Measuring the contribution of stratification and social class at birth to inequality of opportunity

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Introduction

- This paper is motivated by the lack connection between two literatures that are essential for measuring inequality:
  - The literature on the economics of stratification
  - The literature on the inequality of opportunity

The economics of stratification

- Stratification economics was born out of the contribution of American economists to the Black Radical Tradition.[1]
- Darity (2005) argues that unless we assume that members of a marginalized group systematically make choices that leave the marginalized group worse off than the dominant group, these identity-based inequalities must be considered unfair.
- Seguino (2013) extends this idea of racial stratification to the sphere of gender inequality. She asserts that *gender justice* requires equal probabilities of achieving all potential outcomes in all identified social domains.
- Seguino's (2013) definition of gender (or other identity) justice is related to the philosophical argument of equality of opportunity.

[1] The June 2022 issue of the *Journal of Economic Literature* has a symposium on race and economic literature

Equality of opportunity

- Roemer (1998) mathematically formalizes the philosophical idea of equality of opportunity as distinct from equality of outcome (income).
    - The inequality of opportunity approach splits inequalities into two broad categories: inequalities due to individual's responsible decisions (i.e., accountable effort), and inequalities due to the birth lottery (i.e., initial circumstances at birth).
- Roemer (1998) shows that if the conditional distribution of residual luck is the same for all initial circumstances, the equality of opportunity condition requires that the quantile function of outcomes, conditional on the initial circumstances, be the same for all potential combinations of initial circumstances.
- If we include group identity among the individual's initial circumstances, then Roemer's (1998) equal opportunity condition and Seguino's (2013) concept of gender (racial) justice are equivalent.

Objective

- To provide a framework for measuring intergroup identity inequalities related to identity-based stratification.
- Build the link between the literature on the measurement of inequality of opportunity and the literature on the economics of stratification.
- **What we do:** Provide the measurement framework that distinguishes between inequalities due to identity-based stratification and those due to social class at birth.
- **What we don't do:** It is not intended to develop a theoretical framework explaining the emergence of this identity-based stratification.

Contribution

- Adapt the inequality of opportunity measurement framework to allow for the decomposition of inequality of opportunity into a component due to identity-based social stratification and another component due to social class at birth.

- We propose a measurement framework that adapts Temkin's (1986) idea that inequality is an aggregation of the complaints of individuals relative to their counterparts with the same level of *merit*.

Contribution

- We nest this view of inequality within the framework of Roemer's (1998) equal opportunity model by defining peers with the same level of *merit* as those with the same level of *responsible effort*.
    - This framework does not focus on individual outcomes but on the conditional distribution of outcomes related to individual initial circumstances, including identity.
- We propose a wide class of inequality of opportunity indices, develop the distributional properties that these indices should obey, and derive dominance conditions related to these ethical views.

Paper in Brief

- We develop a framework for measuring inequality of opportunity using the definition of inequality of opportunity proposed by Roemer (1998) and the definition of complaint proposed by Temkins (1986) while accounting for the underlying philosophy behind the economics of stratification.

- We take an empirical approach comparable to Pistolesi (2008), who uses a Cox proportional hazard model to address inequality of opportunity.

- In order to model conditional distributions of outcomes, we use a distributional regression approach (Chernozhukov, Fernandez-Vál, and Melly, 2013).

- The chosen empirical approach is also related to Brunori, Palmisano, and Peragine (2019) and Brunori, Ferreira, and Peragine (2021), who compare conditional distributions of outcomes using random forest classification models to identify circumstances that matter.

Paper in Brief

- We also provide an empirical application using data from the Egyptian Labor Market Panel Surveys for 1998, 2006, 2012, and 2018 (OAMDI, 2019).
- The results indicate a decrease in inequality of opportunity in Egypt between 1998 and 2012.
- The results indicate a decrease of the contribution of gender stratification to inequality of opportunity in Egypt until the Arab Spring.
- However, after 2012, the trend reversed and inequality of opportunity due to gender stratification increased.
- Conversely, inequality of opportunity due to social class at birth still decreases between 2012 and 2018.

Measurement framework: the model

- The initial circumstances of individuals are represented by a vector (a, x, g):
  - a: age of the individual (related to the time of birth)
  - x: socioeconomic characteristics
  - g: identity group which can be either dominant (D) or marginalized (M)
- It is useful to define age cohorts: $c \in \mathscr{C}$.
- The income, y, is generated by a function which depends on the initial circumstances, (a, x, g), the raw effort made by the individual, e_R, and the residual luck, ℓ.

$$y = \phi(e_R, a, x, g, \ell) \text{ with } \frac{\partial \phi(\cdot)}{\partial e_R} > 0$$

Measurement framework: the model

- Roemer (1998) argues that an individual's ability to produce raw effort, e_R, is also a function of initial circumstances (a, x, g).
  - Level of effort for which the individual must bear responsibility (accountable effort) is given by $e = G_{E_R|A,X,G}(e_R|a, x, g)$.
  - Roemer (1998) shows that if $\ell \perp\!\!\!\perp A, X, G$, then the individual has the same rank in $G_{E_R|A,X,G}(e_R|a, x, g)$ as in $F_{Y|A,X,G}(y|a, x, g)$.
  - $e = F_{Y|A,X,G}(y|a, x, g)$.

Measurement framework: from the model to the data

- It is important to note that in an empirical application, one cannot identify the level of accountable effort, e_i, associated with one observation.
    - The observed income, y_i is a function of both the individual's unobserved level of effort, e_{Ri}, and her unobserved realization of residual luck, ℓ_i.
- However, in an equality measurement framework, we are interested in the opportunity set that is offered to a person with initial conditions (a, x, g).
    - The quantile function $Q(e|A = a, X = x, G = g)$ associated with initial circumstances (a, x, g) represents the opportunity set of an individual born with these initial circumstances.
    - This mathematical object that can be estimated from the available data.

Measurement framework: what is inequality?

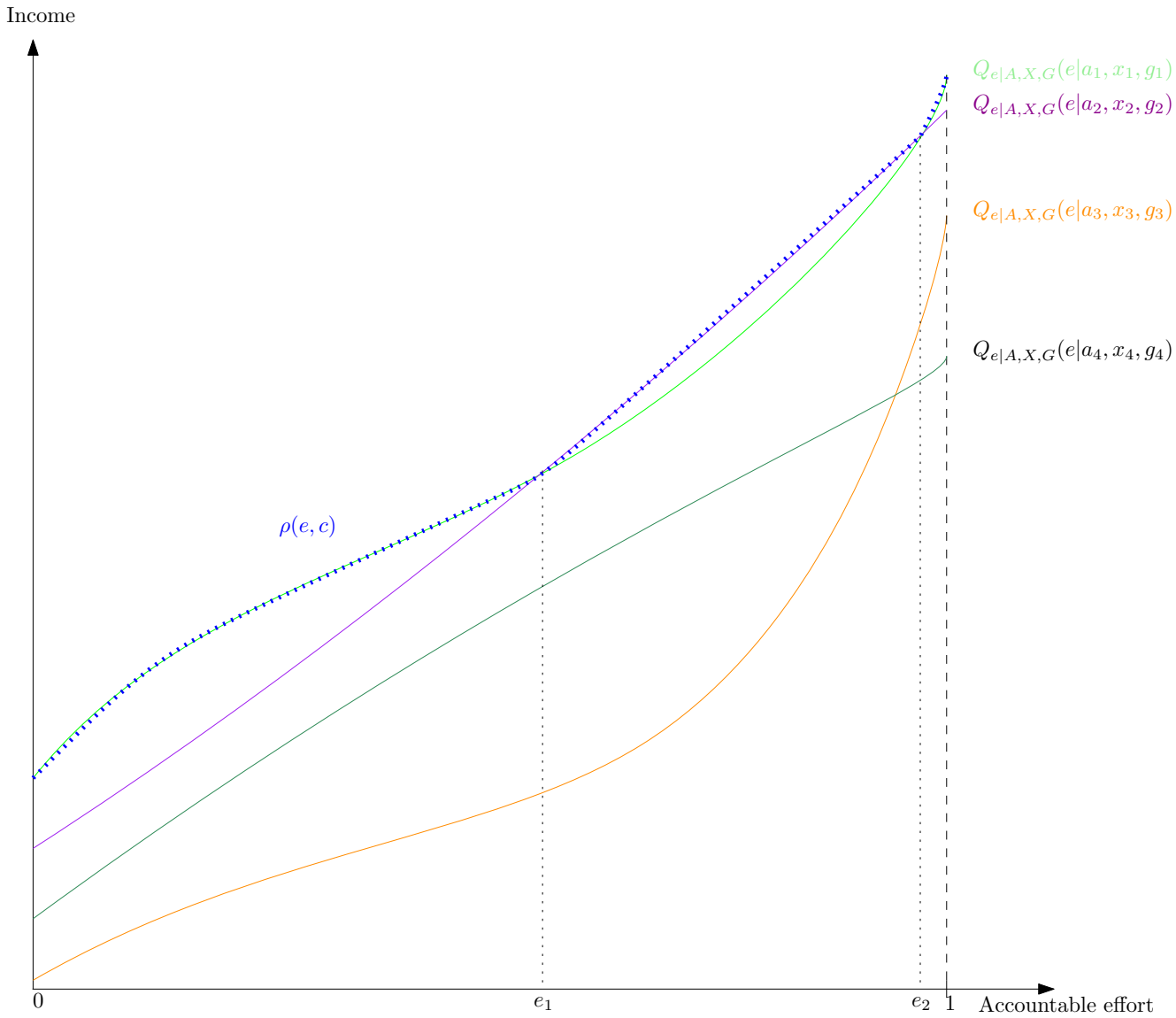
- The inequalities that are considered socially unfair, from an analyst's perspective taking an equal opportunity position, are the inequalities in the values of the conditional quantile function $Q_{Y|A,X,G}(e|a,x,g)$.

- Using Temkin's definition, inequality is then the complaint of an individual, $\kappa(e,a,x,g)$, with initial circumstances (a,x,g) and an accountable effort level e.

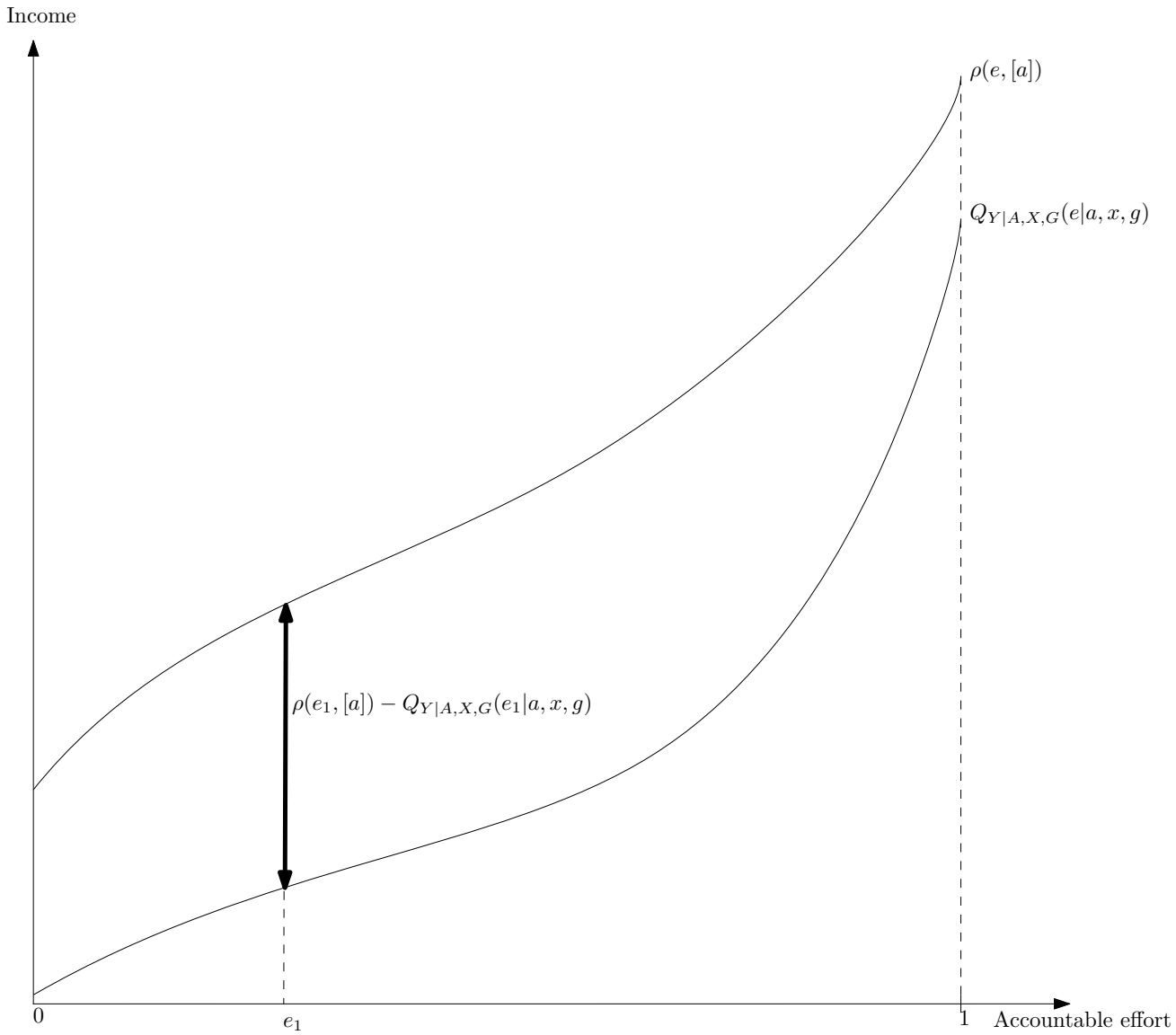
    - $\kappa(e,a,x,g)$ is the relative difference between the reward to effort level e for individuals with initial circumstances (a,x,g) and the maximum reward to effort e for the age cohort $c=[a]$.

- The complaint of an individual, $\kappa(e,a,x,g)$, with initial circumstances (a,x,g) and an accountable effort level e is thus defined with respect to $\rho(e,c)$, the upper envelope of the different quantile functions corresponding to the age cohort $c=[a]$.

The upper envelope, $\rho(e, c)$



Defining the complaint at an accountable effort level e_1



Inequality of opportunity index

- The overall complaint associated with the initial circumstances (a, x, g) can be defined as a weighted sum

$$\widetilde{\kappa}(a, x, g) = \int_0^1 \omega(e)\kappa(e, a, x, g)\mathrm{d}e,$$

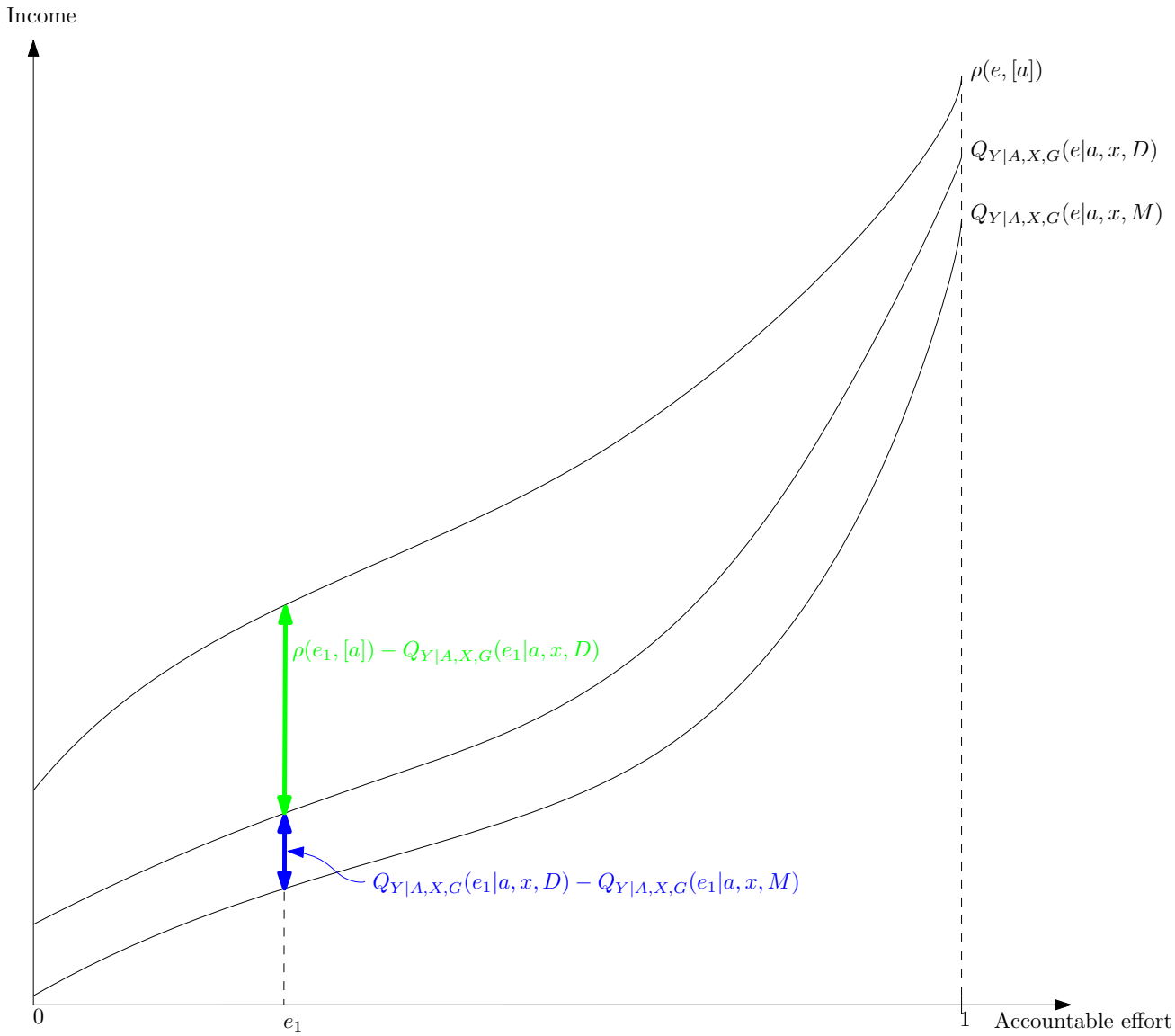
  - $\omega(e)$ is a social weight function related to complaints associated with an effort level e.
  - $\omega(e) \geq 0$ for all $e \in [0, 1]$
  - $\int_0^1 \omega(e)\mathrm{d}e = 1$

- An index of inequality of opportunity can thus be defined as an average of these complaints in the population

$$I(F_{Y,A,X,G}) = E[\widetilde{\kappa}(a, x, g)] = \sum_{g \in \{D,M\}} Pr[G = g] \int_{\mathscr{X}} \widetilde{\kappa}(a, x, g)\mathrm{d}F_{A,X|G}(a, x|g).$$

- $\Omega :=$ set of all opportunity inequality indices satisfying the above conditions.

Decomposition at an accountable effort level e_1



Contribution of stratification and social class at birth

- An index of inequality of opportunity can be decomposed as:

$$I(F_{Y,A,X,G}) = I^{Strat}(F_{Y,A,X,G}) + I^{Class}(F_{Y,A,X,G})$$

- The contribution of identity-based stratification is given by

$$I^{Strat}(F_{Y,A,X,G}) = \mathrm{E}[\widetilde{\kappa}^{Strat}(a,x,g)]$$

- The contribution of social class at birth is given by

$$I^{Class}(F_{Y,A,X,G}) = \mathrm{E}[\widetilde{\kappa}^{Class}(a,x,g)]$$

Complaint incidence curves

- The complaint incidence contribution is given by

$$CI(e, F_{Y,A,X,G}) = E[\kappa(e, a, x, g)|E = e]$$

- The complaint incidence contribution due to stratification is given by

$$CI^{Strat}(e, F_{Y,A,X,G}) = E[\kappa^{Strat}(e, a, x, g)|E = e]$$

- The complaint incidence contribution due to social class at birth is given by

$$CI^{Class}(e, F_{Y,A,X,G}) = E[\kappa^{Class}(e, a, x, g)|E = e]$$

First dominance conditions

Theorem

$\Delta I(F^0_{Y,A,X,G}, F^1_{Y,A,X,G}) \leq 0$ *for all indices* $I(\cdot) \in \Omega$ *if and only if*

$$CI(e, F^1_{Y,A,X,G}) - CI(e, F^0_{Y,A,X,G}) \leq 0 \; \forall e \in [0,1].$$

- We can derive similar results for $\Delta I^{Strat}(F^0_{Y,A,X,G}, F^1_{Y,A,X,G})$ and $\Delta I^{Class}(F^0_{Y,A,X,G}, F^1_{Y,A,X,G})$ using CI^{Strat} and CI^{Class}.

Additional ethical principles

- There are two possible avenues for introducing additional ethical principles

- **Pro-poor view:** The analyst has a greater aversion to complaints at the lower end of the distribution of accountable effort.
  - The weight function $\omega(e)$ is then non-increasing.
  - $\Omega_P \subset \Omega$ is the set of all pro-poor opportunity inequality indices.

- **Meritocratic view:** The analyst has more aversion to complaints at the top of the accountable effort distribution
  - The weight function $\omega(e)$ is then non-decreasing.
  - $\Omega_M \subset \Omega$ is the set of all inequality indices of meritocratic opportunities.

Complaint concentration curves

- The pro-poor complaint concentration contribution is given by

$$CC_p(e, F_{Y,A,X,G}) = \int_0^e CI(s, F_{Y,A,X,G})\mathrm{d}s.$$

- $CC_p^{Strat}(e, F_{Y,A,X,G})$ and $CC_p^{Class}(e, F_{Y,A,X,G})$ are defined analogously.

- The meritocratic complaint concentration contribution is given by

$$CC_m(e, F_{Y,A,X,G}) = \int_e^1 CI(s, F_{Y,A,X,G})\mathrm{d}s.$$

- $CC_m^{Strat}(e, F_{Y,A,X,G})$ and $CC_m^{Class}(e, F_{Y,A,X,G})$ are defined analogously.

Pro-poor dominance conditions

Theorem

$\Delta I(F^0_{Y,A,X,G}, F^1_{Y,A,X,G}) \leq 0$ *for all indices* $I(\cdot) \in \Omega_P$ *if and only if*

$$CC_p(e, F^1_{Y,A,X,G}) - CC_p(e, F^0_{Y,A,X,G}) \leq 0 \ \forall e \in [0,1].$$

- We can derive similar results for $\Delta I^{Strat}(F^0_{Y,A,X,G}, F^1_{Y,A,X,G})$ and $\Delta I^{Class}(F^0_{Y,A,X,G}, F^1_{Y,A,X,G})$ using CC_p^{Strat} and CC_p^{Class}.

Meritocratic dominance conditions

Theorem

$\Delta I(F^0_{Y,A,X,G}, F^1_{Y,A,X,G}) \leq 0$ *for all indices* $I(\cdot) \in \Omega_M$ *if and only if*

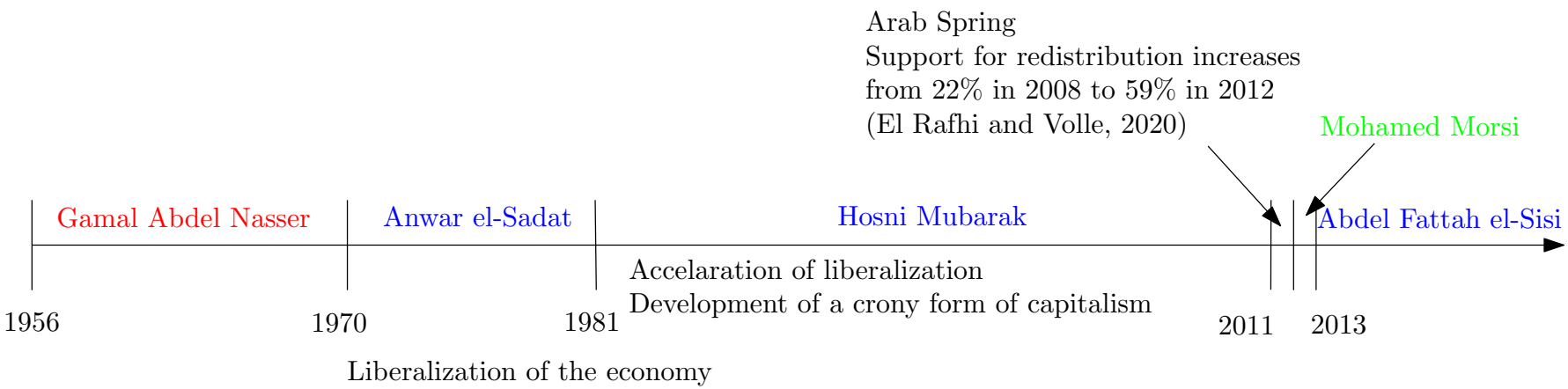
$$CC_m(e, F^1_{Y,A,X,G}) - CC_m(e, F^0_{Y,A,X,G}) \leq 0 \ \forall e \in [0,1].$$

- We can derive similar results for $\Delta I^{Strat}(F^0_{Y,A,X,G}, F^1_{Y,A,X,G})$ and $\Delta I^{Class}(F^0_{Y,A,X,G}, F^1_{Y,A,X,G})$ using CC^{Strat}_m and CC^{Class}_m.

Estimation and inference

- The estimation approach we use in this paper is a distributional regression model à la Chernozhukov, Fernandez-Vál, and Melly (2013).
- Chernozhukov, Fernandez-Vál, and Melly (2013) have shown the validity of the exchangeable bootstrap for the model, its counterfactual and their smooth functionals, including Kolmogorov-Smirnov type of statistics.
- We adopt a testing procedure that builds on Schechtman, Shelef, Yitzhaki, and Zitikis (2008) and Khaled, Makdissi, and Yazbeck (2018). This testing procedure uses a directional version of a testing statistics akin to the Kolmogorov-Smirnov statistics.

Egyptian context



Empirical application

- Our objective is to study the evolution of inequality of opportunity in Egypt. We also want to decompose this evolution into a component due to gender stratification and another due to social class at birth.

- We use the 1998, 2006, 2012, and 2018 cycles of the Egypt Labor Market Panel Survey (ELMPS).

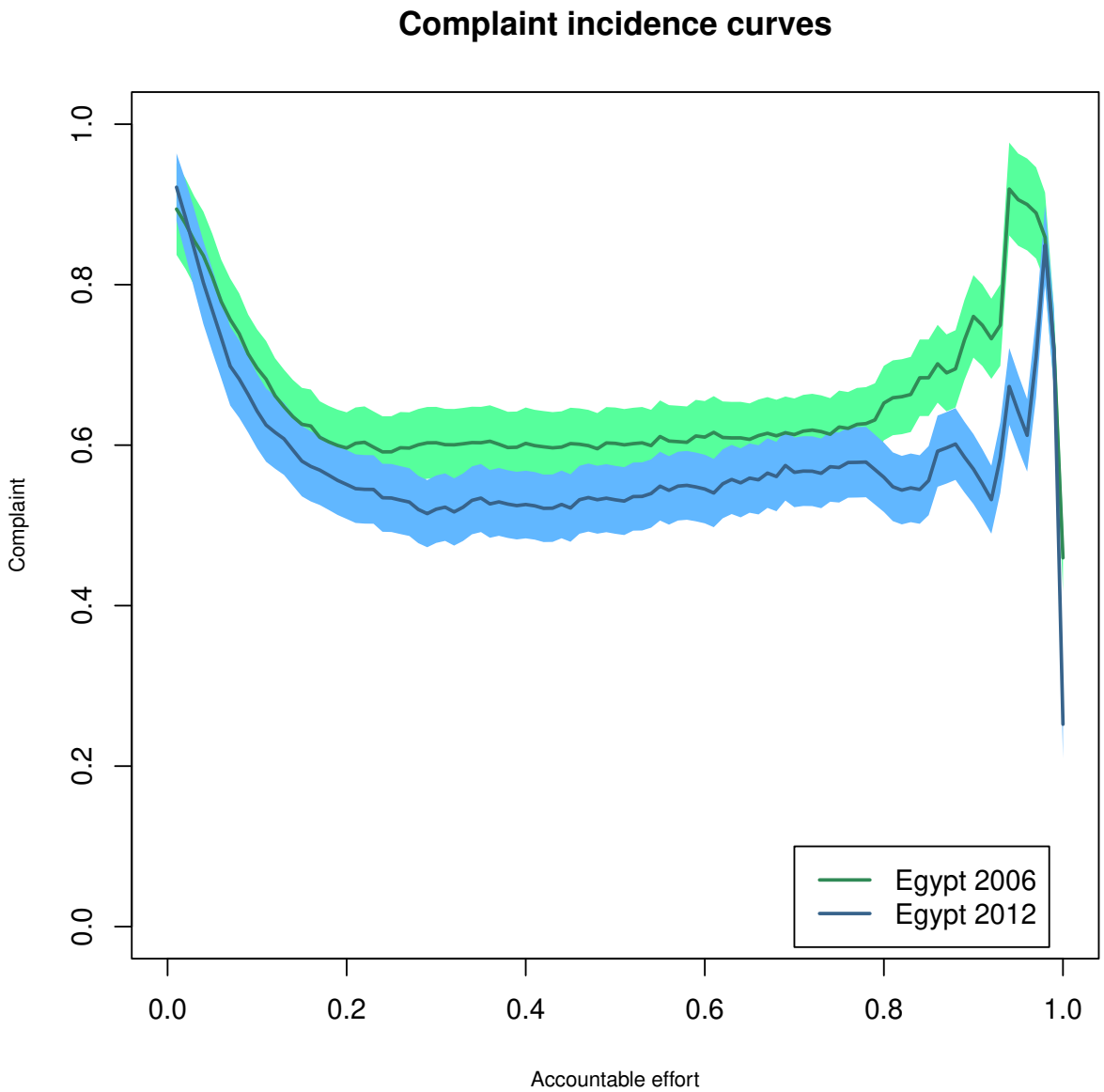
- **Outcome variable:** labor income

- **Initial circumstances:** education of both parents, type of employment of the father, region of birth, year of birth (age), gender.

Empirical application

- The ELMPS has an explicit question about the individual's main work activity that includes a category of unpaid family worker (not household production). Women make up the majority of these workers who have a wage of 0.
- Experts on the Egyptian labor market introduced an extended definition for employment that includes these unpaid employment activities (see Assaad and Kraft, 2015; Nazier and Ramadan, 2018).
- Since we are interested in stratification, this modeling choice allows us to include women in our analysis.
- We do not model labor market participation because unemployment in Egypt is primarily a phenomenon of the privileged (Assaad, Krafft, Roemer, and Salehi-Isfahani, 2018).
- Including individuals who are not in the labor force and have zero labor income may distort the picture of inequality of opportunity for this developing country.

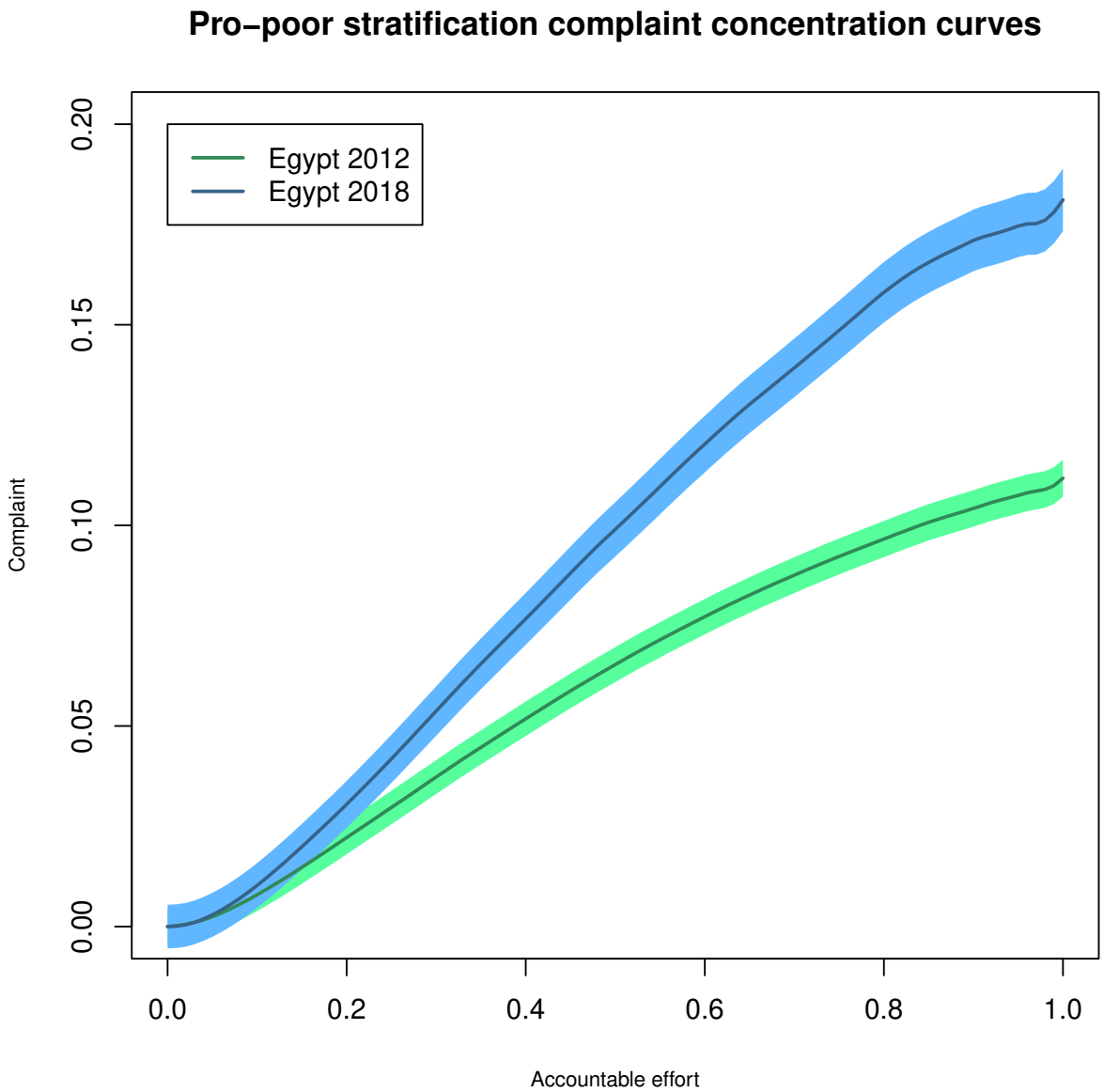
Changes in inequality of opportunity



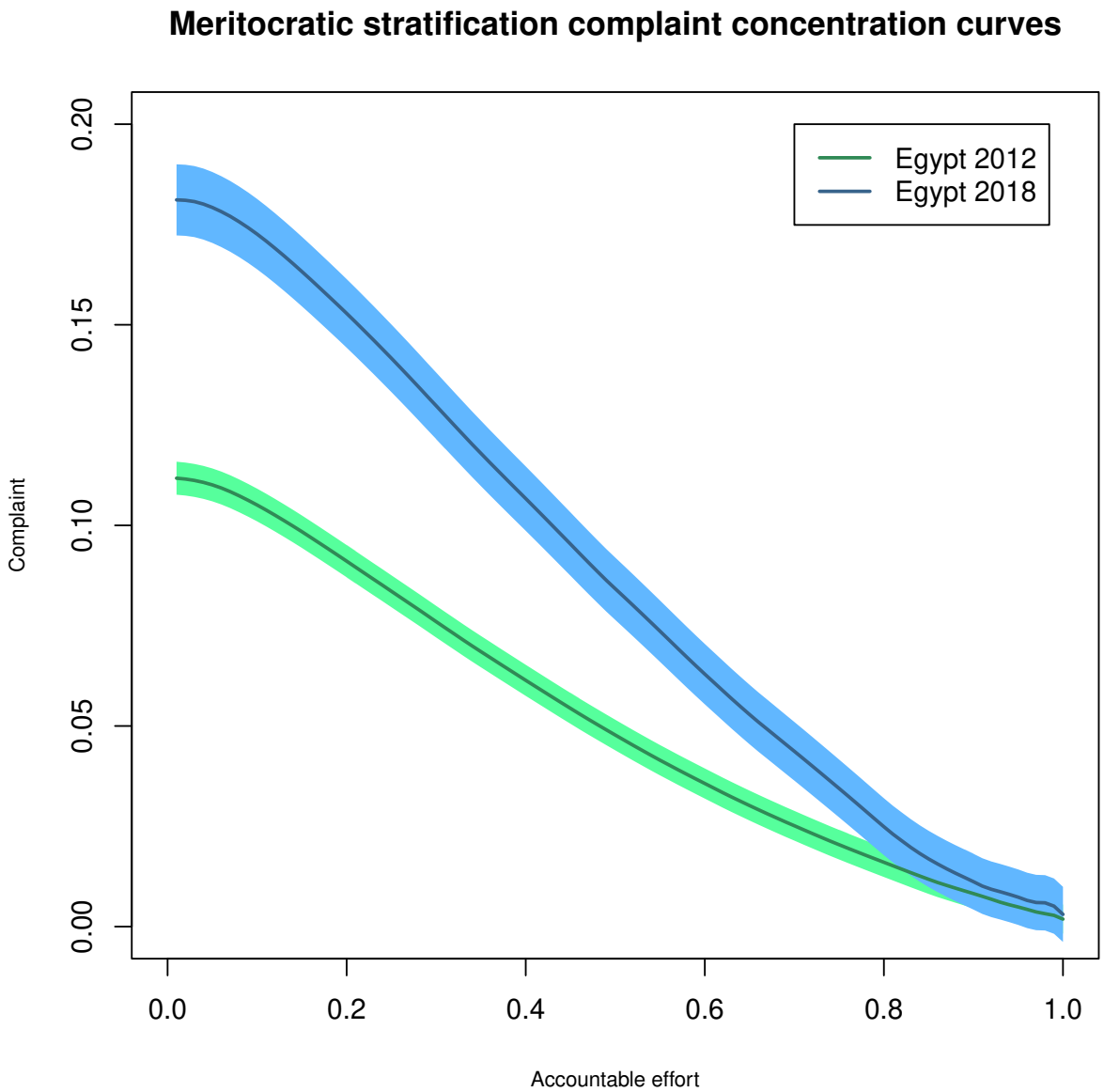
Changes in inequality of opportunity

- **Overall ranking:** $2018 \sim 2012 \begin{matrix} \succeq^{***}_{\Omega_P} \\ \succeq^{***}_{\Omega_M} \end{matrix} 2006 \sim 1998$
- **More rankings:** $2012 \succeq^{***}_{\Omega} 2006$
  $2012 \succeq^{**}_{\Omega} 1998$
- **Legend:**
  - $\sim$: No dominance
  - $\succeq_{\Omega}$: Dominance for all indices in Ω
  - $\succeq_{\Omega_P}$ Dominance for all indices in Ω_P
  - $\succeq_{\Omega_M}$ Dominance for all indices in Ω_M
  - $***$: Dominance $p-value \leq 0.01$
  - $**$: Dominance $p-value \leq 0.05$

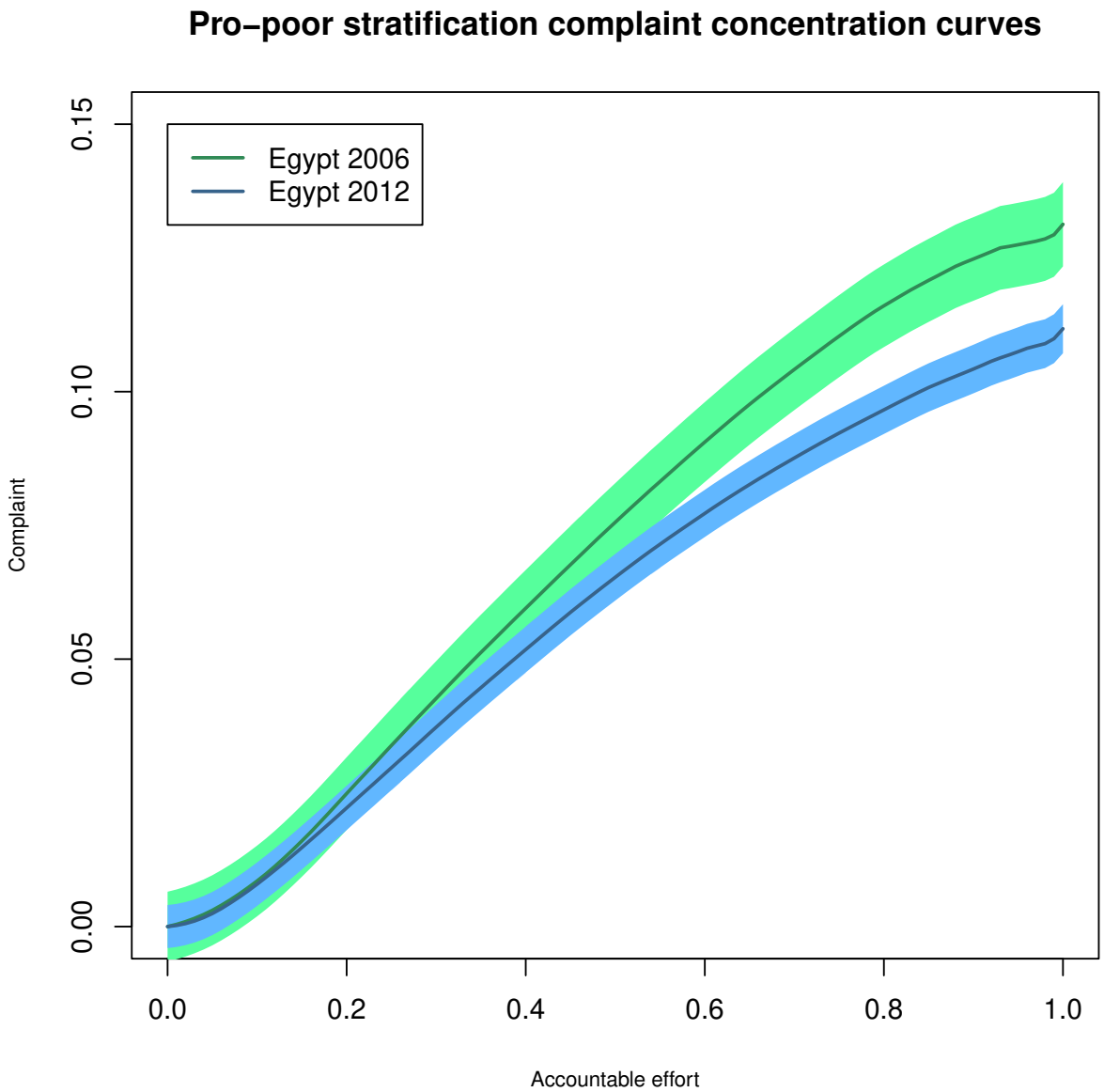
Changes in inequality of opportunity due to gender stratification



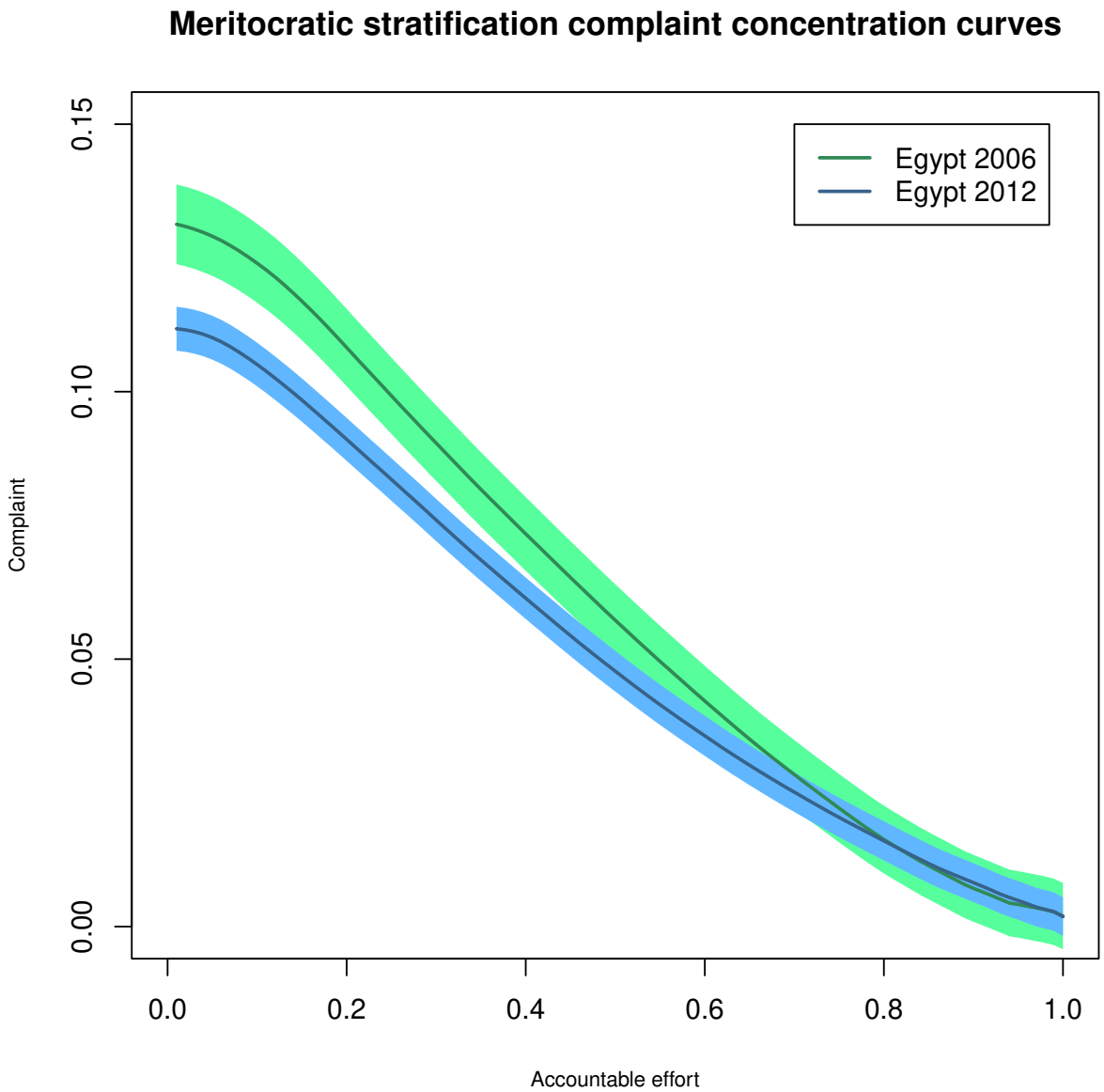
Changes in inequality of opportunity due to gender stratification



Changes in inequality of opportunity due to gender stratification



Changes in inequality of opportunity due to gender stratification

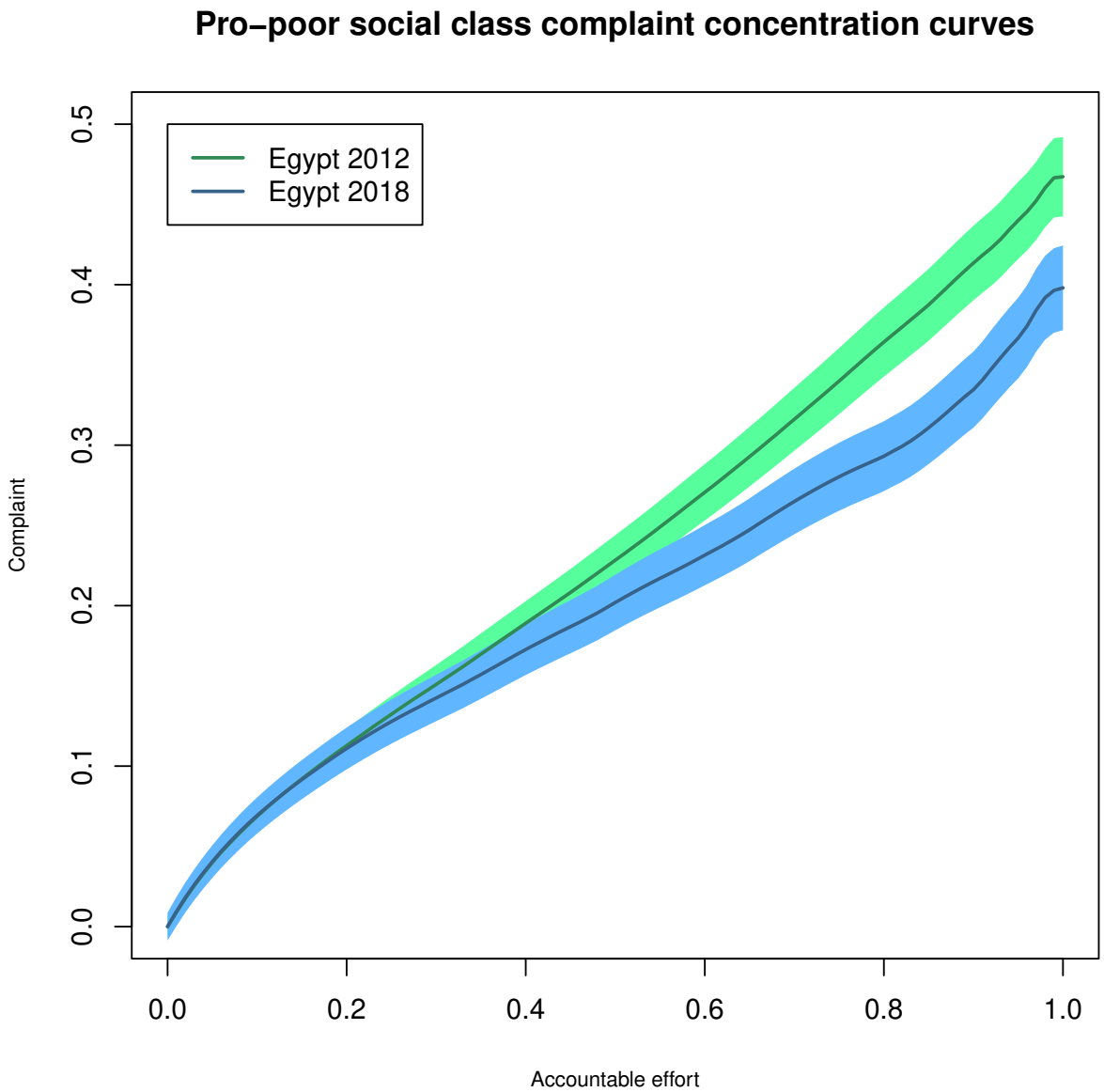


Changes in inequality of opportunity due to gender stratification

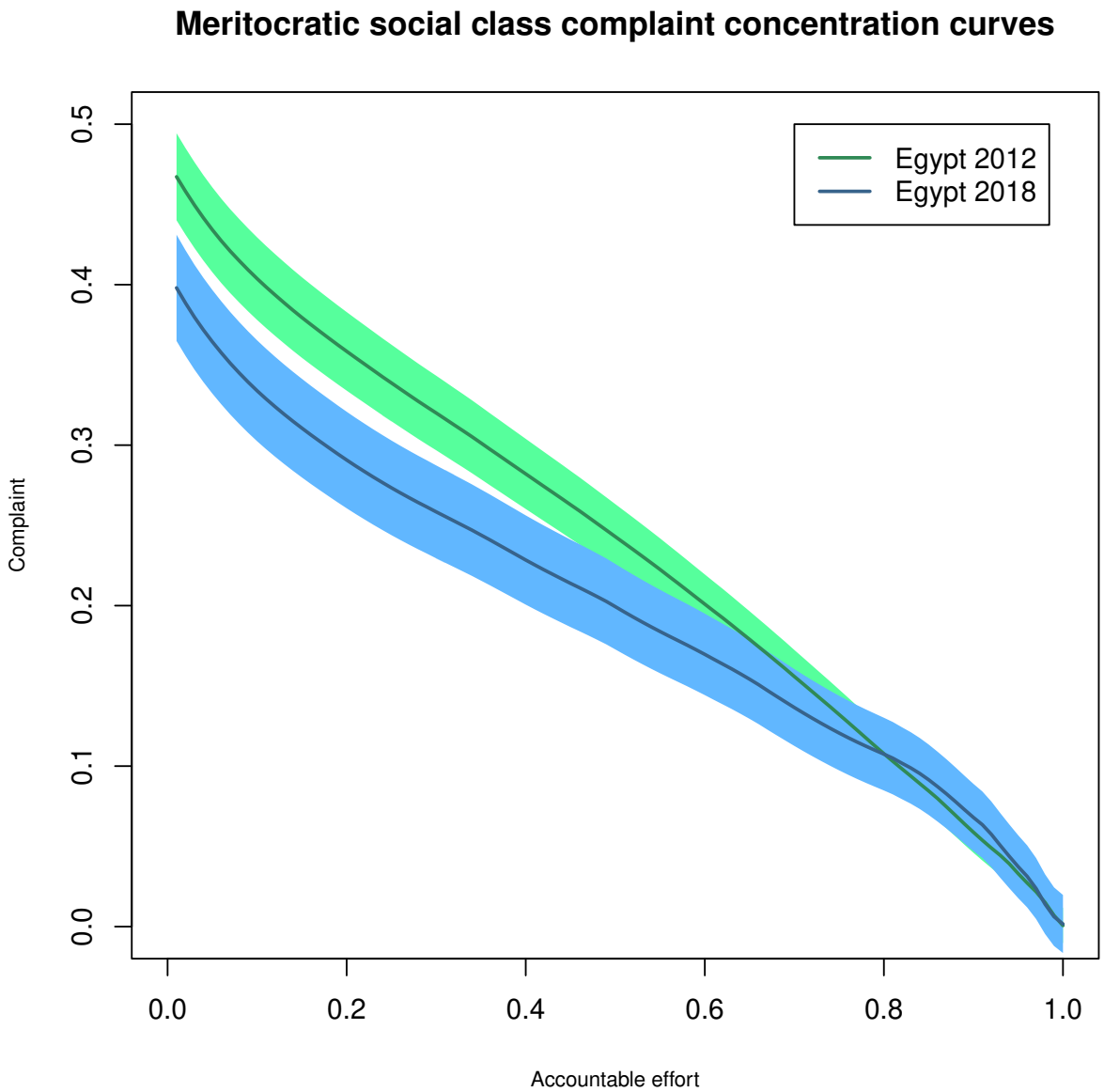
- **Overall ranking:** $2012 \underset{\succeq_{\Omega_M}^{**}}{\overset{\succeq_{\Omega_P}^{**}}{\succ}} 2006 \sim 1998 \underset{\succeq_{\Omega_M}^{***}}{\overset{\succeq_{\Omega_P}^{***}}{\succ}} 2018$

- **Legend:**
  - $\sim$: No dominance
  - $\succeq_{\Omega}$: Dominance for all indices in Ω
  - $\succeq_{\Omega_P}$ Dominance for all indices in Ω_P
  - $\succeq_{\Omega_M}$ Dominance for all indices in Ω_M
  - $***$: Dominance $p - value \leq 0.01$
  - $**$: Dominance $p - value \leq 0.05$

Changes in inequality of opportunity due to social class at birth



Changes in inequality of opportunity due to social class at birth



Changes in inequality of opportunity due to social class at birth

- **Overall ranking:** $2018 \begin{matrix} \succeq^{**}_{\Omega_P} \\ \succeq^{**}_{\Omega_M} \end{matrix} 2012 \begin{matrix} \succeq^{**}_{\Omega_P} \\ \succeq^{**}_{\Omega_M} \end{matrix} 2006 \sim 1998$

- **More rankings:**

$$2018 \begin{matrix} \succeq^{***}_{\Omega_P} \\ \succeq^{***}_{\Omega_M} \end{matrix} 2012$$

$$2018 \begin{matrix} \succeq^{***}_{\Omega_P} \\ \succeq^{***}_{\Omega_M} \end{matrix} 2006$$

$$2018 \begin{matrix} \succeq^{***}_{\Omega_P} \\ \succeq^{***}_{\Omega_M} \end{matrix} 1998$$

- **Legend:**
  - $\sim$: No dominance
  - $\succeq_{\Omega}$: Dominance for all indices in Ω
  - $\succeq_{\Omega_P}$ Dominance for all indices in Ω_P
  - $\succeq_{\Omega_M}$ Dominance for all indices in Ω_M
  - $***$: Dominance $p - value \leq 0.01$
  - $**$: Dominance $p - value \leq 0.05$

Changes in inequality of opportunity for men

- **Overall ranking:** $2018 \begin{matrix} \succeq^{**}_{\Omega_P} \\ \succeq^{**}_{\Omega_M} \end{matrix} 2012 \begin{matrix} \succeq^{**}_{\Omega_P} \\ \succeq^{**}_{\Omega_M} \end{matrix} 2006 \sim 1998$

- **More rankings:** $2018 \begin{matrix} \succeq^{***}_{\Omega_P} \\ \succeq^{***}_{\Omega_M} \end{matrix} 2012 \begin{matrix} \succeq^{***}_{\Omega_P} \\ \succeq^{***}_{\Omega_M} \end{matrix} 1998$

  $2018 \begin{matrix} \succeq^{***}_{\Omega_P} \\ \succeq^{***}_{\Omega_M} \end{matrix} 2006$

- **Legend:**
  - $\sim$: No dominance
  - $\succeq_{\Omega}$: Dominance for all indices in Ω
  - $\succeq_{\Omega_P}$ Dominance for all indices in Ω_P
  - $\succeq_{\Omega_M}$ Dominance for all indices in Ω_M
  - $***$: Dominance $p - value \leq 0.01$
  - $**$: Dominance $p - value \leq 0.05$

Changes in inequality of opportunity for women

- **Overall ranking:**
  $2012 \succeq^{***}_{\Omega} 2018$
  $2012 \succeq^{***}_{\Omega} 2006$
  $2012 \succeq^{**}_{\Omega} 1998$
  $2018 \sim 1998$
  $2006 \sim 1998$

- **More rankings:**
  $2012 \succeq^{***}_{\Omega_P} 1998$
  $2012 \succeq^{***}_{\Omega_M} 1998$
  $2006 \succeq^{**}_{\Omega_P} 2018$

- **Legend:**
  - $\sim$: No dominance
  - $\succeq_{\Omega}$: Dominance for all indices in Ω
  - $\succeq_{\Omega_P}$ Dominance for all indices in Ω_P
  - $\succeq_{\Omega_M}$ Dominance for all indices in Ω_M
  - $***$: Dominance $p - value \leq 0.01$
  - $**$: Dominance $p - value \leq 0.05$

Conclusion

- We develop a framework for measuring inequality of opportunity using the definition of inequality of opportunity proposed by Roemer (1998) and the definition of complaint proposed by Temkins (1986)
- We show how this framework allows us to decompose these inequalities into a component due to social class at birth and another component due to stratification based on an identity marker.
- This paper provides a new inequality of opportunity measurement framework that accounts for identity stratification.
- We provide the dominance conditions for all inequality of opportunity indices. We also provide dominance conditions for pro-poor indices and meritocratic indices.
- We use the available econometric models to estimate the model and test the dominance conditions

Conclusion

- We offer an empirical application aiming at measuring the contribution of gender stratification to inequality of opportunity in Egypt between 1998 and 2006.
- This twenty-year period in Egypt is an interesting case because it witnessed uprisings related to the Arab Spring, and an increase in demand for more equity in the population.
- It is interesting to note that confronted with an increased demand for equality, empirical evidences seem to suggest that the social system adjusted by decreasing the burden of inequalities of opportunity for the dominant group, men, while increasing it for the marginalized group, women.
- The method we propose can be adapted to other contexts in which stratification is another identity marker.
- It can also be adapted to incorporate multiple identities and potentially assess the impact of intersectionality of discrimination.