9.920 0.000 77.061 0.184  
## .GvtSpnd (.14.) 385.849 29.287 13.175 0.000 385.849 0.840  
## .BsnssFr (.15.) 74.486 6.099 12.213 0.000 74.486 0.352  
## .LbrFrdm (.16.) 150.599 11.451 13.152 0.000 150.599 0.809  
## .MntryFr (.17.) 35.063 2.780 12.612 0.000 35.063 0.673  
## .InvstmF (.18.) 104.583 12.746 8.205 0.000 104.583 0.241  
## .FnnclFr (.19.) 60.365 9.986 6.045 0.000 60.365 0.169  
## Legal 324.427 36.408 8.911 0.000 1.000 1.000  
## Market 17.008 3.386 5.023 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.951  
## JudclEffctvnss 0.724  
## GvrnmntIntgrty 0.816  
## GovtSpending 0.160  
## BusinessFreedm 0.648  
## LaborFreedom 0.191  
## MonetaryFreedm 0.327  
## InvestmentFrdm 0.759  
## FinancialFredm 0.831

table\_fit[7, ] <- c("Strict Model", round(fitmeasures(strict.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 91.682 | 25 | 0.97 | 0.087 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2019 Model | 52.055 | 25 | 0.976 | 0.078 | 0.039 |
| Configural Model | 110.172 | 50 | 0.974 | 0.083 | 0.04 |
| Metric Model | 122.309 | 57 | 0.971 | 0.081 | 0.052 |
| Scalar Model | 144.353 | 64 | 0.965 | 0.084 | 0.055 |
| Strict Model | 149.01 | 73 | 0.967 | 0.077 | 0.056 |

Overall, there is very little change in CFI, so it can be said that there is complete invariance!

### Latent Means - 2020 and 2019

Next, is to check if the latent means between the groups are different.

data20202019$sum <- apply(data20202019[, c(4, 5, 6, 7, 10, 12, 14, 15)], 1, sum)  
tapply(data20202019$sum, data20202019$Year, mean)

## 2019 2020   
## 469.5068 476.4795

latent\_means <- lavPredict(strict.fit)  
  
table(data20202019$Year)

##   
## 2019 2020   
## 176 176

latent\_means <- as.data.frame(do.call(rbind, latent\_means))  
latent\_means$Year <- c(rep("2019", 176), rep("2020", 176))  
  
options(scipen = 999)  
tapply(latent\_means$Legal, latent\_means$Year, mean)

## 2019 2020   
## 0.000003990794 -3.387786427818

tapply(latent\_means$Market, latent\_means$Year, mean)

## 2019 2020   
## 0.000001544202 -0.005514832864

tapply(latent\_means$Legal, latent\_means$Year, mean) \* #latent mean  
 tapply(data20202019$sum, data20202019$Year, sd, na.rm = T) + #real sum  
 tapply(data20202019$sum, data20202019$Year, mean, na.rm = T)

## 2019 2020   
## 469.5072 151.3524

tapply(latent\_means$Market, latent\_means$Year, mean) \* #latent mean  
 tapply(data20202019$sum, data20202019$Year, sd, na.rm = T) + #real sum  
 tapply(data20202019$sum, data20202019$Year, mean, na.rm = T)

## 2019 2020   
## 469.5070 475.9503

M <- tapply(latent\_means$Market, latent\_means$Year, mean)  
SD <- tapply(latent\_means$Market, latent\_means$Year, sd)  
N <- tapply(latent\_means$Market, latent\_means$Year, length)  
  
effect\_size <- d.ind.t(M[1], M[2], SD[1], SD[2], N[1], N[2], a = .05)  
effect\_size$estimate

## [1] "$d\_s$ = 0.00, 95\\% CI [-0.21, 0.21]"

effect\_size$statistic

## [1] "$t$(350) = 0.01, $p$ = .989"

M <- tapply(latent\_means$Legal, latent\_means$Year, mean)  
SD <- tapply(latent\_means$Legal, latent\_means$Year, sd)  
N <- tapply(latent\_means$Legal, latent\_means$Year, length)  
  
effect\_size <- d.ind.t(M[1], M[2], SD[1], SD[2], N[1], N[2], a = .05)  
effect\_size$estimate

## [1] "$d\_s$ = 0.19, 95\\% CI [-0.02, 0.40]"

effect\_size$statistic

## [1] "$t$(350) = 1.82, $p$ = .070"

Using a cutoff for d of 0.20, there are not significant differences between the groups.

### MGCFA 2020-2017 Data

The second model is to compare 2020 to 2017. The same steps and models will be used as above

data20202017 <- data3[data3$Year == 2017 | data3$Year == 2020,]  
Model <- "  
Legal =~ PropertyRights + JudicalEffectiveness + GovernmentIntegrity + GovtSpending + BusinessFreedom + LaborFreedom  
Market =~ MonetaryFreedom + InvestmentFreedom + FinancialFreedom  
JudicalEffectiveness ~~ GovernmentIntegrity  
"  
Overall.fit <- cfa(Model, data = data20202017, meanstructure = T)  
summary(Overall.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 143 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 29  
##   
## Number of observations 351  
##   
## Model Test User Model:  
##   
## Test statistic 83.775  
## Degrees of freedom 25  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2183.936  
## Degrees of freedom 36  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.973  
## Tucker-Lewis Index (TLI) 0.961  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12254.129  
## Loglikelihood unrestricted model (H1) -12212.241  
##   
## Akaike (AIC) 24566.258  
## Bayesian (BIC) 24678.221  
## Sample-size adjusted Bayesian (BIC) 24586.222  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.082  
## 90 Percent confidence interval - lower 0.063  
## 90 Percent confidence interval - upper 0.102  
## P-value RMSEA <= 0.05 0.004  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.037  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 17.669 0.955  
## JudclEffctvnss 0.921 0.036 25.362 0.000 16.270 0.856  
## GvrnmntIntgrty 1.021 0.032 31.511 0.000 18.040 0.919  
## GovtSpending -0.516 0.062 -8.308 0.000 -9.122 -0.418  
## BusinessFreedm 0.640 0.029 21.949 0.000 11.311 0.799  
## LaborFreedom 0.310 0.039 8.025 0.000 5.482 0.406  
## Market =~   
## MonetaryFreedm 1.000 4.287 0.584  
## InvestmentFrdm 4.171 0.363 11.492 0.000 17.881 0.849  
## FinancialFredm 3.903 0.332 11.752 0.000 16.731 0.906  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 13.199 6.239 2.116 0.034 13.199 0.174  
## Legal ~~   
## Market 59.209 7.112 8.325 0.000 0.782 0.782  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 55.977 0.987 56.698 0.000 55.977 3.026  
## .JudclEffctvnss 46.237 1.014 45.600 0.000 46.237 2.434  
## .GvrnmntIntgrty 44.222 1.048 42.205 0.000 44.222 2.253  
## .GovtSpending 65.699 1.165 56.380 0.000 65.699 3.009  
## .BusinessFreedm 65.112 0.756 86.125 0.000 65.112 4.597  
## .LaborFreedom 60.154 0.721 83.410 0.000 60.154 4.452  
## .MonetaryFreedm 76.568 0.392 195.506 0.000 76.568 10.435  
## .InvestmentFrdm 58.661 1.125 52.161 0.000 58.661 2.784  
## .FinancialFredm 49.430 0.986 50.151 0.000 49.430 2.677  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 29.922 5.298 5.648 0.000 29.922 0.087  
## .JudclEffctvnss 96.155 9.078 10.592 0.000 96.155 0.266  
## .GvrnmntIntgrty 59.895 7.048 8.498 0.000 59.895 0.155  
## .GovtSpending 393.414 30.003 13.112 0.000 393.414 0.825  
## .BusinessFreedm 72.681 6.019 12.076 0.000 72.681 0.362  
## .LaborFreedom 152.507 11.622 13.122 0.000 152.507 0.835  
## .MonetaryFreedm 35.458 2.844 12.466 0.000 35.458 0.659  
## .InvestmentFrdm 124.215 14.326 8.671 0.000 124.215 0.280  
## .FinancialFredm 61.052 10.371 5.887 0.000 61.052 0.179  
## Legal 312.209 26.169 11.930 0.000 1.000 1.000  
## Market 18.380 3.206 5.733 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.913  
## JudclEffctvnss 0.734  
## GvrnmntIntgrty 0.845  
## GovtSpending 0.175  
## BusinessFreedm 0.638  
## LaborFreedom 0.165  
## MonetaryFreedm 0.341  
## InvestmentFrdm 0.720  
## FinancialFredm 0.821

table\_fit <- matrix(NA, nrow = 8, ncol = 6)  
colnames(table\_fit) = c("Model", "X2", "df", "CFI", "RMSEA", "SRMR")  
table\_fit[1, ] <- c("Overall Model", round(fitmeasures(Overall.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 83.775 | 25 | 0.973 | 0.082 | 0.037 |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |

Next, is the individual 2017 and 2020 models

model2020.fit <- cfa(Model, data = data20202017[data20202017$Year == 2020,], meanstructure = T)  
summary(model2020.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 163 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 29  
##   
## Number of observations 176  
##   
## Model Test User Model:  
##   
## Test statistic 58.117  
## Degrees of freedom 25  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 1180.401  
## Degrees of freedom 36  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.971  
## Tucker-Lewis Index (TLI) 0.958  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -6079.308  
## Loglikelihood unrestricted model (H1) -6050.249  
##   
## Akaike (AIC) 12216.615  
## Bayesian (BIC) 12308.559  
## Sample-size adjusted Bayesian (BIC) 12216.723  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.087  
## 90 Percent confidence interval - lower 0.058  
## 90 Percent confidence interval - upper 0.116  
## P-value RMSEA <= 0.05 0.021  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.041  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 17.024 0.971  
## JudclEffctvnss 0.905 0.047 19.348 0.000 15.398 0.862  
## GvrnmntIntgrty 1.144 0.045 25.342 0.000 19.483 0.929  
## GovtSpending -0.551 0.085 -6.495 0.000 -9.375 -0.450  
## BusinessFreedm 0.677 0.042 16.208 0.000 11.529 0.801  
## LaborFreedom 0.330 0.056 5.910 0.000 5.611 0.416  
## Market =~   
## MonetaryFreedm 1.000 3.654 0.530  
## InvestmentFrdm 4.835 0.660 7.325 0.000 17.666 0.864  
## FinancialFredm 4.589 0.618 7.421 0.000 16.767 0.908  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 13.470 7.904 1.704 0.088 13.470 0.192  
## Legal ~~   
## Market 49.181 8.802 5.588 0.000 0.791 0.791  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 58.062 1.322 43.920 0.000 58.062 3.311  
## .JudclEffctvnss 46.458 1.346 34.512 0.000 46.458 2.601  
## .GvrnmntIntgrty 44.917 1.581 28.418 0.000 44.917 2.142  
## .GovtSpending 67.367 1.571 42.890 0.000 67.367 3.233  
## .BusinessFreedm 64.739 1.085 59.678 0.000 64.739 4.498  
## .LaborFreedom 60.250 1.017 59.262 0.000 60.250 4.467  
## .MonetaryFreedm 75.896 0.519 146.156 0.000 75.896 11.017  
## .InvestmentFrdm 58.807 1.541 38.151 0.000 58.807 2.876  
## .FinancialFredm 49.602 1.393 35.619 0.000 49.602 2.685  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 17.786 5.656 3.145 0.002 17.786 0.058  
## .JudclEffctvnss 81.810 10.473 7.812 0.000 81.810 0.257  
## .GvrnmntIntgrty 60.111 9.816 6.124 0.000 60.111 0.137  
## .GovtSpending 346.309 37.262 9.294 0.000 346.309 0.798  
## .BusinessFreedm 74.198 8.505 8.724 0.000 74.198 0.358  
## .LaborFreedom 150.431 16.159 9.309 0.000 150.431 0.827  
## .MonetaryFreedm 34.110 3.795 8.987 0.000 34.110 0.719  
## .InvestmentFrdm 106.092 18.139 5.849 0.000 106.092 0.254  
## .FinancialFredm 60.200 14.157 4.252 0.000 60.200 0.176  
## Legal 289.813 33.166 8.738 0.000 1.000 1.000  
## Market 13.349 3.682 3.626 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.942  
## JudclEffctvnss 0.743  
## GvrnmntIntgrty 0.863  
## GovtSpending 0.202  
## BusinessFreedm 0.642  
## LaborFreedom 0.173  
## MonetaryFreedm 0.281  
## InvestmentFrdm 0.746  
## FinancialFredm 0.824

table\_fit[2, ] <- c("2020 Model", round(fitmeasures(model2020.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
  
model2017.fit <- cfa(Model, data = data20202017[data20202017$Year == 2017,], meanstructure = T)  
summary(model2017.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 135 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 29  
##   
## Number of observations 175  
##   
## Model Test User Model:  
##   
## Test statistic 43.329  
## Degrees of freedom 25  
## P-value (Chi-square) 0.013  
##   
## Model Test Baseline Model:  
##   
## Test statistic 1076.550  
## Degrees of freedom 36  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.982  
## Tucker-Lewis Index (TLI) 0.975  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -6136.144  
## Loglikelihood unrestricted model (H1) -6114.480  
##   
## Akaike (AIC) 12330.289  
## Bayesian (BIC) 12422.067  
## Sample-size adjusted Bayesian (BIC) 12330.233  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.065  
## 90 Percent confidence interval - lower 0.030  
## 90 Percent confidence interval - upper 0.096  
## P-value RMSEA <= 0.05 0.211  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.038  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 18.353 0.957  
## JudclEffctvnss 0.929 0.053 17.501 0.000 17.054 0.850  
## GvrnmntIntgrty 0.898 0.042 21.231 0.000 16.477 0.907  
## GovtSpending -0.491 0.089 -5.529 0.000 -9.012 -0.398  
## BusinessFreedm 0.609 0.039 15.600 0.000 11.168 0.802  
## LaborFreedom 0.291 0.053 5.477 0.000 5.338 0.394  
## Market =~   
## MonetaryFreedm 1.000 4.970 0.645  
## InvestmentFrdm 3.656 0.403 9.072 0.000 18.168 0.838  
## FinancialFredm 3.342 0.356 9.377 0.000 16.608 0.900  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 18.625 9.155 2.034 0.042 18.625 0.230  
## Legal ~~   
## Market 70.751 11.370 6.222 0.000 0.776 0.776  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 53.879 1.450 37.150 0.000 53.879 2.808  
## .JudclEffctvnss 46.015 1.517 30.323 0.000 46.015 2.292  
## .GvrnmntIntgrty 43.522 1.373 31.707 0.000 43.522 2.397  
## .GovtSpending 64.021 1.713 37.368 0.000 64.021 2.825  
## .BusinessFreedm 65.487 1.052 62.230 0.000 65.487 4.704  
## .LaborFreedom 60.056 1.023 58.701 0.000 60.056 4.437  
## .MonetaryFreedm 77.245 0.582 132.650 0.000 77.245 10.027  
## .InvestmentFrdm 58.514 1.638 35.713 0.000 58.514 2.700  
## .FinancialFredm 49.257 1.395 35.308 0.000 49.257 2.669  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 31.256 8.370 3.734 0.000 31.256 0.085  
## .JudclEffctvnss 112.133 14.805 7.574 0.000 112.133 0.278  
## .GvrnmntIntgrty 58.239 9.169 6.352 0.000 58.239 0.177  
## .GovtSpending 432.453 46.671 9.266 0.000 432.453 0.842  
## .BusinessFreedm 69.068 8.170 8.454 0.000 69.068 0.356  
## .LaborFreedom 154.684 16.691 9.268 0.000 154.684 0.844  
## .MonetaryFreedm 34.644 4.051 8.553 0.000 34.644 0.584  
## .InvestmentFrdm 139.712 22.025 6.343 0.000 139.712 0.297  
## .FinancialFredm 64.757 14.842 4.363 0.000 64.757 0.190  
## Legal 336.827 39.952 8.431 0.000 1.000 1.000  
## Market 24.697 5.405 4.569 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.915  
## JudclEffctvnss 0.722  
## GvrnmntIntgrty 0.823  
## GovtSpending 0.158  
## BusinessFreedm 0.644  
## LaborFreedom 0.156  
## MonetaryFreedm 0.416  
## InvestmentFrdm 0.703  
## FinancialFredm 0.810

table\_fit[3, ] <- c("2017 Model", round(fitmeasures(model2017.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 83.775 | 25 | 0.973 | 0.082 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2017 Model | 43.329 | 25 | 0.982 | 0.065 | 0.038 |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |

The 2017 model has a higher CFI, which should be noted, but overall everything is okay. Next is the configural model where it is stated that there are separate groups.

configural.fit <- cfa(Model, data = data20202017, meanstructure = T, group = "Year")  
summary(configural.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 267 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 58  
##   
## Number of observations per group:   
## 2020 176  
## 2017 175  
##   
## Model Test User Model:  
##   
## Test statistic 101.446  
## Degrees of freedom 50  
## P-value (Chi-square) 0.000  
## Test statistic for each group:  
## 2020 58.117  
## 2017 43.329  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2256.951  
## Degrees of freedom 72  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.976  
## Tucker-Lewis Index (TLI) 0.966  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12215.452  
## Loglikelihood unrestricted model (H1) -12164.729  
##   
## Akaike (AIC) 24546.904  
## Bayesian (BIC) 24770.829  
## Sample-size adjusted Bayesian (BIC) 24586.832  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.077  
## 90 Percent confidence interval - lower 0.055  
## 90 Percent confidence interval - upper 0.098  
## P-value RMSEA <= 0.05 0.024  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.040  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
##   
## Group 1 [2020]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 17.024 0.971  
## JudclEffctvnss 0.905 0.047 19.348 0.000 15.398 0.862  
## GvrnmntIntgrty 1.144 0.045 25.342 0.000 19.483 0.929  
## GovtSpending -0.551 0.085 -6.495 0.000 -9.375 -0.450  
## BusinessFreedm 0.677 0.042 16.208 0.000 11.529 0.801  
## LaborFreedom 0.330 0.056 5.910 0.000 5.611 0.416  
## Market =~   
## MonetaryFreedm 1.000 3.654 0.530  
## InvestmentFrdm 4.835 0.660 7.325 0.000 17.666 0.864  
## FinancialFredm 4.589 0.618 7.421 0.000 16.767 0.908  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 13.470 7.904 1.704 0.088 13.470 0.192  
## Legal ~~   
## Market 49.181 8.802 5.588 0.000 0.791 0.791  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 58.062 1.322 43.920 0.000 58.062 3.311  
## .JudclEffctvnss 46.458 1.346 34.512 0.000 46.458 2.601  
## .GvrnmntIntgrty 44.917 1.581 28.418 0.000 44.917 2.142  
## .GovtSpending 67.367 1.571 42.890 0.000 67.367 3.233  
## .BusinessFreedm 64.739 1.085 59.678 0.000 64.739 4.498  
## .LaborFreedom 60.250 1.017 59.262 0.000 60.250 4.467  
## .MonetaryFreedm 75.896 0.519 146.156 0.000 75.896 11.017  
## .InvestmentFrdm 58.807 1.541 38.151 0.000 58.807 2.876  
## .FinancialFredm 49.602 1.393 35.619 0.000 49.602 2.685  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 17.786 5.656 3.145 0.002 17.786 0.058  
## .JudclEffctvnss 81.810 10.473 7.812 0.000 81.810 0.257  
## .GvrnmntIntgrty 60.111 9.816 6.124 0.000 60.111 0.137  
## .GovtSpending 346.309 37.262 9.294 0.000 346.309 0.798  
## .BusinessFreedm 74.198 8.505 8.724 0.000 74.198 0.358  
## .LaborFreedom 150.431 16.159 9.309 0.000 150.431 0.827  
## .MonetaryFreedm 34.110 3.795 8.987 0.000 34.110 0.719  
## .InvestmentFrdm 106.092 18.139 5.849 0.000 106.092 0.254  
## .FinancialFredm 60.200 14.157 4.252 0.000 60.200 0.176  
## Legal 289.813 33.166 8.738 0.000 1.000 1.000  
## Market 13.349 3.682 3.626 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.942  
## JudclEffctvnss 0.743  
## GvrnmntIntgrty 0.863  
## GovtSpending 0.202  
## BusinessFreedm 0.642  
## LaborFreedom 0.173  
## MonetaryFreedm 0.281  
## InvestmentFrdm 0.746  
## FinancialFredm 0.824  
##   
##   
## Group 2 [2017]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PropertyRights 1.000 18.353 0.957  
## JudclEffctvnss 0.929 0.053 17.501 0.000 17.054 0.850  
## GvrnmntIntgrty 0.898 0.042 21.231 0.000 16.477 0.907  
## GovtSpending -0.491 0.089 -5.529 0.000 -9.012 -0.398  
## BusinessFreedm 0.609 0.039 15.600 0.000 11.168 0.802  
## LaborFreedom 0.291 0.053 5.477 0.000 5.338 0.394  
## Market =~   
## MonetaryFreedm 1.000 4.970 0.645  
## InvestmentFrdm 3.656 0.403 9.072 0.000 18.168 0.838  
## FinancialFredm 3.342 0.356 9.377 0.000 16.608 0.900  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 18.625 9.155 2.034 0.042 18.625 0.230  
## Legal ~~   
## Market 70.751 11.370 6.222 0.000 0.776 0.776  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 53.879 1.450 37.150 0.000 53.879 2.808  
## .JudclEffctvnss 46.015 1.517 30.323 0.000 46.015 2.292  
## .GvrnmntIntgrty 43.522 1.373 31.707 0.000 43.522 2.397  
## .GovtSpending 64.021 1.713 37.368 0.000 64.021 2.825  
## .BusinessFreedm 65.487 1.052 62.230 0.000 65.487 4.704  
## .LaborFreedom 60.056 1.023 58.701 0.000 60.056 4.437  
## .MonetaryFreedm 77.245 0.582 132.650 0.000 77.245 10.027  
## .InvestmentFrdm 58.514 1.638 35.713 0.000 58.514 2.700  
## .FinancialFredm 49.257 1.395 35.308 0.000 49.257 2.669  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 31.256 8.370 3.734 0.000 31.256 0.085  
## .JudclEffctvnss 112.133 14.805 7.574 0.000 112.133 0.278  
## .GvrnmntIntgrty 58.239 9.169 6.352 0.000 58.239 0.177  
## .GovtSpending 432.453 46.671 9.266 0.000 432.453 0.842  
## .BusinessFreedm 69.068 8.170 8.454 0.000 69.068 0.356  
## .LaborFreedom 154.684 16.691 9.268 0.000 154.684 0.844  
## .MonetaryFreedm 34.644 4.051 8.553 0.000 34.644 0.584  
## .InvestmentFrdm 139.712 22.025 6.343 0.000 139.712 0.297  
## .FinancialFredm 64.757 14.842 4.363 0.000 64.757 0.190  
## Legal 336.827 39.952 8.431 0.000 1.000 1.000  
## Market 24.697 5.405 4.569 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.915  
## JudclEffctvnss 0.722  
## GvrnmntIntgrty 0.823  
## GovtSpending 0.158  
## BusinessFreedm 0.644  
## LaborFreedom 0.156  
## MonetaryFreedm 0.416  
## InvestmentFrdm 0.703  
## FinancialFredm 0.810

table\_fit[4, ] <- c("Configural Model", round(fitmeasures(configural.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 83.775 | 25 | 0.973 | 0.082 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2017 Model | 43.329 | 25 | 0.982 | 0.065 | 0.038 |
| Configural Model | 101.446 | 50 | 0.976 | 0.077 | 0.04 |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |

There is no large drop in CFI , so the next model is the metric model where the loadings are set to equal.

metric.fit <- cfa(Model, data = data20202017, meanstructure = T, group = "Year",  
 group.equal = c("loadings"))  
summary(metric.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 245 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 58  
## Number of equality constraints 7  
##   
## Number of observations per group:   
## 2020 176  
## 2017 175  
##   
## Model Test User Model:  
##   
## Test statistic 125.316  
## Degrees of freedom 57  
## P-value (Chi-square) 0.000  
## Test statistic for each group:  
## 2020 69.773  
## 2017 55.543  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2256.951  
## Degrees of freedom 72  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.969  
## Tucker-Lewis Index (TLI) 0.961  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12227.387  
## Loglikelihood unrestricted model (H1) -12164.729  
##   
## Akaike (AIC) 24556.774  
## Bayesian (BIC) 24753.674  
## Sample-size adjusted Bayesian (BIC) 24591.883  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.083  
## 90 Percent confidence interval - lower 0.063  
## 90 Percent confidence interval - upper 0.102  
## P-value RMSEA <= 0.05 0.004  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.055  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
##   
## Group 1 [2020]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.375 0.981  
## JdclEff (.p2.) 0.918 0.036 25.805 0.000 15.945 0.867  
## GvrnmnI (.p3.) 1.020 0.032 31.844 0.000 17.717 0.902  
## GvtSpnd (.p4.) -0.524 0.062 -8.440 0.000 -9.111 -0.438  
## BsnssFr (.p5.) 0.651 0.029 22.380 0.000 11.304 0.793  
## LbrFrdm (.p6.) 0.314 0.039 8.058 0.000 5.464 0.407  
## Market =~   
## MntryFr 1.000 4.220 0.588  
## InvstmF (.p8.) 4.180 0.361 11.584 0.000 17.640 0.865  
## FnnclFr (.p9.) 3.895 0.329 11.825 0.000 16.434 0.898  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 17.656 7.976 2.214 0.027 17.656 0.227  
## Legal ~~   
## Market 57.913 8.608 6.728 0.000 0.790 0.790  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 58.062 1.336 43.471 0.000 58.062 3.277  
## .JudclEffctvnss 46.458 1.387 33.494 0.000 46.458 2.525  
## .GvrnmntIntgrty 44.917 1.481 30.339 0.000 44.917 2.287  
## .GovtSpending 67.367 1.569 42.934 0.000 67.367 3.236  
## .BusinessFreedm 64.739 1.074 60.270 0.000 64.739 4.543  
## .LaborFreedom 60.250 1.013 59.500 0.000 60.250 4.485  
## .MonetaryFreedm 75.896 0.541 140.235 0.000 75.896 10.571  
## .InvestmentFrdm 58.807 1.537 38.271 0.000 58.807 2.885  
## .FinancialFredm 49.602 1.380 35.949 0.000 49.602 2.710  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 12.083 5.564 2.171 0.030 12.083 0.038  
## .JudclEffctvnss 84.361 10.550 7.996 0.000 84.361 0.249  
## .GvrnmntIntgrty 71.901 9.843 7.304 0.000 71.901 0.186  
## .GovtSpending 350.300 37.606 9.315 0.000 350.300 0.808  
## .BusinessFreedm 75.291 8.534 8.822 0.000 75.291 0.371  
## .LaborFreedom 150.613 16.149 9.326 0.000 150.613 0.835  
## .MonetaryFreedm 33.746 3.809 8.859 0.000 33.746 0.655  
## .InvestmentFrdm 104.370 17.256 6.048 0.000 104.370 0.251  
## .FinancialFredm 64.983 13.239 4.908 0.000 64.983 0.194  
## Legal 301.903 33.657 8.970 0.000 1.000 1.000  
## Market 17.806 3.445 5.168 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.962  
## JudclEffctvnss 0.751  
## GvrnmntIntgrty 0.814  
## GovtSpending 0.192  
## BusinessFreedm 0.629  
## LaborFreedom 0.165  
## MonetaryFreedm 0.345  
## InvestmentFrdm 0.749  
## FinancialFredm 0.806  
##   
##   
## Group 2 [2017]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.474 0.939  
## JdclEff (.p2.) 0.918 0.036 25.805 0.000 16.036 0.836  
## GvrnmnI (.p3.) 1.020 0.032 31.844 0.000 17.817 0.928  
## GvtSpnd (.p4.) -0.524 0.062 -8.440 0.000 -9.163 -0.404  
## BsnssFr (.p5.) 0.651 0.029 22.380 0.000 11.368 0.809  
## LbrFrdm (.p6.) 0.314 0.039 8.058 0.000 5.495 0.404  
## Market =~   
## MntryFr 1.000 4.350 0.587  
## InvstmF (.p8.) 4.180 0.361 11.584 0.000 18.186 0.836  
## FnnclFr (.p9.) 3.895 0.329 11.825 0.000 16.943 0.910  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 11.938 8.863 1.347 0.178 11.938 0.159  
## Legal ~~   
## Market 58.776 8.947 6.569 0.000 0.773 0.773  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 53.879 1.407 38.301 0.000 53.879 2.895  
## .JudclEffctvnss 46.015 1.450 31.725 0.000 46.015 2.398  
## .GvrnmntIntgrty 43.522 1.451 29.999 0.000 43.522 2.268  
## .GovtSpending 64.021 1.715 37.328 0.000 64.021 2.822  
## .BusinessFreedm 65.487 1.062 61.645 0.000 65.487 4.660  
## .LaborFreedom 60.056 1.027 58.462 0.000 60.056 4.419  
## .MonetaryFreedm 77.245 0.560 137.852 0.000 77.245 10.421  
## .InvestmentFrdm 58.514 1.645 35.576 0.000 58.514 2.689  
## .FinancialFredm 49.257 1.407 35.015 0.000 49.257 2.647  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 40.965 8.026 5.104 0.000 40.965 0.118  
## .JudclEffctvnss 110.999 14.566 7.620 0.000 110.999 0.302  
## .GvrnmntIntgrty 50.889 9.190 5.537 0.000 50.889 0.138  
## .GovtSpending 430.801 46.535 9.258 0.000 430.801 0.837  
## .BusinessFreedm 68.265 8.142 8.384 0.000 68.265 0.346  
## .LaborFreedom 154.484 16.688 9.257 0.000 154.484 0.837  
## .MonetaryFreedm 36.024 4.086 8.817 0.000 36.024 0.656  
## .InvestmentFrdm 142.686 21.568 6.616 0.000 142.686 0.301  
## .FinancialFredm 59.264 14.320 4.139 0.000 59.264 0.171  
## Legal 305.341 35.807 8.528 0.000 1.000 1.000  
## Market 18.924 3.663 5.166 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.882  
## JudclEffctvnss 0.698  
## GvrnmntIntgrty 0.862  
## GovtSpending 0.163  
## BusinessFreedm 0.654  
## LaborFreedom 0.163  
## MonetaryFreedm 0.344  
## InvestmentFrdm 0.699  
## FinancialFredm 0.829

table\_fit[5, ] <- c("Metric Model", round(fitmeasures(metric.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 83.775 | 25 | 0.973 | 0.082 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2017 Model | 43.329 | 25 | 0.982 | 0.065 | 0.038 |
| Configural Model | 101.446 | 50 | 0.976 | 0.077 | 0.04 |
| Metric Model | 125.316 | 57 | 0.969 | 0.083 | 0.055 |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |

Again the drop in CFI is still good, so the next model is the scalar model where the intercepts are set to be equal in addition to the loadings.

scalar.fit <- cfa(Model, data = data20202017, meanstructure = T, group = "Year",  
 group.equal = c("loadings", "intercepts"))  
summary(scalar.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 294 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 60  
## Number of equality constraints 16  
##   
## Number of observations per group:   
## 2020 176  
## 2017 175  
##   
## Model Test User Model:  
##   
## Test statistic 154.953  
## Degrees of freedom 64  
## P-value (Chi-square) 0.000  
## Test statistic for each group:  
## 2020 81.589  
## 2017 73.364  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2256.951  
## Degrees of freedom 72  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.958  
## Tucker-Lewis Index (TLI) 0.953  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12242.206  
## Loglikelihood unrestricted model (H1) -12164.729  
##   
## Akaike (AIC) 24572.411  
## Bayesian (BIC) 24742.286  
## Sample-size adjusted Bayesian (BIC) 24602.702  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.090  
## 90 Percent confidence interval - lower 0.072  
## 90 Percent confidence interval - upper 0.108  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.060  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
##   
## Group 1 [2020]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.382 0.978  
## JdclEff (.p2.) 0.915 0.036 25.445 0.000 15.907 0.866  
## GvrnmnI (.p3.) 1.021 0.032 31.494 0.000 17.740 0.903  
## GvtSpnd (.p4.) -0.517 0.063 -8.262 0.000 -8.979 -0.431  
## BsnssFr (.p5.) 0.646 0.029 21.939 0.000 11.235 0.789  
## LbrFrdm (.p6.) 0.314 0.039 8.035 0.000 5.454 0.406  
## Market =~   
## MntryFr 1.000 4.214 0.585  
## InvstmF (.p8.) 4.187 0.364 11.502 0.000 17.643 0.865  
## FnnclFr (.p9.) 3.901 0.332 11.736 0.000 16.440 0.898  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 17.569 8.049 2.183 0.029 17.569 0.226  
## Legal ~~   
## Market 57.916 8.632 6.709 0.000 0.791 0.791  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR (.23.) 57.673 1.336 43.162 0.000 57.673 3.246  
## .JdclEff (.24.) 47.273 1.321 35.782 0.000 47.273 2.573  
## .GvrnmnI (.25.) 45.583 1.422 32.062 0.000 45.583 2.320  
## .GvtSpnd (.26.) 65.306 1.260 51.843 0.000 65.306 3.132  
## .BsnssFr (.27.) 65.962 0.973 67.774 0.000 65.962 4.631  
## .LbrFrdm (.28.) 60.535 0.781 77.495 0.000 60.535 4.507  
## .MntryFr (.29.) 76.538 0.456 167.824 0.000 76.538 10.617  
## .InvstmF (.30.) 58.656 1.482 39.568 0.000 58.656 2.877  
## .FnnclFr (.31.) 49.391 1.351 36.555 0.000 49.391 2.698  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 13.514 5.742 2.354 0.019 13.514 0.043  
## .JudclEffctvnss 84.483 10.650 7.933 0.000 84.483 0.250  
## .GvrnmntIntgrty 71.326 9.912 7.196 0.000 71.326 0.185  
## .GovtSpending 354.144 38.028 9.313 0.000 354.144 0.815  
## .BusinessFreedm 76.701 8.703 8.813 0.000 76.701 0.378  
## .LaborFreedom 150.628 16.158 9.322 0.000 150.628 0.835  
## .MonetaryFreedm 34.214 3.858 8.868 0.000 34.214 0.658  
## .InvestmentFrdm 104.457 17.278 6.046 0.000 104.457 0.251  
## .FinancialFredm 64.827 13.251 4.892 0.000 64.827 0.193  
## Legal 302.129 33.816 8.934 0.000 1.000 1.000  
## Market 17.760 3.456 5.139 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.957  
## JudclEffctvnss 0.750  
## GvrnmntIntgrty 0.815  
## GovtSpending 0.185  
## BusinessFreedm 0.622  
## LaborFreedom 0.165  
## MonetaryFreedm 0.342  
## InvestmentFrdm 0.749  
## FinancialFredm 0.807  
##   
##   
## Group 2 [2017]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.427 0.932  
## JdclEff (.p2.) 0.915 0.036 25.445 0.000 15.948 0.833  
## GvrnmnI (.p3.) 1.021 0.032 31.494 0.000 17.785 0.930  
## GvtSpnd (.p4.) -0.517 0.063 -8.262 0.000 -9.002 -0.395  
## BsnssFr (.p5.) 0.646 0.029 21.939 0.000 11.263 0.803  
## LbrFrdm (.p6.) 0.314 0.039 8.035 0.000 5.468 0.403  
## Market =~   
## MntryFr 1.000 4.343 0.583  
## InvstmF (.p8.) 4.187 0.364 11.502 0.000 18.181 0.836  
## FnnclFr (.p9.) 3.901 0.332 11.736 0.000 16.942 0.910  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 11.352 8.985 1.263 0.206 11.352 0.153  
## Legal ~~   
## Market 58.495 8.939 6.544 0.000 0.773 0.773  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR (.23.) 57.673 1.336 43.162 0.000 57.673 3.085  
## .JdclEff (.24.) 47.273 1.321 35.782 0.000 47.273 2.470  
## .GvrnmnI (.25.) 45.583 1.422 32.062 0.000 45.583 2.385  
## .GvtSpnd (.26.) 65.306 1.260 51.843 0.000 65.306 2.869  
## .BsnssFr (.27.) 65.962 0.973 67.774 0.000 65.962 4.703  
## .LbrFrdm (.28.) 60.535 0.781 77.495 0.000 60.535 4.457  
## .MntryFr (.29.) 76.538 0.456 167.824 0.000 76.538 10.280  
## .InvstmF (.30.) 58.656 1.482 39.568 0.000 58.656 2.696  
## .FnnclFr (.31.) 49.391 1.351 36.555 0.000 49.391 2.654  
## Legal -2.466 1.906 -1.293 0.196 -0.142 -0.142  
## Market 0.016 0.486 0.032 0.974 0.004 0.004  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 45.809 8.513 5.381 0.000 45.809 0.131  
## .JudclEffctvnss 111.977 14.841 7.545 0.000 111.977 0.306  
## .GvrnmntIntgrty 49.107 9.249 5.310 0.000 49.107 0.134  
## .GovtSpending 437.257 47.227 9.259 0.000 437.257 0.844  
## .BusinessFreedm 69.839 8.330 8.384 0.000 69.839 0.355  
## .LaborFreedom 154.595 16.705 9.254 0.000 154.595 0.838  
## .MonetaryFreedm 36.571 4.144 8.826 0.000 36.571 0.660  
## .InvestmentFrdm 142.625 21.596 6.604 0.000 142.625 0.301  
## .FinancialFredm 59.333 14.370 4.129 0.000 59.333 0.171  
## Legal 303.686 35.860 8.469 0.000 1.000 1.000  
## Market 18.859 3.671 5.137 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.869  
## JudclEffctvnss 0.694  
## GvrnmntIntgrty 0.866  
## GovtSpending 0.156  
## BusinessFreedm 0.645  
## LaborFreedom 0.162  
## MonetaryFreedm 0.340  
## InvestmentFrdm 0.699  
## FinancialFredm 0.829

table\_fit[6, ] <- c("Scalar Model", round(fitmeasures(scalar.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 83.775 | 25 | 0.973 | 0.082 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2017 Model | 43.329 | 25 | 0.982 | 0.065 | 0.038 |
| Configural Model | 101.446 | 50 | 0.976 | 0.077 | 0.04 |
| Metric Model | 125.316 | 57 | 0.969 | 0.083 | 0.055 |
| Scalar Model | 154.953 | 64 | 0.958 | 0.09 | 0.06 |
| NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA |

There is a CFI change of more than 0.01, namely 0.011! Next is to see if some of the intercepts can be fixed so that the model is still good.

partial\_syntax <- paste(colnames(data20202017)[c(4, 5, 6, 7, 10, 12, 14, 15)],   
 "~", 1) # intercepts  
partial\_syntax

## [1] "PropertyRights ~ 1" "JudicalEffectiveness ~ 1"  
## [3] "GovernmentIntegrity ~ 1" "TaxBurden ~ 1"   
## [5] "BusinessFreedom ~ 1" "MonetaryFreedom ~ 1"   
## [7] "InvestmentFreedom ~ 1" "FinancialFreedom ~ 1"

CFI\_list <- 1:length(partial\_syntax)  
names(CFI\_list) <- partial\_syntax  
  
for (i in 1:length(partial\_syntax)){  
   
 temp <- cfa(model = Model,   
 data = data20202017,  
 meanstructure = TRUE,  
 group = "Year",  
 group.equal = c("loadings", "intercepts"),  
 group.partial = partial\_syntax[i])  
   
 CFI\_list[i] <- fitmeasures(temp, "cfi")  
}  
  
CFI\_list

## PropertyRights ~ 1 JudicalEffectiveness ~ 1 GovernmentIntegrity ~ 1   
## 0.9667939 0.9590425 0.9585864   
## TaxBurden ~ 1 BusinessFreedom ~ 1 MonetaryFreedom ~ 1   
## 0.9583729 0.9613657 0.9600932   
## InvestmentFreedom ~ 1 FinancialFreedom ~ 1   
## 0.9579785 0.9581782

which.max(CFI\_list)

## PropertyRights ~ 1   
## 1

Adding the property rights intercept gets it back up 0.967 which get it back into the correct range. Next is to create a partial fit.

partial.fit <- cfa(Model, data = data20202017, meanstructure = T, group = "Year",   
 group.equal = c("loadings", "intercepts"),  
 group.partial = c("PropertyRights ~ 1"))  
  
summary(partial.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 289 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 60  
## Number of equality constraints 15  
##   
## Number of observations per group:   
## 2020 176  
## 2017 175  
##   
## Model Test User Model:  
##   
## Test statistic 135.554  
## Degrees of freedom 63  
## P-value (Chi-square) 0.000  
## Test statistic for each group:  
## 2020 74.818  
## 2017 60.735  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2256.951  
## Degrees of freedom 72  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.967  
## Tucker-Lewis Index (TLI) 0.962  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12232.506  
## Loglikelihood unrestricted model (H1) -12164.729  
##   
## Akaike (AIC) 24555.012  
## Bayesian (BIC) 24728.747  
## Sample-size adjusted Bayesian (BIC) 24585.991  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.081  
## 90 Percent confidence interval - lower 0.062  
## 90 Percent confidence interval - upper 0.100  
## P-value RMSEA <= 0.05 0.005  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.057  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
##   
## Group 1 [2020]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.378 0.981  
## JdclEff (.p2.) 0.917 0.036 25.803 0.000 15.937 0.866  
## GvrnmnI (.p3.) 1.019 0.032 31.780 0.000 17.707 0.901  
## GvtSpnd (.p4.) -0.522 0.062 -8.378 0.000 -9.077 -0.435  
## BsnssFr (.p5.) 0.650 0.029 22.327 0.000 11.290 0.792  
## LbrFrdm (.p6.) 0.314 0.039 8.059 0.000 5.462 0.407  
## Market =~   
## MntryFr 1.000 4.214 0.585  
## InvstmF (.p8.) 4.186 0.364 11.501 0.000 17.639 0.865  
## FnnclFr (.p9.) 3.902 0.332 11.737 0.000 16.443 0.898  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 17.903 8.004 2.237 0.025 17.903 0.229  
## Legal ~~   
## Market 57.823 8.615 6.712 0.000 0.790 0.790  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR 58.062 1.335 43.480 0.000 58.062 3.277  
## .JdclEff (.24.) 46.406 1.338 34.694 0.000 46.406 2.522  
## .GvrnmnI (.25.) 44.370 1.447 30.662 0.000 44.370 2.258  
## .GvtSpnd (.26.) 65.767 1.265 51.996 0.000 65.767 3.152  
## .BsnssFr (.27.) 65.284 0.987 66.110 0.000 65.284 4.580  
## .LbrFrdm (.28.) 60.224 0.783 76.883 0.000 60.224 4.483  
## .MntryFr (.29.) 76.538 0.456 167.836 0.000 76.538 10.618  
## .InvstmF (.30.) 58.656 1.482 39.578 0.000 58.656 2.877  
## .FnnclFr (.31.) 49.390 1.351 36.548 0.000 49.390 2.697  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 11.871 5.573 2.130 0.033 11.871 0.038  
## .JudclEffctvnss 84.496 10.557 8.004 0.000 84.496 0.250  
## .GvrnmntIntgrty 72.523 9.898 7.327 0.000 72.523 0.188  
## .GovtSpending 353.043 37.894 9.317 0.000 353.043 0.811  
## .BusinessFreedm 75.683 8.572 8.829 0.000 75.683 0.373  
## .LaborFreedom 150.632 16.151 9.327 0.000 150.632 0.835  
## .MonetaryFreedm 34.205 3.857 8.868 0.000 34.205 0.658  
## .InvestmentFrdm 104.402 17.268 6.046 0.000 104.402 0.251  
## .FinancialFredm 64.901 13.257 4.896 0.000 64.901 0.194  
## Legal 301.987 33.651 8.974 0.000 1.000 1.000  
## Market 17.756 3.455 5.139 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.962  
## JudclEffctvnss 0.750  
## GvrnmntIntgrty 0.812  
## GovtSpending 0.189  
## BusinessFreedm 0.627  
## LaborFreedom 0.165  
## MonetaryFreedm 0.342  
## InvestmentFrdm 0.749  
## FinancialFredm 0.806  
##   
##   
## Group 2 [2017]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.487 0.939  
## JdclEff (.p2.) 0.917 0.036 25.803 0.000 16.038 0.836  
## GvrnmnI (.p3.) 1.019 0.032 31.780 0.000 17.819 0.928  
## GvtSpnd (.p4.) -0.522 0.062 -8.378 0.000 -9.134 -0.401  
## BsnssFr (.p5.) 0.650 0.029 22.327 0.000 11.362 0.808  
## LbrFrdm (.p6.) 0.314 0.039 8.059 0.000 5.496 0.404  
## Market =~   
## MntryFr 1.000 4.343 0.583  
## InvstmF (.p8.) 4.186 0.364 11.501 0.000 18.178 0.835  
## FnnclFr (.p9.) 3.902 0.332 11.737 0.000 16.946 0.911  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 12.117 8.887 1.363 0.173 12.117 0.160  
## Legal ~~   
## Market 58.731 8.960 6.555 0.000 0.773 0.773  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR 54.329 1.531 35.477 0.000 54.329 2.919  
## .JdclEff (.24.) 46.406 1.338 34.694 0.000 46.406 2.418  
## .GvrnmnI (.25.) 44.370 1.447 30.662 0.000 44.370 2.310  
## .GvtSpnd (.26.) 65.767 1.265 51.996 0.000 65.767 2.889  
## .BsnssFr (.27.) 65.284 0.987 66.110 0.000 65.284 4.644  
## .LbrFrdm (.28.) 60.224 0.783 76.883 0.000 60.224 4.432  
## .MntryFr (.29.) 76.538 0.456 167.836 0.000 76.538 10.279  
## .InvstmF (.30.) 58.656 1.482 39.578 0.000 58.656 2.696  
## .FnnclFr (.31.) 49.390 1.351 36.548 0.000 49.390 2.655  
## Legal -0.450 1.965 -0.229 0.819 -0.026 -0.026  
## Market 0.016 0.486 0.032 0.974 0.004 0.004  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PropertyRights 40.698 8.025 5.072 0.000 40.698 0.117  
## .JudclEffctvnss 111.078 14.569 7.625 0.000 111.078 0.302  
## .GvrnmntIntgrty 51.359 9.233 5.562 0.000 51.359 0.139  
## .GovtSpending 434.874 46.968 9.259 0.000 434.874 0.839  
## .BusinessFreedm 68.556 8.172 8.389 0.000 68.556 0.347  
## .LaborFreedom 154.483 16.688 9.257 0.000 154.483 0.836  
## .MonetaryFreedm 36.583 4.144 8.827 0.000 36.583 0.660  
## .InvestmentFrdm 143.041 21.604 6.621 0.000 143.041 0.302  
## .FinancialFredm 59.032 14.335 4.118 0.000 59.032 0.171  
## Legal 305.805 35.852 8.530 0.000 1.000 1.000  
## Market 18.858 3.671 5.137 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.883  
## JudclEffctvnss 0.698  
## GvrnmntIntgrty 0.861  
## GovtSpending 0.161  
## BusinessFreedm 0.653  
## LaborFreedom 0.164  
## MonetaryFreedm 0.340  
## InvestmentFrdm 0.698  
## FinancialFredm 0.829

table\_fit[7, ] <- c("Partial (Scalar) Model PR", round(fitmeasures(partial.fit, c("chisq", "df", "cfi",  
 "rmsea", "srmr")),3))  
  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 83.775 | 25 | 0.973 | 0.082 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2017 Model | 43.329 | 25 | 0.982 | 0.065 | 0.038 |
| Configural Model | 101.446 | 50 | 0.976 | 0.077 | 0.04 |
| Metric Model | 125.316 | 57 | 0.969 | 0.083 | 0.055 |
| Scalar Model | 154.953 | 64 | 0.958 | 0.09 | 0.06 |
| Partial (Scalar) Model PR | 135.554 | 63 | 0.967 | 0.081 | 0.057 |
| NA | NA | NA | NA | NA | NA |

The CFI is back into an acceptable range, so the strict model can now be run.

strict.fit <- cfa(Model, data = data20202017, meanstructure = T, group = "Year",   
 group.equal = c("loadings", "intercepts", "residuals"),  
 group.partial = c("PropertyRights ~ 1"))  
  
summary(strict.fit, rsquare = T, fit.measures = T, standardized = T)

## lavaan 0.6-7 ended normally after 197 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 60  
## Number of equality constraints 24  
##   
## Number of observations per group:   
## 2020 176  
## 2017 175  
##   
## Model Test User Model:  
##   
## Test statistic 154.631  
## Degrees of freedom 72  
## P-value (Chi-square) 0.000  
## Test statistic for each group:  
## 2020 86.306  
## 2017 68.325  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2256.951  
## Degrees of freedom 72  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.962  
## Tucker-Lewis Index (TLI) 0.962  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12242.045  
## Loglikelihood unrestricted model (H1) -12164.729  
##   
## Akaike (AIC) 24556.090  
## Bayesian (BIC) 24695.078  
## Sample-size adjusted Bayesian (BIC) 24580.872  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.081  
## 90 Percent confidence interval - lower 0.063  
## 90 Percent confidence interval - upper 0.098  
## P-value RMSEA <= 0.05 0.003  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.063  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Structured  
##   
##   
## Group 1 [2020]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.485 0.962  
## JdclEff (.p2.) 0.918 0.036 25.789 0.000 16.049 0.852  
## GvrnmnI (.p3.) 1.014 0.032 31.827 0.000 17.722 0.912  
## GvtSpnd (.p4.) -0.518 0.062 -8.381 0.000 -9.055 -0.416  
## BsnssFr (.p5.) 0.641 0.029 22.356 0.000 11.206 0.797  
## LbrFrdm (.p6.) 0.310 0.038 8.046 0.000 5.413 0.401  
## Market =~   
## MntryFr 1.000 4.240 0.581  
## InvstmF (.p8.) 4.147 0.358 11.593 0.000 17.586 0.846  
## FnnclFr (.p9.) 3.864 0.326 11.849 0.000 16.386 0.900  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 15.344 7.549 2.033 0.042 15.344 0.195  
## Legal ~~   
## Market 59.232 8.814 6.721 0.000 0.799 0.799  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR 58.063 1.370 42.376 0.000 58.063 3.194  
## .JdclEff (.24.) 46.439 1.351 34.372 0.000 46.439 2.466  
## .GvrnmnI (.25.) 44.443 1.439 30.893 0.000 44.443 2.287  
## .GvtSpnd (.26.) 65.585 1.270 51.659 0.000 65.585 3.010  
## .BsnssFr (.27.) 65.253 0.980 66.590 0.000 65.253 4.642  
## .LbrFrdm (.28.) 60.221 0.782 77.051 0.000 60.221 4.466  
## .MntryFr (.29.) 76.560 0.458 167.302 0.000 76.560 10.499  
## .InvstmF (.30.) 58.624 1.493 39.271 0.000 58.624 2.819  
## .FnnclFr (.31.) 49.396 1.345 36.735 0.000 49.396 2.714  
## Legal 0.000 0.000 0.000  
## Market 0.000 0.000 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR (.11.) 24.689 5.003 4.935 0.000 24.689 0.075  
## .JdclEff (.12.) 97.202 8.964 10.844 0.000 97.202 0.274  
## .GvrnmnI (.13.) 63.638 7.070 9.002 0.000 63.638 0.168  
## .GvtSpnd (.14.) 392.650 29.924 13.121 0.000 392.650 0.827  
## .BsnssFr (.15.) 72.012 5.939 12.126 0.000 72.012 0.364  
## .LbrFrdm (.16.) 152.543 11.616 13.132 0.000 152.543 0.839  
## .MntryFr (.17.) 35.199 2.828 12.446 0.000 35.199 0.662  
## .InvstmF (.18.) 123.339 14.248 8.657 0.000 123.339 0.285  
## .FnnclFr (.19.) 62.641 10.323 6.068 0.000 62.641 0.189  
## Legal 305.725 34.929 8.753 0.000 1.000 1.000  
## Market 17.979 3.472 5.178 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.925  
## JudclEffctvnss 0.726  
## GvrnmntIntgrty 0.832  
## GovtSpending 0.173  
## BusinessFreedm 0.636  
## LaborFreedom 0.161  
## MonetaryFreedm 0.338  
## InvestmentFrdm 0.715  
## FinancialFredm 0.811  
##   
##   
## Group 2 [2017]:  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## Legal =~   
## PrprtyR 1.000 17.901 0.964  
## JdclEff (.p2.) 0.918 0.036 25.789 0.000 16.431 0.857  
## GvrnmnI (.p3.) 1.014 0.032 31.827 0.000 18.144 0.915  
## GvtSpnd (.p4.) -0.518 0.062 -8.381 0.000 -9.270 -0.424  
## BsnssFr (.p5.) 0.641 0.029 22.356 0.000 11.473 0.804  
## LbrFrdm (.p6.) 0.310 0.038 8.046 0.000 5.542 0.409  
## Market =~   
## MntryFr 1.000 4.393 0.595  
## InvstmF (.p8.) 4.147 0.358 11.593 0.000 18.221 0.854  
## FnnclFr (.p9.) 3.864 0.326 11.849 0.000 16.978 0.906  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .JudicalEffectiveness ~~   
## .GvrnmntIntgrty 15.573 7.584 2.053 0.040 15.573 0.198  
## Legal ~~   
## Market 60.470 9.164 6.599 0.000 0.769 0.769  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR 54.318 1.512 35.930 0.000 54.318 2.924  
## .JdclEff (.24.) 46.439 1.351 34.372 0.000 46.439 2.424  
## .GvrnmnI (.25.) 44.443 1.439 30.893 0.000 44.443 2.242  
## .GvtSpnd (.26.) 65.585 1.270 51.659 0.000 65.585 2.998  
## .BsnssFr (.27.) 65.253 0.980 66.590 0.000 65.253 4.573  
## .LbrFrdm (.28.) 60.221 0.782 77.051 0.000 60.221 4.449  
## .MntryFr (.29.) 76.560 0.458 167.302 0.000 76.560 10.370  
## .InvstmF (.30.) 58.624 1.493 39.271 0.000 58.624 2.747  
## .FnnclFr (.31.) 49.396 1.345 36.735 0.000 49.396 2.637  
## Legal -0.439 1.994 -0.220 0.826 -0.025 -0.025  
## Market 0.018 0.490 0.036 0.971 0.004 0.004  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PrprtyR (.11.) 24.689 5.003 4.935 0.000 24.689 0.072  
## .JdclEff (.12.) 97.202 8.964 10.844 0.000 97.202 0.265  
## .GvrnmnI (.13.) 63.638 7.070 9.002 0.000 63.638 0.162  
## .GvtSpnd (.14.) 392.650 29.924 13.121 0.000 392.650 0.820  
## .BsnssFr (.15.) 72.012 5.939 12.126 0.000 72.012 0.354  
## .LbrFrdm (.16.) 152.543 11.616 13.132 0.000 152.543 0.832  
## .MntryFr (.17.) 35.199 2.828 12.446 0.000 35.199 0.646  
## .InvstmF (.18.) 123.339 14.248 8.657 0.000 123.339 0.271  
## .FnnclFr (.19.) 62.641 10.323 6.068 0.000 62.641 0.179  
## Legal 320.450 36.630 8.748 0.000 1.000 1.000  
## Market 19.302 3.721 5.188 0.000 1.000 1.000  
##   
## R-Square:  
## Estimate  
## PropertyRights 0.928  
## JudclEffctvnss 0.735  
## GvrnmntIntgrty 0.838  
## GovtSpending 0.180  
## BusinessFreedm 0.646  
## LaborFreedom 0.168  
## MonetaryFreedm 0.354  
## InvestmentFrdm 0.729  
## FinancialFredm 0.821

table\_fit[8, ] <- c("Strict Model", round(fitmeasures(strict.fit, c("chisq", "df", "cfi", "rmsea", "srmr")),3))  
kable(table\_fit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | X2 | df | CFI | RMSEA | SRMR |
| Overall Model | 83.775 | 25 | 0.973 | 0.082 | 0.037 |
| 2020 Model | 58.117 | 25 | 0.971 | 0.087 | 0.041 |
| 2017 Model | 43.329 | 25 | 0.982 | 0.065 | 0.038 |
| Configural Model | 101.446 | 50 | 0.976 | 0.077 | 0.04 |
| Metric Model | 125.316 | 57 | 0.969 | 0.083 | 0.055 |
| Scalar Model | 154.953 | 64 | 0.958 | 0.09 | 0.06 |
| Partial (Scalar) Model PR | 135.554 | 63 | 0.967 | 0.081 | 0.057 |
| Strict Model | 154.631 | 72 | 0.962 | 0.081 | 0.063 |

The CFI drop is within the threshold, so overall the model is partially invariate! 2020 has a slightly higher intercept (4 points) than 2017.

### Latent Means - 2020 and 2017

Next, is to check if the latent means between the groups are different.

data20202017$sum <- apply(data20202017[, c(4, 5, 6, 7, 10, 12, 14, 15)], 1, sum)  
tapply(data20202017$sum, data20202017$Year, mean)

## 2017 2020   
## 471.5607 476.4795

latent\_means <- lavPredict(strict.fit)  
  
table(data20202017$Year)

##   
## 2017 2020   
## 175 176

latent\_means <- as.data.frame(do.call(rbind, latent\_means))  
latent\_means$Year <- c(rep("2017", 175), rep("2020", 176))  
  
options(scipen = 999)  
tapply(latent\_means$Legal, latent\_means$Year, mean)

## 2017 2020   
## 0.1494690 -0.5852806

tapply(latent\_means$Market, latent\_means$Year, mean)

## 2017 2020   
## 0.04827426 -0.03040785

tapply(latent\_means$Legal, latent\_means$Year, mean) \* #latent mean  
 tapply(data20202017$sum, data20202017$Year, sd, na.rm = T) + #real sum  
 tapply(data20202017$sum, data20202017$Year, mean, na.rm = T)

## 2017 2020   
## 486.0835 420.3099

tapply(latent\_means$Market, latent\_means$Year, mean) \* #latent mean  
 tapply(data20202017$sum, data20202017$Year, sd, na.rm = T) + #real sum  
 tapply(data20202017$sum, data20202017$Year, mean, na.rm = T)

## 2017 2020   
## 476.2511 473.5613

M <- tapply(latent\_means$Market, latent\_means$Year, mean)  
SD <- tapply(latent\_means$Market, latent\_means$Year, sd)  
N <- tapply(latent\_means$Market, latent\_means$Year, length)  
  
effect\_size <- d.ind.t(M[1], M[2], SD[1], SD[2], N[1], N[2], a = .05)  
effect\_size$estimate

## [1] "$d\_s$ = 0.02, 95\\% CI [-0.19, 0.23]"

effect\_size$statistic

## [1] "$t$(349) = 0.18, $p$ = .858"

M <- tapply(latent\_means$Legal, latent\_means$Year, mean)  
SD <- tapply(latent\_means$Legal, latent\_means$Year, sd)  
N <- tapply(latent\_means$Legal, latent\_means$Year, length)  
  
effect\_size <- d.ind.t(M[1], M[2], SD[1], SD[2], N[1], N[2], a = .05)  
effect\_size$estimate

## [1] "$d\_s$ = 0.04, 95\\% CI [-0.17, 0.25]"

effect\_size$statistic

## [1] "$t$(349) = 0.40, $p$ = .692"

Using a cutoff of 0.20, there is not a significant difference in the groups for the 2020 and 2017 model as well.

## Discussion

There are multiple takeaways from this exercise. First, the theoretical number of factors does not match the actual best model. The one factor and the four factor model was poor. The best model was a two factor model, but not all of the variables were important. However, the two factor model had very good fit statistics. This is not necessarily a bad thing as the word done by the Heritage Foundation is important, but this shows that measuring economic freedom is a very complex thing.

The second takeaway is that the structure for 2020 and 2019 is statistically the same. Throughout the process, CFI barely dropped with each step which shows it’s very stable. This is interesting, because of the pandemic which affected every country economically.

The third takeaway is that the 2020 and 2017 MGCFA is partially invariate. This may be because of a few reasons. The Heritage Foundation still did this project before 2017 but used a different set of variables (2020 Index of Economic Freedom). 2017 was the first year using the current setup of freedom variables, so it may be because of the change in methods. Another reason is that responses and methodologies are changing over time and their methods might not be measuring the latents in the same way as they once started.

Future work should test all combinations of years of current data to see if the structure matches every year. Each year an exercise similar to this should be done to make sure the structure doesn’t change over time. It will be important to see if the structure matches the next few years due to the countries recovering from the pandemic. Finally, there are most likely more complex models than a simple two factor model as well. There might be a model that utilizes all of the freedom variables as well as any other outside economic features.

### References

2020 index of economic freedom. (n.d.). Retrieved February 12, 2021, from https://www.heritage.org/index/