Is the Great Gatsby Curve Robust? 
Comment on Corak (2013)

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Abstract
The Great Gatsby Curve is the relationship between inequality and the intergenerational elasticity of earnings (IGE). I demonstrate that the leading estimate of the Great Gatsby Curve, the least-squares regression of Corak (2013, The Journal of Economic Perspectives), fails three tests of robustness. First, noticing that Corak compares after taxes-and-transfers Gini coefficients (as the measure of inequality) to before taxes-and-transfers earnings mobility, I find that the Great Gatsby Curve’s slope becomes statistically insignificant when using the before taxes-and-transfers Gini coefficients. Second, I show that, because Corak adjusts the estimates in the literature before fitting the Great Gatsby Curve using an anchoring scheme of proportionality to the United States’ IGE, the magnitude of the Great Gatsby Curve’s slope can be arbitrarily controlled by choosing among plausible, alternate IGE estimates of the United States. Third, by choosing among plausible, alternate IGE estimates for only three of the 13 included countries, I produce a Great Gatsby Curve with negative slope and confirm that the positive slope is not robust to alternate IGE estimates in a sensitivity analysis. Following the suggestion of these results, I conclude by estimating a modified Great Gatsby Curve by disentangling the effects of inequality, taxes, and transfers. I find that inequality has a positive and somewhat statistically significant effect on intergenerational elasticity of earnings after accounting for taxes and transfers, while taxes and transfers each have negative and statistically significant effects.

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Introduction

The Great Gatsby Curve is the relationship between inequality and the intergenerational elasticity of earnings (IGE). The IGE is the coefficient, $\beta$, in the log-linear regression,

$$\ln Y_{i,j}^c = \alpha_j + \beta_j \ln Y_{i,j}^p + \delta_j X_{i,j} + \epsilon_{i,j},$$

where $Y^p$ is parents’ lifetime earnings, $Y^c$ is children’s lifetime earnings, $X$ is a vector of covariates often including a polynomial in parent’s age, $j$ is the index over countries, and $i$ is the index over individuals. See Black and Devereaux (2011) for a recent survey of the methodology of IGE estimation, and see Corak (2006) for a survey of the IGE estimates used in Corak (2013) and referenced in the present paper.

The Great Gatsby Curve, popularized by Krueger (2012), is defined by Corak (2013) as the regression,

$$\beta_j = \gamma_0 + \gamma_1 G_j + \eta_j,$$

where $G$ is the disposable income Gini coefficient (a measure of inequality) and $\beta$ is estimated from Equation (1). Prior to fitting the equation, Corak (2013) uses the following procedure from Corak (2006) to select and adjust IGE estimates:


2. Among the 41 IGE estimates surveyed for the USA, choose a “preferred” estimate in two steps:
   
   (a) First, choose the estimation method of Grawe (2004) because it is, “the most recent and extensive to explicitly make cross-country comparisons in [IGE].”
   
   (b) Since Grawe (2004) produces two IGE estimates for the USA corresponding to the NLSY ($\hat{\beta}_{\text{USA}} = 0.154$) and PSID ($\hat{\beta}_{\text{USA}} = 0.473$) longitudinal data sets, Corak chooses the larger estimate based on the following evidence:
      
      i. Mazumder (2001) uses administrative data to find estimates ranging from 0.31 to 0.61 increasing in the number of years he averages.

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1 Estimates for Australia, Canada, Italy, Japan, and New Zealand have been added or amended since Corak (2006) from, respectively: Leigh (2007), Corak, Lindquist, and Mazumder (2013), Piraino (2007), LeFranc, Ojima, and Yoshida (2012), and Gibbons (2010). Information about these IGE estimates was provided by Miles Corak in email correspondence on December 31, 2013 and January 05, 2014.

2 No explicit reference to the error $\eta$ is made in the literature, but this error structure is presupposed by the OLS estimation employed. Left implicit is the least strong assumption needed for unbiasedness and consistency of OLS, that $G$ and $\eta$ are uncorrelated. In an open economy, I expect this condition to be violated as omitted variables (e.g., labor supply, the skill distribution, technology) are expected to causally affect both inequality and earnings, and to vary across countries. Nevertheless, I suspend disbelief in this paper by assuming that Equation (2) represents the true relationship between inequality and intergenerational mobility. I also assume that the Gini coefficient is the inequality measure of interest.
ii. Behman and Taubman (1990) suggest that using father-to-son IGE estimates underestimates household IGE, and,

iii. A regression of 22 USA IGE estimates on the father’s age, $T$, and number of years of earnings averaged in the study, $A$, yields fitted elasticities between 0.40 and 0.52 when father’s age is between 40 and 50 years.\(^3\)

3. Among the surveyed estimates available for each of the eight countries outside of the USA, choose an estimate based on Corak’s “understanding of the literature”. This means choosing the estimate that he considers to be estimated in the manner most similar to Grawe’s (2004) method.

4. Having chosen the preferred IGE, $\hat{\beta}_j$, for each country $j$ from among surveyed estimates, Corak adjusts the estimates using the following method:

(a) Find the estimate of USA IGE obtained using the method most similar to $\hat{\beta}_j$, for each non-USA $j$. Denote by $\phi_j$ the USA IGE matched to $\hat{\beta}_j$.

(b) Define the adjustment factor as,

$$F_j = \frac{\hat{\beta}_{USA}}{\phi_j}, \forall j \neq USA.$$  \hspace{1cm} (3)

Replace $\hat{\beta}_j$ with the adjusted IGE, $\tilde{\beta}_j$, defined by,

$$\tilde{\beta}_j = F_j \hat{\beta}_j, \forall j \neq USA.$$  \hspace{1cm} (4)

5. Lastly, among the disposable income Gini coefficients available in OECD (2011), the Gini coefficient computed closest in time to 1985 is chosen for each country.\(^4\)

Corak’s chosen USA IGE estimate, $\hat{\beta}_{USA}$, and the adjusted IGE estimates, $\tilde{\beta}_j$ for each $j \neq USA$, are then regressed on the Gini coefficient by the least squares sample analog of Equation (2), resulting in Corak’s Great Gatsby Curve, faithfully reproduced in Figure 1. Corak does not report the slope or associated $p$-value for this OLS regression, but I find that the slope is $\hat{\gamma}_1 = 2.05$ with associated $p$-value 0.001. Thus, Corak’s Great Gatsby Curve has a statistically significant and positive slope.

\(^3\)I find the choice of the higher Grawe (2004) estimate not convincingly supported by Corak’s (2006) evidence, presented in Step 2(b) above, for these reasons: (i) If we are to believe that Mazumder’s (2001) estimates are methodologically superior to Grawe’s lower estimate, then they must also be superior to Grawe’s higher estimate, derived using an almost identical estimation routine. (ii) If the father-to-son IGE estimates understate household IGE, then every estimate in the survey is understated as they all use father-to-son IGE estimates, so consistency requires that all or none of the IGE estimates have this correction. (iii) Of the 41 available IGE estimates, 20 are above 0.40, yet the regression is fit using 21 of these estimates, 13 of which are above 0.40, so the regression is biased to produce fitted values greater than 0.40. Even if the regression were not biased in this way, it is unclear that these fitted values are good choices.

\(^4\)In years, the furthest Gini coefficient from 1985 is France’s 1996 Gini coefficient.
Three Tests of Robustness

Robustness to Before Tax-and-Transfer Gini Coefficients

Corak’s Great Gatsby Curve uses Gini coefficients that measure inequality after taxes and transfers, but compares them to IGE estimates from earnings before taxes and transfers. This is a comparison between two very different states of the world, and we cannot distinguish the effect of taxes and transfers on intergenerational elasticity of earnings from the effect of inequality. How does this methodological choice affect the Great Gatsby Curve?

In Figure 2, I show Corak’s Great Gatsby Curve when after taxes-and-transfers Gini coefficients are replaced with before taxes-and-transfers Gini coefficients from the same years (OECD 2013).\(^5\) The change to the Great Gatsby Curve is staggering: the \(p\)-value on the OLS slope coefficient rises from 0.001 to 0.093, so the slope has become indistinguishable from zero at the 5% level of significance. Thus, the statistical significance of Corak’s Great Gatsby Curve is fully attributable to a methodological choice between types of Gini coefficients.

Robustness to Corak’s Adjustments

Even if we accept that the adjustment factors, \(F_j\), permit valid cross-country comparisons, the implications of the adjustment process defined by Equations (3) and (4) pose serious challenges to the robustness of the OLS estimates of the Great Gatsby Curve’s slope, \(\gamma_1\), from Equation (2).\(^6\) In particular, recall that 41 estimates of the USA IGE were available in 2004, with many more becoming available in the decade since. Of these 41, Corak has chosen the 12th highest. Perhaps most conspicuous is the assumption that Grawe’s (2004) estimate of the USA IGE, 0.473, is the true USA IGE, even as Grawe also presents 0.154 as an equally plausible estimate in the same paper.

Consider how Corak’s Great Gatsby Curve would be changed by the switch from one of Grawe’s (2004) plausible estimates to the other. The matched IGE estimates, \(\phi\), are, by construction, indifferent to the choice of USA IGE, \(\hat{\beta}_{USA}\). Selecting an USA IGE that differs from \(\hat{\beta}_{USA}\) by a factor of \(x\) (that is, the new USA IGE, \(\tilde{\beta}_{USA}\), is related to the original by \(\tilde{\beta}_{USA} = x\hat{\beta}_{USA}\)), it follows that the new adjustment factors, \(\tilde{F}_j\), are,

\[
\tilde{F}_j = \frac{\hat{\beta}_{USA}}{\phi_j} = \frac{x\hat{\beta}_{USA}}{\phi_j} = xF_j, \ j \neq USA
\]

so that all of the adjustment factors change by exactly the factor \(x\). Because the \(p\)-value on the OLS slope is indifferent to a change in units, the \(p\)-value remains unchanged. However, the OLS slope estimate, \(\hat{\gamma}_1\), is changed by the same factor \(x\).

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5. The rank correlation between the before tax-and-transfer and after tax-and-transfer Gini coefficients is statistically significant (Spearman’s \(\rho\) is 0.39 with corresponding \(p\)-value on hypothesis of independent rank is 0.183).

6. Beyond assuming that Equations (1) and (2) represent the true model and that the errors in the Great Gatsby Curve are uncorrelated with inequality, further conditions must hold in order for us to believe that, if an estimation method understates the true USA IGE by a factor of \(1/F_j\), then a similar method applied to country \(j\) can be made comparable to the true USA IGE by multiplying country \(j\)’s IGE by \(F_j\). Corak (2006, 2013) does not state or derive any such conditions.
Thus, due to Corak’s adjustment in Equations (3) and (4), the magnitude of the slope estimate, $\hat{\gamma}_1$, is arbitrarily controlled by the (at least partly) subjective decision of which USA IGE estimate to use. In the example of changing from Grawe’s high estimate to his low estimate, $x = 0.154/0.473 = 0.326$ so that Corak’s adjusted IGE estimates and OLS slope estimate fall to less than one-third of their original magnitude while the $p$-value remains 0.001. This example is demonstrated in Figure 3.

Clearly, the magnitude of the slope of Corak’s Great Gatsby Curve is not robust to the choice of plausible USA IGE estimate, which is at least in part a subjective choice. For contrast, the slope coefficient rises from 2.00 to 2.49 while the $p$-value remains statistically significant at 0.004 if Corak’s adjustments are discarded. Even though the rank correlation between the original and adjusted IGE estimates differs insignificantly (Spearman’s rho is 0.86 and the corresponding $p$-value on the null hypothesis of independent rank is 0.000), the Great Gatsby Curve is largely unaffected. Thus, Corak’s adjustments are not driving the statistical significance of the Great Gatsby Curve, holding all of Croak’s other choices unchanged. However, using the before taxes-and-transfers Gini coefficients raises the $p$-value to 0.187 without Corak’s adjustments.

**Robustness to Alternate Estimates for Other Countries**

Consider the following example: begin with Corak’s preferred IGE estimates for the 11 countries. Replace the higher USA estimate from Grawe (2004) with the lower USA estimate, described above. Replace Corak’s IGE choice for Norway, estimated by Bratberg, et al. (2003), with the estimate from Bjorklund, et al. (2003), which is the same source and similar methodology as the IGE estimates chosen for Denmark and Finland. Finally, replace the estimate for the UK, computed by Grawe (2004) using an IV method, with the OLS estimate from Dearden, et al. (1997).

As shown in Figure 4, our three choices of alternate estimates are sufficient to produce a negatively-sloped Great Gatsby Curve. The OLS slope coefficient estimate is $\hat{\gamma}_1 = -0.14$ and the $p$-value is statistically insignificant at 0.859. From this, I conjecture that not only the magnitude but also the sign of the Great Gatsby Curve’s slope is not robust to alternate, plausible estimate choices.

I perform a general sensitivity analysis by computing the Great Gatsby Curve slope coefficient and associated $p$-value for all possible combinations of IGE’s reported in Corak’s (2006) survey across the 13 countries. There are 246,000 such combinations.

Among all combinations of regressions on before tax-and-transfer Gini coefficients, 97.6% have positive estimated slope coefficient but only 0.003% of these slope estimates are statistically significant ($p$-value less than 0.05). The mean of the coefficients is 0.916 and the standard deviation is 0.467, so zero is just within two standard deviations of the mean. This distribution of slope estimates is shown in Figure 5 with the distribution of corresponding $p$-values in Figure 6.

Among all combinations of regressions on after tax-and-transfer Gini coefficients, none has negative estimated slope coefficient and 83% of these slope estimates are statistically significant. The mean coefficient is 1.846 and the standard deviation is 0.509. This distribution of slope estimates is shown in Figure 7 with the distribution of corresponding $p$-values in Figure 8.
Interestingly, the slope coefficients corresponding to Corak’s chosen IGE’s, 1.425 using before tax-and-transfer Gini coefficients and 2.487 using after tax-and-transfer Gini coefficients, are greater than 85% and 90% of their respective distributions. I conclude that the positive slope of the Great Gatsby Curve is not robust to choice of alternate IGE choices using before tax-and-transfer Gini coefficients.

Conclusions and Suggestions for Further Research

I have demonstrated that the leading estimate of the Great Gatsby Curve, the least-squares regression of Corak (2013), fails three tests of robustness. First, noticing that Corak compares after tax-and-transfer Gini coefficients to before tax-and-transfer IGE’s, I find that the Great Gatsby Curve’s slope becomes statistically insignificant when using the before tax-and-transfer Gini coefficients. Second, I show that, because Corak adjusts the estimates in the literature before fitting the Great Gatsby Curve using an anchoring scheme of proportionality to the United States’ IGE, the magnitude of the Great Gatsby Curve’s slope can be arbitrarily controlled by choosing among plausible, alternate estimates of the United States’ IGE. Third, by choosing among plausible, alternate IGE estimates for only three of the 13 included countries, a Great Gatsby Curve is produced with negative slope and confirm that the positive slope is not robust to alternate IGE estimates in a sensitivity analysis.

Thus, I conclude that the positive slope of Corak’s Great Gatsby Curve is not a robust empirical relationship. It should be emphasized that it has not been disproven that the Great Gatsby Curve has a statistically significant and positive slope. I have only demonstrated that the leading Great Gatsby Curve in the literature arrives at this result using questionable, non-robust methodology. This analysis raises the question: how might the Great Gatsby Curve be better estimated? Due to the demonstrated sensitivity of the estimates to the choice of before or after tax-and-transfer Gini coefficients, I propose disentangling the effects of earnings inequality, taxes, and transfers on the IGE.\(^7\)

Using estimates by the OECD (2011) of average tax rate \((T)\) payed by the top 20% of the earnings distribution and average benefit as a fraction of income \((B)\) transferred to the bottom 20% of the earnings distribution, I fit all possible combinations of IGE estimates to the modified Great Gatsby Curve,\(^8\)

\[
\beta_j = \gamma_0 + \gamma_1 G_j^B + \gamma_2 T_j + \gamma_3 B_j + \eta_j, \tag{6}
\]

where \(G_j^B\) is the before tax-and-transfer Gini coefficient. I find that the mean coefficient is 1.428 and 37.7% are statistically significant. Furthermore, I find that the mean coefficients on taxes and transfers are -0.833 and -0.204 and 70.5% and 95.7% are statistically significant, respectively. Thus, I conclude that inequality has a positive and somewhat statistically significant effect on IGE, while taxes and transfers have negative and mostly statistically significant effects on IGE.\(^9\)

\(^7\)I continue to suspend disbelief regarding omitted variables, as described in Footnote 2.
\(^8\)Even more so than the Gini coefficients from the OECD (2011,2013), the tax and transfer estimates correspond to more recent years than the IGE estimates, so the validity of the estimates depends on similarity over time in the Gini coefficients and tax and transfer rates.
\(^9\)I have no reason to believe that these results are robust to alternate model or statistical assumptions.
References


OECD (2011). Divided We Stand: Why Inequality Keeps Rising.

Figure 1: The Great Gatsby Curve of Corak (2013)

Figure 2: Corak’s Great Gatsby Curve (Corrected Gini)
Figure 3: Corak’s Great Gatsby Curve with Lower USA IGE Estimate

Figure 4: Great Gatsby Curve using Three Alternate Elasticities (Corrected Gini)
Figure 5: Distributions of Great Gatsby Curve Slopes for All IGE Combinations

Figure 6: Distributions of Great Gatsby Curve $p$-values for All IGE Combinations
Figure 7: Distributions of Great Gatsby Curve Slopes for All IGE Combinations

Figure 8: Distributions of Great Gatsby Curve $p$-values for All IGE Combinations