Dear Sir or Madam,

I am a PhD student from the Toulouse School of Economics (TSE), currently working under the supervision of prof. Christian Gollier, and I am expected to complete the program in 2028. I am very grateful to apply for the PhD Student Workshop on Climate Finance as my core research interests lie at the intersection between Finance and Environmental Economics. In particular, using tools from the structural econometrics literature, I aim to investigate how firm behaviour related to environmental and social sustainability can have an effect both on firm climate change adaptation and on the economy at large.

My first project, which I am submitting to the Workshop and you can find attached, concerns the interplay between firms' corporate sustainability practices and the labour market. My goal is to quantify the importance of worker preferences towards corporate social responsibility (CSR) and to measure the impact of investing in such initiatives on firm wage spending. Preliminary results show that workers have been willing to pay a compensating differential to work for greener companies in recent years, and, drawing on methods from the labour economics tradition, I develop a framework that allows to characterize how the differential varies with worker unobserved ability and thus how different workforce composition can determine differences in wage bill savings from increased sustainability performances for otherwise similar firms.

In the future, I am also planning to focus on other issues in the field of sustainable and climate finance. For instance, I am working with a fellow student to start a project on the natural catastrophe reinsurance system in France. We would be interested in studying how the availability of government-backed reinsurance is influencing the pricing and location decisions of private insurers. More in general, I am interested in the impact of climate change on firm location and in the trade-offs that firms face when deciding whether to invest in green technologies.

The PhD Workshop appears then as a very good fit for my research and I am sure it will constitute an extraordinary occasion to discuss my projects, as well as to meet and exchange ideas with faculty and fellow students that work on similar topics. I am confident that my background both in Finance and Environmental Economics will allow me to contribute to the intellectual discourse of the Workshop and to produce meaningful interactions with the other participants. I would also be happy to actively attend the presentations of the subsequent conference, as they will undoubtedly uphold high standards and align closely with my research interests.

For these reasons, I am very excited to submit my application for the PhD Student Workshop on Climate Finance. Do not hesitate to contact me in case you wish any further information or to write to my advisor, professor Gollier, if you need a reference. Looking forward to hearing from you, thank you very much for your attention and for your consideration.

Best regards,

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RESEARCH INTERESTS

Finance, Environmental Economics, Applied Microeconomics

WORKING PAPERS

Do workers care about CSR? Compensating differentials and sorting implications of sustainability ratings

EDUCATION

09/23 - present	**PhD in Economics** Toulouse School of Economics – Toulouse, France *Supervisor: prof. Christian Gollier*
09/20 – 09/22	**Master Analysis and Policy in Economics (APE)** Paris School of Economics – Paris, France *Thesis: "Vertical differentiation and bounded rationality: how do responsible firms behave?"*
09/19 – 09/23	**Diplôme de l'École Normale Supérieure** (ENS "grande école" higher education diploma) **Minor in Cognitive Science | Minor "East Asia"** École Normale Supérieure (ENS Ulm) – Paris, France
09/16 – 07/19	**Laurea in Economia e Commercio** (Bachelor's degree in Economics and Business) Università Ca' Foscari Venezia – Venice, Italy *Thesis: "Market structure, public officials and users: an economic analysis of corruption"*
09/16 – 07/19	**Higher Education Diploma of Excellence** | **Minor in Digital Humanities** Ca' Foscari International College – Venice, Italy
09/14 – 06/15	**High School Graduation Diploma** West Kings District High School – Auburn, NS, Canada
09/11 – 07/16	**Diploma Di Maturità Scientifica** (Secondary School Diploma in Scientific Studies) Liceo Scientifico Statale "Leonardo Da Vinci" – Treviso, Italy

INTERNATIONAL EXPERIENCES

09/22 – 06/23	**Graduate non-degree visiting student (ENS exchange program)** University of Chicago	Chicago, USA
02/18 – 06/18	**Erasmus Mobility Program** *5 months* Universidade Nova de Lisboa School of Business and Economics	Lisbon, Portugal
09/14 – 06/15	**Nova Scotia International Students Program** *10 months*	Kingston, Canada

TEACHING EXPERIENCE

2024	Microeconomics 1, Microeconomics 5 (Teaching Assistant) *Toulouse School of Economics*	Toulouse, France
2022/2023	French (Language Assistant, Lecturer) *Department of Romance Languages and Literatures, UChicago*	Chicago, USA

WORK AND VOLUNTEERING

2019/2020	"Dynamics of Capitalism" Teacher, *TALENS program*	Paris, France
2019	Intern (labour law consultancy) *Studio Ass. Pannisco Consulenza del Lavoro*	Treviso, Italy
2018/2019	Organiser of the event "Intersezioni", *College students' initiative*	Venice, Italy
2018/2019	Students' Representative, *Ca' Foscari International College*	Venice, Italy
2016	Italian teacher for foreigners, *Caritas Tarvisina*	Treviso, Italy

AWARDS AND SCOLARSHIPS

2023	Recipient of a "Contrat Doctoral Spécifique Normalien" (CDSN) doctoral contract
2022 – 2023	Recipient of UChicago – ENS exchange program stipend
2019 – 2022	"Sélection Internationale Lettres" (SIL) bursary of the École Normale Supérieure (ENS)
2018	Admitted to Columbia University (New York, USA) Master of Arts in Economics
2018	First prize as best first year student of bachelor's degree in Economics and Business
2016 and 2018	Recipient of Ca' Foscari International College voucher for total expenses coverage
2017	Recipient of Ca' Foscari International College voucher for 75% expenses coverage
2016 and 2017	University tuition scholarship from the National Institute of Italian Magistrates
2016	High school honours with distinction scholarship (*Contributo per lode agli esami di Stato*)
2015	Bronze Standard of the Duke of Edinburgh's Award
2015	West Kings Junior Varsity Boys Basketball Coaches Award 2014-2015
2015	Grade 12 Subject Award in Global Economics; Grade 11 Subject Award in Canadian History
2013	Third place of 2nd year students, Certamen "Ludi Canoviani" II edition (*Latin competition*)

COMPUTING SKILLS

R, MATLAB, Stata, Julia, Python, SQLite Studio, Processing

LANGUAGES

Italian (native); English, French (fluent); Portuguese (Advanced); Japanese, German, Russian, Gaelic (beginner).

Do workers care about Corporate Social Responsibility? Compensating differentials and sorting implications of firm sustainability ratings

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Abstract

This study aims to assess the effects of CSR (Corporate Social Responsibility) on the labour market. CSR encompasses policies aimed at reducing environmental impact, creating an inclusive workplace, and improving the firm's internal decision-making processes. Associated with ESG measures (Environmental, Social, Governance), CSR is increasingly becoming a key criterion for job seekers, especially for the young generations, who specifically look for companies that are environmentally friendly, transparent, and inclusive. Adopting these practices can then be a way for companies to attract and retain talent. This study builds a model of the labour market that allows to estimate the importance of employee preferences towards CSR practices and the impact of these preferences on sorting patterns across firms. Using matched employer-employee data from France and ESG scores from LSEG (formerly Refinitiv) for the period 2002-2021, preliminary reduced-form results show that the relationship between firm fixed effects from an interactive regression model and corporate sustainability has become increasingly negative over time. This suggests that the importance of CSR in employment decisions has grown steadily during the period considered, meaning that, in later years in our sample, workers have accepted lower compensating differentials for the same increase in firm sustainability.

1 Introduction

Corporate Social Responsibility (CSR) designs any type of corporate initiative which aims at improving a firm's environmental impact, fostering a safe, inclusive and diverse workplace environment and making internal decision-making processes fair and transparent. All these actions are associated with implementation costs that the firm willingly uptakes in order to increase social welfare rather than profit. Despite the investment that it requires, Corporate Social Responsibility has been gathering considerable momentum over the recent years and businesses all around the world are striving to adopt sustainability initiatives. Rajan, Ramella, and Zingales (2023) show, for example, that the percentage of companies mentioning environmental and diversity related objectives in their shareholder letter has risen from 20% in 1980 to 90% in 2020. At the same time, Environment Social and Governance (ESG) rankings, which are produced by third-party rating agencies and are designed to reflect a company's performance with regard to environmental and social issues, have taken increasingly more space in investors' decisions. According to Bloomberg, total ESG assets worldwide reached $30 trillion in 2022 are are projected to surpass $40 trillion by 2030, which would represent about 25% of total assets under management. These figures raise the obvious question: why would profit-driven companies engage in CSR activities at all, given that they are costly?

Many possible explanations can justify the adoption of CSR practices by the firm. For instance, the fact that companies might care about CSR because of shareholder or consumer activism is well established (Gollier and Pouget, 2022; Broccardo, Hart, and Zingales, 2022). Less attention has, however, been given to another important mechanism that could explain the rise of ESG in the corporate world, namely workers' preferences and their impact on employment decisions. Indeed, one may not only want to buy green products and invest in ESG assets, but also work for a socially responsible company. Job-seekers might preferentially look for green companies and potentially even accept a lower salary to work in a firm that is deemed more sustainable. Corporate sustainability, as measured by ESG scores, could then be perceived as a workplace amenity and workers could potentially be willing to pay a compensating differential, i.e. a wage reduction, to obtain it. If this is the case, investing to improve the company's social and environmental impact would become a way to attract and retain talent.

Evidence from surveys (Climate Vault Solutions, 2023) and experimental studies on online job search platforms (Burbano, 2016; Colonnelli et al., 2024) suggest that workers indeed care about

workplace sustainability and might accept lower salaries to work in a company that mentions CSR engagement in its job offers. It is then natural to ask: does observational data also show evidence of employee preferences towards CSR? And which consequences do these preferences have on labour market sorting and firm incentives in setting CSR agendas?

To answer these questions, drawing on a large literature in labour economics (Rosen, 1974; Bonhomme, Lamadon, and Manresa, 2019; Lamadon, Mogstad, and Setzler, 2022; Lavetti, 2023), the goal of this study is to leverage rich matched employer-employee data from France to estimate a model of the labour market where workers' utility is allowed to depend on their company's CSR level, as measured by their firm ESG Score. Our model of the labour market allows for unobserved heterogeneity both in firm and worker productivity, so that it can capture potential difference in sensitivity to corporate responsibility across worker types and can therefore accommodate rich patterns of labour market sorting. Our empirical strategy proceeds in steps, progressively adding more structure. We start by implementing the classical two-way fixed effect regression framework of Abowd, Kramarz, and Margolis (1999) to get an initial estimate of the average compensating differential at different points in time, under specific functional forms and strong assumptions on unobservables. Then, we relax these assumptions, by exploiting the structure of matched employer-employee data, first through a group fixed effect approach (Bonhomme, Lamadon, and Manresa, 2019) and then imposing additional moment conditions derived from the model to recover the full parameter space.

Our results will help shed light on three important aspects. First, we will be able to recover worker preferences directly exploiting information on their observed wage and employment choices, to characterize the magnitude of the compensating differential and its trend in time. Second, the model will allow to explore sorting induced by the firms' sustainability practices. Third, we will also be able quantify the benefit of raising CSR for the firms in terms of increased talent attraction and reduced total wage bill. Moreover, estimating the model will also permit to conduct counterfactual analysis. We plan in particular to use our model to analyze the consequence of an increase in ESG investment costs, as well as of an exogeneous shock to employee CSR preferences.

More specifically, a first aim of this paper is to determine how relevant the firm's social responsibility is for employment decisions. Although the concept of compensating differential is quite simple and intuitive, formally characterizing equalizing wage differences across jobs with observational data has proven to be quite challenging (Lavetti, 2023). In common with other contributions, the main source

of difficulty in the estimation of compensating differential in our setting is that the econometrician does not observe how the set of available job offers vary across worker unobserved types. In particular, workers of different unobserved skill might not have access to the same offers. In our model, substitutability of worker types and differentiation in job offers ensure that all firms employ all type of workers, but, importantly, at varying degrees, in line with evidence from previous contributions (Bonhomme, Lamadon, and Manresa, 2019). Exploiting these structural assumptions, it is possible to quantify different worker types' willingness to pay for workplace corporate sustainability from their observed wages and employment choices. Results from an interactive regression model (Abowd, Kramarz, and Margolis, 1999) show a decreasing trend in the relationship between firm fixed effects and ESG Scores over time. In early years in our sample, workers seem to have accepted higher salaries for higher ESG ratings, all else being equal, while in later years in our sample this trend reverses and we find evidence suggestive of a negative compensating differential.

A second aspect that our analysis addresses relates to labour market sorting. Indeed, exactly as workers differ in skill, firms are also likely to be heterogeneous in productivity, with this second dimension also being fundamentally unobservable. The degree of complementarity between these two unobserved components is subject of debate (Bagger and Lentz, 2019; Lentz, Piyapromdee, and Robin, 2023), but if skill and productivity are complements, one may expect some positive assortative matching. High-skill workers will choose to work preferentially for productive firms. But if workers are heterogeneous in their preference for ESG, one also expects more engaged workers to work preferentially for more responsible firms. How do these two aspects interact? In our model, imperfect competition prevents perfect assortative matching and answering this question is non-trivial. Notably, the intensity, sign and distribution of preferences for ESG across different worker types crucially shape the magnitude and size of aggregate sorting effects. Our empirical strategy based on Bonhomme, Lamadon, and Manresa (2019) aims to recover preferences for CSR across different worker types and will thus be informative about the interplay between productivity and preference sorting in our sample.

Finally, with regard to impact of workers' employment preferences on the firm incentives, if workers are willing to give up some of their wage in order to work in a more responsible firm, then firms that raise their ESG level will simultaneously increase production and reduce their total wage bill. Even if they do not care about sustainability *per se*, corporations will then have an incentive to invest

in a socially responsible way to attract talent at lower cost. This result is symmetric to reduced cost of capital due to investor activism and increased revenues due to consumer preferences for green products. In order to quantify the relative importance of the labour market mechanism with respect to these other channels, a full estimation of the parameter space of our model will help determine how impactful the choice of corporate sustainability is on firm profitability through its effect on wages. The analysis could then help to gauge how much worker preferences are contributing to corporate green transitions and to compare with investor and consumer effects.

The paper is organized as follows. Section 2 reviews the literature. Section 3 presents the model of the labour market and its equilibrium. Section 4 discusses at length the structure of the model and their theoretical consequences under simple assumptions. Section 5 illustrates our empirical research design and the subsequent sections (6, 7 and 8) detail each method and its results. Section 9 concludes.

2 Literature

This study relates to three different streams of literature. First, there exist a large body of works on the importance of meaning at work and on the role of the firm social performance in shaping employee welfare (Turban and Greening, 1997; Cassar and Meier, 2018; Portocarrero and Burbano, 2024; Ashraf et al., 2025). We contribute to it by quantifying workers' preferences for corporate social responsibility directly from observational employer-employee data. To the best of our knowledge, this is the first attempt at estimating a model of the labour market with CSR amenities from historical data.

A few contributions in this literature relate closely. Some works (Burbano, 2016; Hedblom, Hickman, and List, 2019; Colonnelli et al., 2024) have used different experimental designs on job-matching platforms to show evidence of preferences towards CSR messages. They all find significant effects of mentioning CSR in job offers: Burbano (2016) documents a 44% reduction in wage bids, Hedblom, Hickman, and List (2019) finds an increase of 25% in number of applications received by the firm and Colonnelli et al. (2024) estimates an average compensating differential of 8% of the mean wage. At the same time, one other important focus of our study is to characterize the consequences of worker preferences on sorting across firms when ESG levels are chosen endogeneously by the firm and are costly. Colonnelli et al. (2024) also develops a similar model, but in their counterfactual they predict

ESG adoption using survey data, rather than relying on the model structure.

Our study also puts an emphasis on double-sided heterogeneity, both in worker and firm productivity. Since we cannot rely on good measures of workers' skill and firm productivity, these will be inferred from wages and job choices. Differently, Krueger, Metzger, and Wu (2023) explores the relationship between ESG and wages relying on matches between ESG leader and laggard firms by industry, under the assumption that these firms have comparable productivity. Unlike in our setting, they also have measures of employee skill and argue that they are accurate. Since skill is observed and firms are homogeneous, results from a Mincer type regression of wages on ESG levels, controlling for skill, can indeed be interpreted directly as evidence of compensating differentials. Provided these assumptions hold, the evidence from Krueger, Metzger, and Wu (2023) suggests that workers care about ESG, especially so if they are more skilled.

More generally, our work relates to the large literature on ESG and CSR in general (Bénabou and Tirole, 2010; Gillan, Koch, and Starks, 2021). Some contributions adopt a normative perspective, fuelling the discussion around the objective of the firm and especially about whether firms should pursue goals other than shareholder value (Friedman, 1970; Hart and Zingales, 2017). In our model, instead, firms are profit-driven but CSR arises because of worker preferences towards sustainability. Many other works adopt a similar approach and are concerned with explaining the rise of ESG, but usually focus on investors' motivations (Broccardo, Hart, and Zingales, 2022; Gollier and Pouget, 2022; Oehmke and Opp, 2025; Gillan, Koch, and Starks, 2021) or consumer activism (Leonidou, Katsikeas, and Morgan, 2013). Very little attention has instead been dedicated to other stakeholders, employees in particular (Edmans, 2012; Edmans et al., 2024).

Finally, our work draws on a very large literature on compensating differentials and sorting in the labour market. Concerning compensating differentials, a seminal work in this field is Rosen (1974), with more recent literature focused on structural approaches, such as Gronberg and Reed (1994), Burdett and Mortensen (1998), Dey and Flinn (2005), Bonhomme and Jolivet (2009) and Jarosch (2023). With regard to sorting, a separate stream of the literature has focused either on two-way fixed effect approaches, in the spirit of Abowd, Kramarz, and Margolis (1999), or on structural models of the labour market (Bagger and Lentz, 2019; Bonhomme et al., 2023). Bridging the two, Bonhomme, Lamadon, and Manresa (2019) shows how fixed effect specifications can encompass a large class of models. Still, these works ignore compensating differentials, as adding non-wage amenities when

workers are heterogeneous leads to the aforementioned problem of unobservability of the offer set (Lavetti, 2023). To overcome this issue, previous contributions have either exploited quasi-random variation in amenities (Lavetti, 2020), or relied on assumptions on the labour market. For example, Lavetti and Schmutte (2018) assumes search, while Lamadon, Mogstad, and Setzler (2022) assumes imperfect competition. If instead a good measure of skill or a skill proxy is available, such is in Bell (2022) or Maideu-Morera (2024), then it is possible to make assumptions linking job offers directly to worker ability. However, this will not be the case with the data used in this paper.

3 Model

In our model, we revisit a setting of imperfect competition in the labour market, such as in Lamadon, Mogstad, and Setzler (2022) and Colonnelli et al. (2024), but we allow corporate sustainability levels to be costly and endogeneously chosen by the firm. In this section, we show the fundamental assumptions of the model and we characterize its equilibrium, highlighting the features that are relevant to address the questions raised in the introduction.

We consider a labour market with I workers, indexed by i, and J firms, indexed by j. Each worker has a type s from a finite, discrete set of types $\{\varsigma_1, \varsigma_2, ..., \varsigma_S\}$, and corresponding productivity $A(s)$. Firms have productivity A_j that we also consider to take values from a finite, discrete set of firm productivity levels.

Workers. Worker i derives the following utility from working at firm j:

$$u_{ij}(w_j, E_j, B_j) = \log w_j + \log G(s_i, E_j) + \log B_j(s_i) + \frac{1}{\tau}\varepsilon_{ij} \tag{1}$$

where w_j is the wage offered by firm j, s_i is the type of worker i, B_j are the non-wage amenities at firm j, τ is a parameter and ε_{ij} is an idiosyncratic component which is specific to the worker-firm match. The term G encapsulates the "green" amenity, i.e. how much utility a worker of type s_i derives from the social responsibility level of firm j, E_j. There are many possible justifications for this term. For example, workers that care about environmental or social issues might benefit from the fact of working with like-minded people. The presence of this type of network effects would lead "green" workers to care about the ESG dimension of the firm because it would mean that they are

more likely to find other "green" employees at that firm. Also, workers might value adhering to their own moral standards. Suppose for example that a job-seeker cares a lot about recycling. Then working in a company that does differentiate waste and promotes recycling could enable her to keep her habit on the workplace and it might be valuable *per se*.

Notice that both the valuation of the sustainability amenity and other non-wage amenities depend on worker type, because we want to allow for heterogeneous preferences for ESG initiatives. Indeed, it is hard to believe that all workers would care equally for corporate sustainability. Still, our assumption implies that workers of the same type cannot have different valuations of corporate sustainability. Up to this point, we have been agnostic on the content of the type, but since each type s maps to a specific productivity $A(s)$, this is equivalent to say that equally productive workers have the same valuation of social responsibility. This is true if there exist some link between components of type, such as skill, and preferences. For example, high-skill workers are usually more educated and individuals that are more educated are also more likely to be informed about climate and social issues. That could be one reason why high-skill workers might care relatively more for the environment. This assumption can however be limiting and we plan to relax it in a more general version of our model.

In the remaining part of this and the next section (Section 4), we will focus on CSR amenities and thus disregard the $B_j(s)$ term for all worker types.

Firms. Firms face the following production function:

$$Y_j = A_j \left(\sum_s A(s) L_j(s) \right)^{1-\alpha} \tag{2}$$

where Y_j is output of firm j, $A(s)$ is the productivity of workers with skill s, A_j is the productivity of the firm, $L_j(s)$ is the number of employed workers of type s and α is a parameter governing returns to scale. We will assume $0 < \alpha < 1$. The chosen shape of the production function implies that workers of different skills as substitutes, while firm productivity and worker productivity are complementary. As a consequence, any firm will hire all types of workers. It is important to keep these assumptions in mind when considering the results that will follow.

Firms face monopsonistic competition on the labour market. They have some market power, but they are small relative to the market, so they anticipate the effect of their choices on their own labour supply but they do not internalize the consequences on other firms, i.e. they do not behave

strategically with respect to their competitors. Formally, firms choose demand by posting wages for each worker type and corporate social responsibility levels so that profit is maximized subject to the constraint that demand must not exceed supply. The problem of the firm is then:

$$\max_{w_j(s),E_j} A_j \left(\sum_s A(s) L_j(s) \right)^{1-\alpha} - \sum_s w_j(s) L_j(s) - C_j(E_j) \quad \text{s.t.} \quad L_j(s) = S_j(s, w_j, E_j) \tag{3}$$

where C_j is the cost of picking CSR level E_j and is assumed to be non-decreasing in E_j, i.e. $C'(E_j) \geq 0$ for all j. We will indicate the profit of the firm Π_j as a function of labour demand for each type wages for each type $\{L_j(s)\}_{s=1}^S$, wages for each type $\{w_j(s)\}_{s=1}^S$ and social responsibility level E_j.

Equilibrium. An equilibrium in this setting is a set of worker choices $j(i)$ for each i, offered wages $w_j(s)$ for each firm j and each worker type s and CSR level E_j for each firm j such that:

- workers choose the firm that maximizes their utility, i.e. for each i:

$$j(i) = \arg\max_j \log w_j + \log G(s_i, E_j) + \frac{1}{\tau} \varepsilon_{ij} \tag{4}$$

- firms choose offered wages $\{w_j(s)\}_{s=1}^S$ and ESG level E_j to maximize profits:

$$\begin{aligned} \{w_j(s)\}_{s=1}^S, E_j = \arg\max_j \Pi_j \left(\{L_j(s)\}_{s=1}^S, \{w_j(s)\}_{s=1}^S, E_j \right) \\ \text{s.t.} \quad L_j(s) = S_j(s, w_j, E_j) \, \forall s \end{aligned} \tag{5}$$

Concerning workers' employment decisions, under the assumption that ε_{ij} follows a Type-1 generalized extreme value distribution, if all workers choose optimally, the share of workers of of type s that pick firm j given the set of offered wages $W(s) = \{w_j(s)\}_{j=1}^J$ is

$$\mathbb{P}[j(i) = j | s_i = s, W(s)] = \frac{[w_j(s) G(s, E_j)]^\tau}{\sum_{j'} [w_{j'}(s) G(s, E_{j'})]^\tau} \tag{6}$$

Suppose further that there are $N(s)$ workers of type s so that $\sum_{s'} N(s') = I$. Then supply of workers

of type s to firm j is simply:

$$S_j(s, w_j, E_j) = N(s)\mathbb{P}[j(i) = j | s_i = s, W] \tag{7}$$

Labour supply for a firm j is therefore increasing in wages offered by j and in the level of corporate sustainability E_j as long as no worker type dislikes ESG, i.e. $G'(s, E_j) \geq 0$ for all s. Notice that since firms are small relative to the size of the market, the elasticity of labour supply for a given worker type η_{js} is constant across firms and types and approximately equal to $\eta_{js} \approx \tau$.

For any firm j, first order conditions with respect to wages give the following expression for any worker type s:

$$w_j(s) = \underbrace{\frac{\tau}{1+\tau}}_{\text{markdown}} \underbrace{A_j(1-\alpha)\left(\sum_{s'} A(s')L_j(s')\right)^{-\alpha} A(s)}_{\text{marginal product of labour}} \tag{8}$$

In words, firms equate wages to marked-down marginal product of labour. Market power indeed allows firms to lower wages below marginal product and still attract workers. The wedge between marginal product of labour and wages defines a markdown that directly depends on the labour supply elasticity and thus on the intensity of worker utility idiosyncratic preference shocks.

As for ESG levels, substituting the constraint directly into the objective allows to find the first order condition with respect to corporate sustainability E_j:

$$\frac{\partial C_j(E_j)}{\partial E_j} = \sum_{s'} \frac{w_j(s')}{\tau} \frac{\partial S_j(s', w_j, E_j)}{\partial E_j} \tag{9}$$

This equation has a straightforward interpretation. Each firm will raise its level of responsibility until the marginal cost of raising it further equates the marginal net benefit of increasing production and reducing total wage bill across worker types. This is supposing that the net benefit is positive. If some workers dislike E_j strongly enough, it might be that the RHS of equation (9) is negative for any $E_j > 0$. In this case, the only solution would be for firms to pick $E_j = 0$. However, if E_j is indeed an amenity and the RHS is positive, than any firm would have an incentive to set $E_j > 0$. Firm incentives in setting sustainability levels and their implications will be discussed at length in the next section.

4 Theoretical Analysis

This section highlights how the model proposed in the previous section can help to answer our research questions by accommodating many features that we expect to arise from the data. Specifically, we derive an expression for the compensating wage differential and show that it is differentiated across types. With a measure of the compensating differential for different types, it is immediate to obtain an expression for the impact of ESG level choice on the total wage bill. This in turn allows to characterize the different incentives faced by firms with different levels of productivity and, finally, to characterize how the labour market sorting implications of corporate sustainability practices depend on the shape and intensity of worker utility. At the same time, our analysis also sheds light on how the model would behave under simple assumptions and discusses at length the implications of the modelling choices, which are important to keep in mind when turning to the data.

Compensating differentials. The optimal choice of wages depends on the level of ESG chosen by the firm. Implicit differentiation of the first order condition in (8) allows to recover an expression for the variation of the wage offered by firm j to a worker of type s when the level of corporate responsibility varies:

$$\frac{\partial w_j^*(s,E_j)}{\partial E_j} = (-\alpha)\Lambda_j^{-1}(E_j) w_j^*(s,E_j) \sum_{s'} \frac{\partial S(s', w_j^*(E_j), E_j)}{\partial E_j} A(s') \tag{10}$$

where $\Lambda_j(E_j) = \sum_s A(s)S(s, w_j^*(s,E_j), E_j)$. The term $\frac{\partial S(s', w_j^*(E_j), E_j)}{\partial E_j}$ represents the total derivative of supply with respect to the ESG level of firm j. Since the optimal w_j^* depends on E_j, it can be expressed as the sum of a direct effect of corporate sustainability on supply and an indirect effect of ESG levels on wages, which in turn influence supply. Clearly the sign and magnitude of these effects depend on the preferences of workers for ESG and are thus an empirical question. However, suppose simply that no type of worker dislikes corporate social responsibility and some strictly do. Formally:

Assumption 1. *Corporate social responsibility is an amenity, i.e. no worker type dislikes it and at least one type strictly likes it. Mathematically, $G'(s,E_j) \geq 0, \forall s$ and for at least one s', the inequality holds strictly $G'(s',E_j) > 0$.*

It is interesting to see that Assumption 1 is sufficient to obtain that the compensating differential will be negative for all types of workers.

Proposition 1. *Under Assumption 1, the compensating differential* $\frac{\partial w_j^*(s,E_j)}{\partial E_j}$ *is negative for any firm* j *and any worker type* s*.*

Proof. See Appendix A.1. □

However, labour supply increases only for the workers who care most about corporate sustainability. Indeed, the direct effect of increased attractiveness due to greater corporate social responsibility compensates the indirect effect of decreased attractiveness due to lower wages. For the workers that are instead insensitive to ESG practices, only the indirect effect survives. Thus, labour supply of indifferent workers would decrease. This result crucially hinges on equation 13, which implicitly assumes that different types of workers are substitutes. For a firm the direct effect implies that a raise in its corporate environmental and social performance makes sensitive workers relatively cheaper and as a consequence provides an incentive to substitute towards workers that care about sustainability. This substitution takes place by reducing wages for all workers. While workers that are indifferent decide to quit, those who are most sensitive to corporate sustainability stay and the company can even attract more of this type of workers.

Corporate Social Responsibility choice. Under Assumption 1, all workers are either indifferent or enjoy corporate social responsibility practices. Therefore, if they have not yet invested in environmental and social performance, companies face a marginal benefit of increasing their ESG level, because this would allow them to make at least one type of labor cheaper. Substituting towards that type or those types leads to increased production and lower wage bill. The RHS in the first order conditions of the problem of the firm with respect to E_j (equation 9) is always positive. As a consequence, all firms would set $E_j > 0$.

Firms will however choose different levels of E_j depending on their productivity A_j. In order to see that, consider that the optimal wage choice is a function of the productivity parameter A_j and the choice variable E_j. Thus, it is possible to rewrite the profit of any firm as a function of A_j and E_j only. Proceeding by monotone comparative statics, it can be shown that high A_j firms will choose high E_j in equilibrium when Assumption 1 holds.

Proposition 2. *Under Assumption 1, in equilibrium, high-productivity firms will choose high levels of corporate social responsibility.*

Proof. See Appendix A.2. □

Formally, this is due to the fact that the cross derivative of profit with respect to A_j and E_j is positive. The intuition is that, if wages are chosen optimally by the firms, substitution towards workers that are sensitive to corporate social responsibility leads to greater wage cuts and bigger production increases for firms that are more productive. This in turn is fundamentally due to the fact that worker skill and firm productivity are complements in the way we defined total production in equation (13). Therefore high-productivity firms will have larger incentives to raise E_j to achieve greater wage cuts.

Sorting. Notice that if we take equation (8) and divide it for the same firm j and two types s and s', we obtain:

$$\frac{w_j(s)}{w_j(s')} = \frac{A(s)}{A(s')} \tag{11}$$

Equation (11) implies that, within the same firm, more productive workers are better paid, i.e. if $A(s) > A(s')$ then $w_j(s) > w_j(s')$. Analogously, if we divide equation (10) for the same firm and two worker types s and s', we get:

$$\frac{\frac{\partial w_j^*(s',E)}{\partial E}}{\frac{\partial w_j^*(s,E)}{\partial E}} = \frac{w^*(s',E)}{w^*(s,E)} \tag{12}$$

Therefore, within the same firm, the compensating differential will be greater for workers that are more productive, as the evidence from Krueger, Metzger, and Wu (2023) seems to suggest. Keep in mind, however, that this conclusion is only valid *within firm* and it abstracts from considerations about how the worker's employment decision interacts with firm productivity, which is also likely to matter.

Indeed, if we are interested in characterizing the skill wage gap *across firms*, for example comparing the average $\frac{1}{J}\sum_j w_j(s)$ across types s, then the proportion of workers deciding to work at firms of differing levels of productivity becomes important. It is useful here to think in terms of an ideal experiment comparing two scenarios. In scenario A, Assumption 1 does not hold and all workers are indifferent to firms' corporate sustainability ratings. In Scenario B, Assumption 1 holds and some workers enjoy the green amenity. In A, no firm engages in CSR and all E_j will be null. When switching from A to B, all firms raise E_j and choose a positive level according to first order condition (9). However, higher A_j firms choose higher levels of E_j, in accordance with Proposition 2. Hence,

the more productive a firm is, the more it raises its production and the more the share of workers that like ESG raises at that firm.

Now, it becomes crucial which type of workers enjoys corporate social responsibility. Suppose for example that workers that are more productive care more about ESG initiatives. Then this type of worker will be more likely to work for a high-productivity firm in B than in A. In other words, assortative matching on CSR preferences increases assortative matching on productivity. Under this assumption, the introduction of ESG ratings leads to higher aggregate output. Nevertheless, the change in across-firms average skill wage gap is ambiguous. On one hand, the more productive workers are willing to give up more of their wage for CSR on the workplace, because their preferences are stronger. On the other hand, the share of high-productivity workers matched to high-productivity firms is higher, so their average wage is higher as well. Depending on which effect prevails, the most skilled workers might earn on average more or less in B than in A. Another way to see this mechanism, is that the introduction of ESG creates correlation between A_j and E_j. When high-skill workers like E_j, the attractiveness of ESG levels is more likely to compensate the utility impact of idiosyncratic shock realizations ε_{ij}. Thus, corporate social responsibility tends to "correct" the distortion due to horizontal differentiation. This way, endogeneous firm choice of corporate social responsibility would justify the results from the counterfactual of Colonnelli et al. (2024).

It is important to keep in mind that the opposite situation is possible if instead the workers that are less productive care more about CSR practices. In this case, the low-skilled workers would be the ones that are more attracted to high A_j firms when going from scenario A to scenario B. Consequently, assortative matching based on firm sustainability would counter positive assortative matching based on productivity. In other words, the indifference to ESG would lead the most productive workers away from the most productive firms and thus exacerbate the distortion due to differentiation.

Welfare. The fact that allowing for ESG could lead to increased production under the assumption that the most skilled care the most about sustainability leads to the question of general impact of corporate sustainability ratings on total welfare. Clearly, increased CSR standards should lead to a positive externality (think of social inclusion programs) or a reduction of the negative externality imposed by the firm (think of pollution for example). But if firms increase production and the externality is proportional to production, then the total externality might increase. Indeed, even if the externality per unit is reduced, the number of units increases. If the latter effect is strong enough,

the externality will be bigger with corporate sustainability scores than without.

The main complication when studying the welfare impacts of CSR is however measuring the externality. As ESG scores aggregate multiple different dimensions, they are hard to translate in monetary terms, not to mention the fact that for some categories even the magnitude of the externality is difficult to ascertain (for ex.: how much to value the hiring of individuals from disadvantaged communities?). One way to address this problem is to focus on a subset of categories from the ESG score that have good measures of the corresponding externality. For example, for carbon emissions, estimates of the social cost of carbon are available for many countries. We plan to repeat our analysis with carbon emissions only, using them as a proxy for a company's performance, in order to perform full welfare analysis.

In general, we have shown that our framework is rich enough to accommodate the features that we desire for our analysis and that are likely to arise from the data. We also showed how the structure of the model, namely worker substitutability and skill-productivity complementarity, implies very specific patterns of firm responses to worker preferences for CSR under the very simple Assumption 1. In our empirical analysis, this assumption will not be imposed, and one outcome of interest will precisely be to verify if there is evidence that it holds. It is important, however, to keep in mind the importance of the model structure when reading and interpreting our empirical results.

5 Empirical Analysis

Even though the theoretical analysis provided many insights on how workers' preferences for CSR could influence labour market outcomes, it is evident that empirical work is needed. Indeed, the magnitude and sign of the effects crucially depend on the shape of the workers' preferences, i.e. the function G, as well as on how these vary across different workers types. Another dimension that is critically relevant is heterogeneity in productivity both on the firms and workers' side. Our objective is then to characterize the G function, along with the distribution of firm and employee productivity, from observed labour market data. Other than being object of interest on their own, these elements will allow to determine the economic significance of compensating differentials associated to corporate social responsibility in our sample, the impact of the introduction of CSR on corporate profitability and the interplay between sorting based on corporate sustainability and sorting based on productivity.

5.1 Data

ESG Scores. Data on ESG Scores comes from the London Stock Exchange (LSEG) Workplace platform (formerly known as Refinitiv). ESG Scores are computed both from corporate communications and third party information, such as statistics made available from NGOs and media companies. The score is yearly and for the current year it is updated weekly. It includes a wealth of variables, which are divided in pillars (Environmental, Social and Governance), categories and subcategories. We are able to observe the combined score, as well as each category and subcategory separately. For an overview of the methodology used to compute the scores, refer to London Stock Exchange Group (2025).

In our sample, we restrict attention to French firms. France, a total of 378 public and private companies have received ESG Scores at some point in the time period that goes from 2001 to 2024. The set of firms receiving a score varies overtime, in part due to exit, mergers and acquisitions and in part due to information availability. On average, a firm is scored for a span of 12 years in our sample. The summary statistics for last year (2024) are shown in Table 1.

Table 1: Summary Statistics for last observation of ESG Scores (2024)

	ESG Score	ESG Combined	Environmental	Social	Governance
Average	58.8	55.1	60.2	64.0	50.4
Std. Dev.	20.5	19.1	25.8	22.4	24.4
Min.	3.1	3.1	0.0	0.7	3.4
q_{25}	44.6	41.8	42.7	50.2	30.8
q_{50}	62.2	57.2	66.8	67.6	54.6
q_{75}	75.7	70.7	79.1	81.7	68.7
Max.	92.9	89.5	98.0	97.2	96.6
N	221	221	221	221	221

A couple of remarks are in place. Evidence suggest that these scores might be suffering both in terms of comparability with other provider's scores (Berg, Koelbel, and Rigobon, 2022) and in terms of historical accuracy (Berg, Fabisik, and Sautner, 2020). While the first might not be a crucial source of concern, the second is more worrying. LSEG mentions in their site that it reserves the right to make changes to already published scores up to 5 years prior the most recent observation. Since our

analysis will concern the 2001-2022 period, we are at least partially reassured that the data affected by possible revision is limited to the years 2020-2022. A separate potential issue is that the Social pillar of the score contains variables related to the workforce. This is in principle a threat for the separate identification of G ad B function, because it might introduce correlation between the ESG rating and other workplace amenities.

Matched employer-employee data. We have access to matched employer-employee data from the "Base Tous Salariés" (BTS, formerly known as DADS) dataset produced by the French "Institut National de la Statistique et des Études Économiques" (INSEE). It covers the universe of firms in the country and about 8% of the workforce for each firm in the period from 1976 to 2022. It contains detailed data on firm and worker matches, including wages, hours of work, working location and several demographic variables (year of birth, residence, etc.).

5.2 Empirical Research Design

Given the model described in the previous Section 4 and the data available, we discuss next our empirical strategy. We start by explaining and motivating the theoretical underpinning of our empirical approach. Then we derive the structural equations that will constitute the basis for identification and estimation of our model. Finally, we illustrate how we can use different specifications based on these equations to estimate different parts of the model with varying degrees of structure, starting from a simple two-way fixed effect approach, up to a full-fledged structural estimation. Indeed, the structural equations, together with additional assumptions, allow to interpret results from an interactive regression specification *à la* Abowd, Kramarz, and Margolis (1999) as evidence of compensating differentials. With the method proposed by Bonhomme, Lamadon, and Manresa (2019) it is possible instead to relax some of these assumptions, exploiting the full structure of wages and moves across firms. Finally, additional moments related to value added (as in Lamadon, Mogstad, and Setzler, 2022) and to ESG investment decisions will enable us to estimate the full parameter space of the model.

Theoretical Underpinning. In order to see how the modelling assumptions are crucial for empirical analysis, keep in mind that our framework shares the same fundamental issue of compensating differential models which is discussed at length in Lavetti (2023). The main difficulty is that the econometrician does not observe neither all the characteristics of the jobs, in our case the non-wage

non-ESG unobserved amenities B_j, nor all the individuals characteristics, in our case the unobserved type s. Thus, the econometrician does not know which is the set of offers that each type of worker has access to. In particular we do not observe how the offer set varies with the productivity of the worker.

As mentioned in Section 2, multiple different strategies are available to address the difficulties of estimating compensating differentials. Since we do not have a good direct measure of worker skill available, trying to tie the offer set to observable ability is not feasible. We rely instead on model assumptions about worker and firm behaviour to characterize offered wages. In our model, vertical differentiation appears through preference for ESG and non-ESG amenities, G_j and B_j respectively. Horizontal differentiation is instead embedded in the idiosyncratic component of utility ε. Both B_j and ε, in a way, allow to justify why any type of workers can end up accepting an offer from any type of firm. Without B_j or ε, a productive firm will always be able to offer a higher wage, so that workers of any type will strictly prefer working for high productivity firms, all else being equal, including ESG amenities G_j (Rosen, 1974). If instead the utility includes ε, once this is realized it defines an offered utility set that varies across workers, even if they are of the same type.

Idiosyncratic shocks, together with taste for exogeneous non-ESG amenities B_j, will then constitute the reason why a worker might still accept a job at a lower productivity firm, for a lower wage. At the same time, with our assumptions on the production process, firms have an interest in offering any type of worker a job, because different types are imperfect substitutes. So all types of workers receive and accept offers from all types of firms. This might seem a bit of a stretch, but it is justified by empirical evidence, that shows that even the most productive firms still employ some lower productivity workers, although they do so less intensively than low productivity firms Bonhomme, Lamadon, and Manresa (2019). It is also reasonable if we assume that firms, as workers, belong to a finite set of types, which we can refer to as "classes" so as to distinguish from worker types. Indeed workers may not receive offers from all firms, but they might receive offers from at least one firm in each class.

Structural Equations. Solving the theoretical model leads to the following system of equations:

$$Y_j = A_j \left(\sum_s A(s) S_j(s) \right)^{1-\alpha} \tag{13}$$

$$w_j(s) = \frac{\tau}{(1+\tau)}(1-\alpha)A_j \left(\sum_{s'} A(s')S_j(s') \right)^{-\alpha} A(s) \tag{14}$$

$$S_j(s) = N(s)\frac{[w_j(s)G(s,E_j)B_j(s)]^\tau}{\sum_{j'}[w_{j'}(s)G(s,E_{j'})B_{j'}(s)]^\tau} \tag{15}$$

$$C_j'(E_j) = \sum_s \frac{w_j(s)}{\tau}\frac{\partial S_j(s)}{\partial E_j} \tag{16}$$

It is immediate to see that equations (13), (14) and (15) can be combined to obtain a fixed point equation, similarly to Lamadon, Mogstad, and Setzler (2022). A convenient way to reformulate the problem is to define H_j so that:

$$H_j = \sum_s \frac{A(s)N(s)}{\sum_{j'}[w_{j'}(s)G(s,E_{j'})B_{j'}(s)]^\tau} \left[\frac{\tau(1-\alpha)}{(1+\tau)} A(s)G(s,E_j)B_j(s) \right]^\tau \tag{17}$$

Then it is possible to express the fixed point relationship in terms of H_j only (see details in Appendix B.2).

This definition leads then to the following structural equations:

$$Y_j = A_j^{\frac{2-\alpha(1-\tau)}{1+\tau\alpha}} H_j^{\frac{1-\alpha}{1+\tau\alpha}} \tag{18}$$

$$w_j(s) = \frac{\tau}{(1+\tau)}(1-\alpha)A_j^{\frac{1-\alpha(1-\tau)}{1+\tau\alpha}} H_j^{\frac{-\alpha}{1+\tau\alpha}} A(s) \tag{19}$$

$$\mathbb{P}[j|s,W] = \frac{\left[A_j^{\frac{1-\alpha(1-\tau)}{1+\tau\alpha}} H_j^{\frac{-\alpha}{1+\tau\alpha}} G_j(s)B_j(s) \right]^\tau}{\sum_{j'} \left[A_{j'}^{\frac{1-\alpha(1-\tau)}{1+\tau\alpha}} H_{j'}^{\frac{-\alpha}{1+\tau\alpha}} G_{j'}(s)B_{j'}(s) \right]^\tau} \tag{20}$$

where $\mathbb{P}[j|s,W]$ is the probability that a worker i chooses firm j conditional on her type being s and the offered wage set being W.

Empirical Strategy. Our empirical strategy proceeds in three steps. First, we exploit structural equation (19) to perform a reduced-form regression analysis of a two-way fixed effect specification in the spirit of AKM (Abowd, Kramarz, and Margolis, 1999). Under specific assumptions, including a functional form for ESG preferences, this approach recovers compensating differentials across firms.

In a second step, we leverage the method of BLM (Bonhomme, Lamadon, and Manresa, 2019) to calculate type proportions across firms. Equation (20) can then be used to estimate compensating differentials relaxing some of the assumptions, but a functional form of employees preferences for CSR would still be needed to distinguish the relative importance of ESG and non-ESG amenities. Finally, in a third and final step, we estimate the full-fledged model, including moments derived from equation (18) and the choice of ESG investment by the firm.

The first approach is inspired by Abowd, Kramarz, and Margolis (1999) and subsequent literature and will thus be referred to as AKM specification in the rest of the paper. The motivation for an AKM-type regression in our setting comes from (19). Notice indeed that taking natural logarithms of this expression leads to:

$$\log w_j(s) = \underbrace{\log \frac{\tau}{(1+\tau)}(1-\alpha)}_{\text{intercept } a} + \underbrace{\frac{1-\alpha(1-\tau)}{1+\tau\alpha}\log A_j - \frac{\alpha}{1+\tau\alpha}\log H_j}_{\text{firm effect } \psi_j} + \underbrace{\log A(s)}_{\text{worker effect } \theta_s} \tag{21}$$

The logarithm of wages can then be decomposed in two effects: a firm fixed effect ψ_j and a type fixed effect θ_s. In practice, we can estimate this equation by assuming that wages are observed with a measurement error, and that there are as many types as individuals. Then both sets of fixed effects can be recovered by regressing log-wages on firm and individual dummies, exactly as in the seminal paper by Abowd, Kramarz, and Margolis (1999). The effect of CSR on wages will be incorporated in the ψ_j term directly through H_j and indirectly through technology A_j. Indeed, Proposition 2 suggests that firms with high productivity will on average invest more on ESG. Therefore, ESG preferences will be fundamentally indistinguishable from the pure effect of technology A_j. Still, we can naively regress ψ_j on ESG scores by firm to get an idea of which of the two effects prevails. We can also couple (21) with additional assumptions on the exact shape of G_j and leverage variation in ESG Scores to get tentative estimates of the compensating differential. The validity of results will however crucially hinge on the accuracy of the assumptions in our context of study.

The second approach exploits the methodology introduced by Bonhomme, Lamadon, and Manresa (2019) and will thus be referenced as the BLM specification. Using the full structure of wages and moves across firms, it is indeed possible to perform a two-step procedure where first (i) firms are classified into classes according to a k-means clustering algorithm on the empirical distribution of

wages and ESG scores and then (ii) worker type distributions across firm classes and log-earnings distributions specific to classes and worker types are estimated using an EM algorithm. As a result, each firm is assigned a class, and it is possible to calculate the posterior probability that a worker belongs to a type for each worker. Equation (21) can then be estimated with type fixed effects and we also get a measure of $\mathbb{P}[j|s, W]$ in equation (20). Notice that of all offers in W we only observe the accepted one, i.e. the current wage of each individual w_{ijt}. Then using the class-type proportions and the class-type distributions of log-wages, it is possible to calculate $\mathbb{P}[j|s, w_{ijt}]$ for every individual, every type and every period t. Taking logarithms of (21) and rearranging we get:

$$\begin{aligned}\log \mathbb{P}[j|s, w_{ijt}] = \tau \log w_{ijt} + \tau \log G_j(s, E_j) + \tau \log B_j(s) \\ - \log \sum_{j'} \left[\frac{\tau}{1+\tau} (1-\alpha) A_{j'}^{\frac{1-\alpha(1-\tau)}{1+\tau\alpha}} H_{j'}^{\frac{-\alpha}{1+\tau\alpha}} G(s, E_{j'}) B_{j'}(s) A(s) \right]^{\tau}\end{aligned} \tag{22}$$

This equation can now be estimated because the last term depends only on type s and can thus be captured by a type fixed effect, while the firm fixed effect is exactly the same as in (21). Both the ESG amenity G_j and the non-ESG amenity B_j depend on firm and type and cannot thus be distinguished unless a functional form for the relationship between G_j and E_j is assumed. Notice, however, that we do not need any additional assumption anymore.

Finally, in order to recover all parameters and thus to fully estimate the model, it will be necessary to identify α, τ and the cost function C_j through additional conditions related to firm value added and ESG investment choice. Modelling explicitly both class and firm choice could provide a way to estimate a more flexible specification, the intuition being that when firms have comparable technology and ESG Scores but one is considerably more attractive than the other the the difference in size can be ascribed to the difference in non-ESG amenities.

Sample selection. Given our empirical strategy, we carefully build a sample that is appropriate for our analysis. In particular, we merge ESG Scores with matched employer-employee data through unique firm identifiers (SIREN) and we filter the merged dataset in order to obtain observations that are comparable. The wealth of variables and variability in type of employment and conditions impose a number of choices, which we detail in Appendix B.1.

It is also important to mention that when performing the AKM analysis we need to focus on a subset of firms that are connected by at least one move, otherwise the firm fixed effects will not be

identified and there might be spurious comparisons. Before every interactive regression, we extract from the subset of all movers the unique identifiers of the firms and select only those that are in the largest connected set.

The next sections presents each of our empirical specifications and show their results. Section 6 focuses on the AKM empirical model, section 7 presents the BLM grouped fixed effects estimation and section 8 discusses the full estimation of all parameters in the model.

6 Reduced-form AKM Approach

AKM Specification. The key equation for an approach in the spirit of Abowd, Kramarz, and Margolis (1999) is (21):

$$\log w_j(s) = \underbrace{\log \frac{\tau}{(1+\tau)}(1-\alpha)}_{\text{intercept } a} + \underbrace{\frac{1-\alpha(1-\tau)}{1+\tau\alpha}\log A_j - \frac{\alpha}{1+\tau\alpha}\log H_j}_{\text{firm effect } \psi_j} + \underbrace{\log A(s)}_{\text{worker effect } \theta_s}$$

This corresponds to a two-way fixed effect regression of log-wages on firm fixed effects ψ_j and individual fixed effects θ_i, under the assumption that types are as many as the number of individuals. We also implicitly assume that log-earnings are observed with an independent and identically distributed error η_{ijt} that respects the conditional mean independence assumption. Equation (21) then results in the following specification:

$$\log w_{ijt} = a + \psi_j + \theta_i + \eta_{ijt} \tag{R.1}$$

that can be estimated with OLS under the assumption that our model is correct and the following holds:

Assumption I. *(Conditional mean independence.) The error term η_{ijt} satisfies $[\eta_{ijt}|i,j] = 0$.*

In the following, whenever we introduce measurement error we will suppose Assumption (I) is respected.

A few remarks are here in order. First, remember that the firm effect ψ_j is a composition of an A_j term, which refers to productivity, and an H_j term which refers to both productivity and preferences. The relationships between these terms and ESG Scores are interesting in their own right. Proposition

2 states that high-productivity firms choose higher corporate responsibility levels. At the same time, the term H_j is directly linked to ESG preferences H_j: the stronger worker preferences for ESG are, the greater is H_j. Therefore, theory predicts both A_j and H_j to be positively correlated with ESG Scores E_j. However, A_j enters ψ_j positively, while A_j enters negatively. Consequently, the global relationship between H_j and E_j is only informative about which of the two effects prevails but not on each of them separately.

Second, notice that all time-invariant difference in wages across individuals and firms is captured by either one of the two fixed effects, but in the original contribution of Abowd, Kramarz, and Margolis (1999) and subsequent work, it is usual to include time-varying characteristics that might be of interest, both at the individual and the firm level. The goal is usually to separate out the contribution of these observed characteristics from unobserved individual and firm-level factors. In our case, however, we are only interested in distinguishing the variation in wages that can be ascribed to firms from the variation that can be ascribed to workers, no matter whether it is related to observed or unobserved factors. It is important therefore to take into account variables that could confound this distinction, even though we have not explicitly modelled them. One such variable for example is tenure. The goal of this analysis is not forcibly to separate tenure from unobserved individual effects θ_i, because in principle we could consider a worker type to include tenure as well. All the discussion so far would still apply. However, we do care about distinguishing the effect of tenure from firm effects ψ_j. If all the individuals that move between firm A and firm B have longer experience than those that move from A to firm C we might infer ψ_B to be larger than ψ_C even though firms might be equally productive.

A closely related issue is the time dimension. Our analysis in Section 4 is conditional on a time period t, without restriction. But the implicit assumption behind regression (R.1) is that firm and worker productivity are fixed in time, as well as preferences and ESG Scores. Variation in log-wages over time will be entirely imputed to the error η_{ijt}. Two problems then arise: (i) omitting time-varying characteristics can lead to biased estimates of the fixed effects and (ii) this specification does not allow to exploit the time variation in ESG Scores observed in the data. Regarding (i), if time-varying characteristics make log-wages on average higher on some periods, Assumption I clearly does not hold. Rather than focusing on each variable separately, a simple way to address this concern is to add year fixed effects, as in Lachowska et al. (2023). Taking stock of the observations raised in

the current and the previous paragraph, one would ideally augment (R.1) to include both time and experience, so that the following specification would be robust to trends:

$$\log w_{ijt} = a + \beta x_{it} + \psi_j + \theta_i + t + \eta_{ijt} \tag{R.2}$$

where x_{it} is experience and t is a dummy for years. As pointed out in Card et al. (2018), however, including both experience and time fixed effects can be problematic for the correct estimation of individual fixed effects. We will therefore also report results from the regression without controls for worker experience.

As for (ii), estimating (R.2) for the whole period between 2002 and 2021 will still give us a unique firm fixed effect ψ_j per firm j. All moves between firms at all years are used to compute the fixed effect. But firms are assigned an ESG Score every year. Therefore, the only meaningful way to compare the firm fixed effect to ESG Scores is to regress it on the mean ESG Score over the 2002-2021 period.

Results from both regression (R.1) and (R.2), performed on the respective largest connected set of firms, are shown in Table 2. As we can see, individual fixed effects are significantly increasing in mean (log) ESG Scores, no matter the set of controls. This might happen because more productive workers sort into greener firms as predicted by our model. Firm fixed effects instead do not exhibit a significant relationship with (log) ESG Scores. Perhaps the effect of technology and worker preferences for ESG offset each other in the period of study. Alternatively, comparing aggregate fixed effects across time with mean ESG Scores might mask a lot of across-years variations. We will explore this possibility in the next paragraph.

TV-AKM Specification. Given the previous paragraph specification and results, one is left wondering whether it is possible to refine the analysis, making use of the yearly nature of the ESG ratings. If we consider the choice of ESG investment to be performed at each time period, then the H_j term varies across time. The appropriate specification becomes:

$$\log w_{ijt} = a + \beta x_{it} + \psi_{jt} + \theta_i + \eta_{ijt} \tag{R.3}$$

where ψ_{jt} is a year-firm fixed effect. Beware that we had to drop the year fixed effects because they would be collinear to year-firm fixed effects. Such applications of the AKM framework are sometimes called "time-varying" AKM or TV-AKM (Lachowska et al., 2023). Comparing the fixed effect ψ_{jt}

Table 2: Results from the AKM Specification.

	Firm FE				Individual FE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mean ESG Score	-0.03	0.03	0.05	0.09	0.33***	0.32***	0.26***
	(0.13)	(0.11)	(0.11)	(0.18)	(0.01)	(0.00)	(0.00)
Mean Size				0.03			
				(0.06)			
Intercept	0.82	0.30	0.21		1.27***	1.22***	1.03***
	(0.51)	(0.45)	(0.44)		(0.02)	(0.02)	(0.02)
First stage controls							
Time FE		Y	Y	Y		Y	Y
Experience			Y	Y			Y
Second stage controls							
Sector FE				Y			
Observations	125	125	125	122	113,009	113,009	112,976
R-squared	0.00	0.00	0.00	0.28	0.04	0.02	0.02

Notes: The dependent variables are estimated fixed effects from the AKM regression. Independent variables are in logarithms. First stage controls refer to observables (in logarithms) and fixed effects included in the AKM regression. A few individual observations (33) are missing in column (7) because experience is null. Standard errors are in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

across firms j and years t still combines productivity and preferences variations. To illustrate, consider any $j \in 1, \ldots, J$ and any $t \in [2001, 2021]$. Then:

$$\begin{aligned}\psi_{jt} &= \underbrace{\frac{1-\alpha(1-\tau)}{1+\tau\alpha}}_{a_1} \log A_j - \underbrace{\frac{\alpha}{1+\tau\alpha}}_{a_2} \log H_{jt} = \\ &= a_1 \log A_j - a_2 \log \sum_s A(s) D_t(s) \left[\underbrace{\frac{\tau(1-\alpha)}{(1+\tau)}}_{a_3} A(s) G(s, E_{jt}) B_j(s) \right]^{\tau}\end{aligned} \tag{23}$$

where $D_t(s) = \frac{N(s)}{\sum_{j'}[w_{j't}(s)G(s,E_{j't})B_{j'}(s)]^{\tau}}$ is a market index for an individual of type s at time t. So the correlation between ψ_{jt} and E_{jt} will be a compounded effect of the variation of A_j, D_t, E_{jt} and B_j. Firm and time effects control for the presence of the A_j, D_t and B_j, as long as non-ESG amenities B_j do not vary differentially over time (cf. Appendix B.3), as stated in the following:

Assumption II. *During the period of study, non-ESG amenities are separable in firm and time components, i.e.* $B_{jt}(s) = B_j(s)B_t(s)$ *for all* s*, all* t *and all* j*.*

Furthermore, observe that each element in the second term summation can be seen as $G(s, E_{jt})$ weighted by a coefficient that depends both on j, t and s. A regression of ψ_{jt} on E_{jt} would thus approximately identify an upper bound on the average rate of change of $G(s, E_{jt})$ across s, as shown under an additional assumption in Appendix B.3. in particular, under the specific functional form $G(s, E_{jt}) = E_{jt}^{\gamma_{st}}$, the regression exactly identifies the weighted average of the slope of preferences with respect to E_{jt}, across types s for a given period t. Let us write formally:

Assumption III. *Worker preferences for ESG have the shape* $G(s, E_{jt}) = E_{jt}^{\gamma_{st}}$*.*

Under Assumption (I) to (III) it is then possible to estimate a (weighted) average slope of worker preferences for corporate sustainability across worker types through a regression of the firm-year fixed effect ψ_{jt} on yearly ESG scores E_{jt}, controlling for firm and year effects. This is also equivalent to a direct estimation of an enhanced AKM model of the form:

$$\log w_{ijt} = a + \beta x_{it} + \beta_t \log E_{jt} + t + \psi_j + \theta_i + \nu_{ijt} \tag{R.4}$$

The above specifications, estimated on the largest connected set of year-firm pairs, produces the results shown in Table (3) for firms and (4) for individuals. Interestingly, the relationship between year-firm fixed effects and (log) ESG Score is positive and significant, but becomes insignificant when adding controls for year and firm. Restricting the coefficient to be unique across time, however, masks significant across-year heterogeneity. We report coefficients on ESG Score for 2004, 2008, 2013, 2017 and 2021 to illustrate and keep the table readable. Also, we plot the coefficients by year from the enhanced AKM specification in Figure 1. It stands out from the results that coefficients for the earlier years are positive and significant or insignificant, indicating that the compensating differential for higher ESG Score at the beginning of the period of study was positive. In later years, the coefficient becomes negative, suggesting a negative compensating differential. This implies that at least some worker types in the later years do care about ESG Scores and are willing to accept lower wages in order to work for a firm that has a better sustainability score.

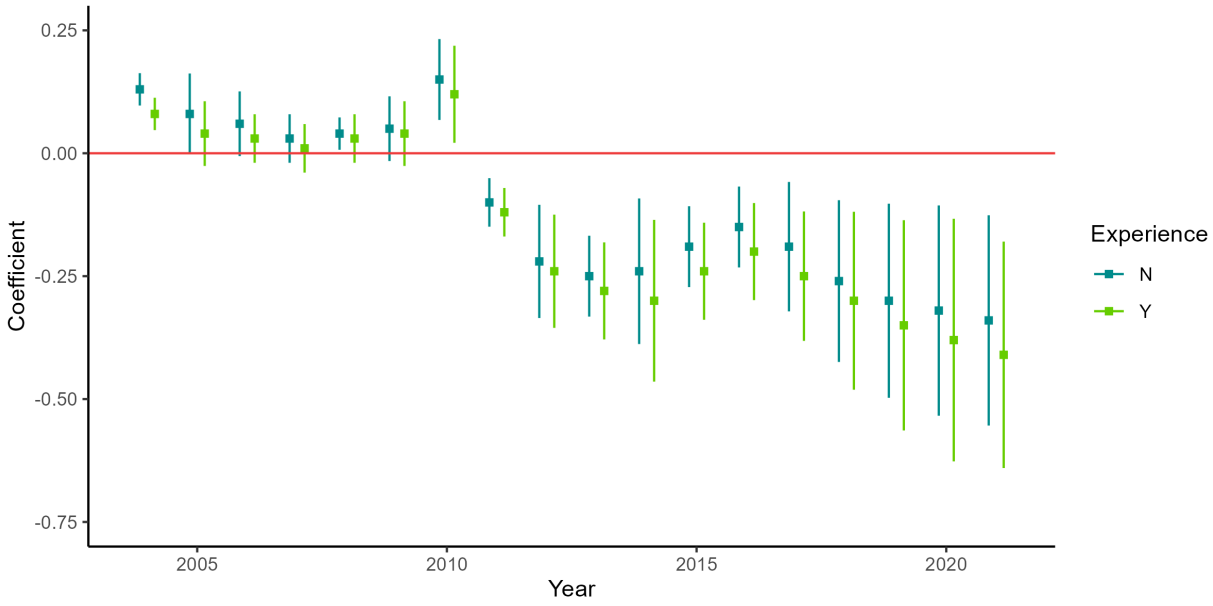


Figure 1: Coefficients from the Enhanced AKM Regression.

The results from the regression of individual fixed effects on ESG Scores show a significant positive relationship, thus confirming results from AKM and suggesting that more productive individuals sort into firms with better ESG scores.

Table 3: Results from TV-AKM and Enhanced AKM - Firms.

	Firm FE					log Wage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ESG Score	0.16**	-0.01					
	(0.07)	(0.04)					
ESG Score × 2004			0.21***	0.16***	0.13**	0.13***	0.08***
			(0.05)	(0.04)	(0.05)	(0.02)	(0.02)
ESG Score × 2008			-0.06	-0.05	-0.08	0.04	0.03
			(0.10)	(0.09)	(0.10)	(0.02)	(0.03)
ESG Score × 2013			-0.13***	-0.14***	-0.16***	-0.25***	-0.28***
			(0.04)	(0.04)	(0.04)	(0.05)	(0.06)
ESG Score × 2017			-0.15*	-0.18**	-0.20**	-0.19**	-0.25**
			(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
ESG Score × 2021			-0.18	-0.23	-0.26	-0.34*	-0.41*
			(0.17)	(0.17)	(0.17)	(0.13)	(0.14)
First stage controls						*Controls*	
Experience				Y	Y		Y
Second stage controls							
Year FE		Y	Y	Y	Y	Y	Y
Firm FE		Y	Y	Y	Y	Y	Y
Size					Y		
Clustered SE			Year & Firm	Year & Firm	Year & Firm	Year & Firm	Year & Firm
Observations	348	348	348	348	387	438,128	438,058
R-squared	0.04	0.96	0.96	0.94	0.94	0.91	0.91

Notes: The dependent variables are estimated fixed effects from the AKM regression in columns (1)-(4) and log-wages in columns (5)-(6). Independent variables are in logarithms. First-stage controls refer to observables (in logs) and fixed effects included in the AKM regression. See full results in Table 8. Standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 4: Results from TV-AKM - Individuals.

	Individual FE	
	(1)	(2)
Mean ESG Score	0.39***	0.29***
	(0.01)	(0.00)
Intercept	1.54***	1.44***
	(0.02)	(0.02)
Controls		
Experience	N	Y
Observations	104,079	104,049
R-squared	0.05	0.04

Notes: The dependent variables are estimated fixed effects from the AKM regression that include corresponding controls. Independent variables are in logarithms. A few observations (30) are lost in (2) because of null experience. Standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

R-AKM Specification. An implicit assumption behind the previous specifications (R.3) and (R.4) is that firm productivity and worker types are fixed across time. Although the inclusion of time-varying individual characteristics x_{it} and time trends should be reassuring, one might still worry that systematic unobserved differences across time could confound the variation due to ESG Scores. Also, the firm year fixed effect in ψ_{jt} of (R.3) and the β_t coefficient in (R.4) will be identified by variation in salaries of both workers that move across firms and workers that stay at the same firm for different years. Our model is silent about the exact dynamics of job movements, so this is not in principle a problem. Still, we might be concerned that salaries of stayers usually only tend to grow with tenure.

One way to address this concern is to estimate (R.2) on consecutive two-years time windows, so that the firm fixed effect is only identified by movers and worker effects are allowed to vary unrestrictedly across years. This specification is sometimes referred to as "revolving" AKM or R-AKM (Lachowska et al., 2023). Reassuringly, as shown in Table 5 and in Figure 2, individual fixed effects are positively and significantly related to the logarithm of ESG scores and the coefficient does not seem to exhibit a strong time trend. Also, when the regression is performed on year-firm fixed effects instead, coefficients keep the same sign as in the previous TV-AKM specification, but they lack power. As the relationship between individual fixed effects and ESG scores does not seem to vary a lot across time, it is likely that the lower precision in the R-AKM regression on firm effects is due to the lower number of observations. Remember that each coefficient is identified exclusively by moves between firms in a given year. But the number of connected firms per year varies between 8 and 29, which seems too low to provide the necessary variation for a precise estimate of all firms effects.

Table 5: Results from R-AKM.

	Year-Firm FE			Individual FE	
	(1)	(2)	(3)	(4)	(5)
ESG Score	0.19	0.42		0.37	
	(0.14)	(0.24)		(0.21)	
ESG Score × 2005			-0.59*		0.47**
			(0.30)		(0.21)
ESG Score × 2008			0.34		0.50**
			(0.62)		(0.21)
ESG Score × 2013			0.96**		0.46**
			(0.45)		(0.20)
ESG Score × 2017			-0.20		0.41*
			(0.52)		(0.21)
ESG Score × 2021			-1.2**		0.36*
			(0.58)		(0.20)
Intercept	-0.70			1.6*	1.4
	(0.58)			(0.93)	(0.89)
Second stage controls					
Year FE		Y	Y		
Firm FE		Y	Y		
Clustered SE			Year & Firm		Year & Firm
Observations	237	237	237	290,695	290,695
R-squared	0.008	0.57	0.61	0.02	0.14

Notes: The dependent variables are estimated fixed effects from the AKM regression or log wages. Independent variables are in logarithms. See all the coefficients in Table 9. Standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

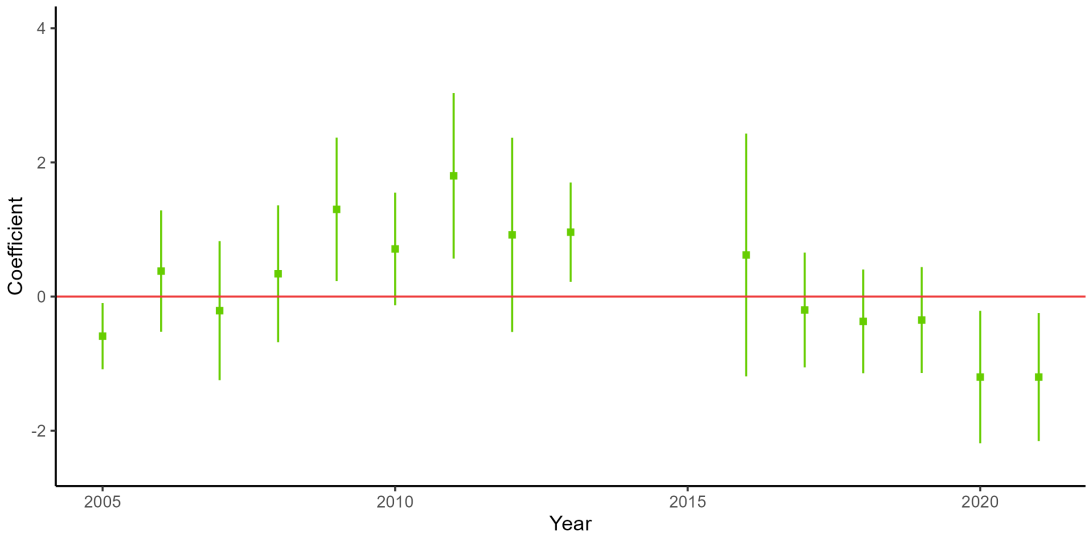


Figure 2: Coefficients from the R-AKM Regression.

7 Grouped Fixed Effects: BLM Approach

We turn next to the estimation procedure proposed by Bonhomme, Lamadon, and Manresa (2019). Since our model predicts that wage depend on worker type and her current firm's class, assuming measurement error so that type-class specific wages follow a log-normal distribution allows to calculate the likelihood of a worker belonging to each type, given the parameters of the log-normal distribution and her class. Developing this intuition, Bonhomme, Lamadon, and Manresa (2019) suggests first to classify firms into classes through k-means clustering of the empirical wage distributions. Then, following the logic of an Expectation-Maximization (EM algorithm), it is possible to recover type-class proportions and the parameters of the distributions. Indeed, starting from a value for the distribution parameters and prior probabilities of a worker being of a given type, it is possible to compute posterior probabilities (E-step) and then fixing the posterior probabilities, log-likelihood maximization allows to compute a new value for the distribution parameters and the prior probabilities (M-step). Each iteration guarantees that the likelihood will be higher so convergence leads to the parameters that maximize it.

Methodology. Suppose each firm j belongs to a class $k \in [0, ..., K]$. Then our model implies that each individual wage in our dataset will follow (14) with a k subscript instead of j, multiplied

by an idiosyncratic error. Assume further that this error is such that wages are distributed according to a lognormal distribution.

Assumption IV. *For each worker of type s employed by a firm of class k, wages are observed with a measurement error so that they follow a log-normal distribution f_{sk} with class-type specific mean and variance μ_{sk} and σ_{sk}.*

Then, if we observe a panel of two periods, we can write the distribution of log-earnings w per firm in the following way:

$$\mathbb{P}[w_{i1} \leq w_1 | j] = \sum_{s=1}^{S} F_{sk}(w_1)\pi_{sk1} \tag{24}$$

where π_{sk1} is the prior probability of belonging to type s for a worker in a firm of class k at period one. This distribution does not depend on j other than through the class j belongs to, k. We can then use the empirical distribution of wages in the first period to perform k-means clustering of firms into classes.

Given firm classification, the log-likelihood of job movers between the two periods can be written as:

$$\sum_{i=1}^{N}\sum_{k=1}^{K}\sum_{k'=1}^{K} \mathbf{1}[k_{i1} = k]\mathbf{1}[k_{i2} = k'] \log\left(\sum_{s=1}^{S} \pi_{skk'} f_{sk}(w_1) f_{sk'}(w_2)\right) \tag{25}$$

where $\pi_{skk'}$ is the prior probability of belonging to type s for an employee that switched job between a firm of class k and class k'. The distribution parameters μ_{sk} and σ_{sk}, as well as the type distributions $\pi_{skk'}$ can then be recovered through an EM algorithm.

Simulation. We simulate the model for two periods, with $S = 3$ types of workers and $K = 3$ classes of firms, at the same time allowing preferences for CSR practices to vary between period one and two. The EM algorithm implemented on the simulated data recovers the parameters well. We report here the true and estimated matrix of group-class specific means and variances for the first period for reference and comparison. The same table for the second period, as well as the estimated and true type probabilities for job switchers, are shown in full in Appendix D.

Estimated μ_{sk} for first period.

	k		
s	**1**	**2**	**3**
1	2.05	2.43	3.04
2	2.49	2.92	3.48
3	3.17	3.32	4.20

True μ_{sk} for first period.

	k		
s	**1**	**2**	**3**
1	1.93	2.40	3.00
2	2.45	2.89	3.47
3	3.17	3.61	4.17

Estimated σ_{sk} for first period.

	k		
s	**1**	**2**	**3**
1	0.09	0.07	0.06
2	0.09	0.10	0.21
3	0.08	0.43	0.18

True σ_{sk} for first period.

	k		
s	**1**	**2**	**3**
1	0.10	0.10	0.10
2	0.10	0.15	0.20
3	0.10	0.18	0.25

	K				
S	**1**	**2**	**3**	**4**	**5**
1	2.0435	2.2042	2.4174	2.6953	3.0438
2	2.3626	2.5233	2.7366	3.0144	3.3630
3	2.7831	2.9437	3.1570	3.4349	3.7834
4	3.2879	3.4485	3.6618	3.9396	4.2882

Table 6: True values of μ_{sk} for the first period.

8 Structural Estimation

[In progress]

	K				
S	**1**	**2**	**3**	**4**	**5**
1	2.1815	2.3562	2.6382	3.0467	3.5045
2	2.3221	2.7703	3.1239	3.4978	3.9305
3	2.8816	3.2148	3.5854	3.9883	4.3369
4	3.4143	3.7125	3.9224	4.4371	4.8822

Table 7: Estimated values of μ_{sk} for the first period.

9 Conclusion

In this paper, we propose a framework to analyze the impact of corporate social responsibility on the labour market. In our model, the preference of some types of workers towards CSR leads firms that engage in sustainable practices to substitute towards those types. Since firms that are more productive choose higher levels of ESG investment, the distribution of worker preferences for ESG matters. When the most productive workers are also those that are more concerned with corporate sustainability, then greenness assortative matching enhances productivity assortative matching and might therefore increase total aggregate output, raising welfare concerns about the mitigation of production externalities. Also, when this happens, the average skill wage gap might increase.

Since effects could have either sign depending on the underlying preference distribution and the patterns of heterogeneous productivity across worker types and firm, we take our model to the data, developing an empirical research design that is comprised of three consecutive steps: (i) a two-way fixed effect approach *à la* Abowd, Kramarz, and Margolis (1999), (ii) a grouped fixed effects strategy in the spirit of Bonhomme, Lamadon, and Manresa (2019) and finally (iii) a full fledged structural estimation of the model that would allow to identify all parameters and perform counterfactual analysis. Following (i), we show that, under some assumptions, a regression of year-firm fixed effects from an AKM specification on yearly ESG Scores identifies a weighted average of worker preferences across time. Results from this procedure show that the relationship between the fixed effect and ESG Scores is increasing for the earlier years in the period of our study, but then decreases over time and becomes decreasing for later years. This is direct evidence of a sign reversal in compensating differentials for ESG Scores, meaning that workers in recent years have on average accepted lower wages to work for a firm with higher corporate sustainability. These results motivate further empirical analysis, which

is necessary to relax some of the assumptions needed for the reduced-form specification to hold and also to allow identification and estimation of the full parameter space of the model.

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A Proofs and Derivations

A.1 Proposition 1.

Proof. Dropping the j subscript, for any s, differentiation of (10) leads to:

$$\frac{\partial w^*(s,E)}{\partial E} = (-\alpha)\Lambda^{-1}(E)w^*(s,E)\sum_{s'}\left[\frac{\partial S(s')}{\partial w^*(s',E)}\frac{\partial w^*(s',E)}{\partial E} + \frac{\partial S(s')}{\partial E_j}\right]A(s') \tag{26}$$

where $\frac{\partial S(s')}{\partial E_j}$ is the derivative of $S(s',w,E)$ with respect to the third argument only – calculated at $w = w^*(s',E)$ – and we make an abuse of notation, by indicating $\frac{\partial S(s')}{\partial w^*(s',E)}$ the derivative of $S(s',w,E)$ with respect to the second argument, calculated at $w^*(s',E)$. Formally, it would be $\frac{\partial S(s')}{\partial w^*(s',E)} = \frac{\partial S(s')}{\partial w}\big|_{w=w^*(s',E)}$.

Now, we can us the fact that compensating differentials are proportional across type and within the same firm, as a consequence of equation (12):

$$\frac{\partial w^*(s',E)}{\partial E} = \frac{w^*(s',E)}{w^*(s,E)}\frac{\partial w^*(s,E)}{\partial E}$$

Replacing back in (10):

$$\frac{\partial w^*(s,E)}{\partial E} = (-\alpha)\Lambda^{-1}(E)\left[\sum_{s'}\frac{\partial S(s')}{\partial w^*(s',E)}w^*(s',E)\frac{\partial w^*(s,E)}{\partial E}A(s') + w^*(s,E)\sum_{s'}\frac{\partial S(s')}{\partial E_j}A(s')\right] \tag{27}$$

And finally rearranging:

$$\frac{\partial w^*(s,E)}{\partial E}\left[1+\alpha\Lambda^{-1}(E)\sum_{s'}\frac{\partial S(s')}{\partial w^*(s',E)}w^*(s',E)A(s')\right] = (-\alpha)\Lambda^{-1}(E)w^*(s,E)\sum_{s'}\frac{\partial S(s')}{\partial E_j}A(s') \tag{28}$$

Under Assumption 1, the term on the RHS is negative, because labour supply is strictly increasing in E for at least some worker type. The coefficient in the square brackets on the LHS is positive because labour supply is increasing in wages. Therefore, the compensating differential $\frac{\partial w^*(s,E)}{\partial E}$ is negative for any s. □

A.2 Proposition 2.

Proof. Let us indicate with $w_j^*(s, A_j, E_j)$ the optimal wage for type s at firm j given A_j and E_j. Replacing the constraint, the profit of the firm wit respect to corporate social responsibility can be written as:

$$\begin{aligned}\Pi_j(A_j, E_j) =& A_j \left(\sum_s A(s) S_j(s, w_j^*(s, A_j, E_j), E_j) \right)^{1-\alpha} - \\ &- \sum_s w_j^*(s, A_j, E_j) S_j(s, w_j^*(s, A_j, E_j), E_j) - C_j(E_j)\end{aligned} \tag{29}$$

We proceed by monotone comparative statics. Suppose two firms p and q differ in productivity and $A_p > A_q$. Denote E_p the value of ESG that maximizes Π_e and E_q the maximizer of Π_q. Then, $E_p > E_q$ if for any j, $\frac{\partial^2 \Pi_j}{\partial A_j \partial E_j} > 0$. To prove the proposition, it is then sufficient to show that the cross derivative of profit Π_j is positive.

Let us denote $\Lambda_j(A_j, E_j) = \sum_s A(s) S_j(s, w_j^*(s, A_j, E_j), E_j)$. Start by computing the derivative of profit Π_j with respect to A_j. We drop the subscript j for readability:

$$\begin{aligned}\frac{\partial \Pi}{\partial A} &= \Lambda(A,E)^{1-\alpha} + A(1-\alpha)\Lambda(A,E)^{-\alpha}\frac{\partial \Lambda}{\partial A} - \sum_s \left[\frac{\partial w^*(s)}{\partial A} S(s) + w^*(s) \frac{\partial S(s)}{\partial w^*(s)} \frac{\partial w^*(s)}{\partial A} \right] = \\ &= \Lambda(A,E)^{1-\alpha} + \sum_s \left[A(1-\alpha)\Lambda(A,E)^{-\alpha} A(s) \frac{\partial S(s)}{\partial w^*(s)} \frac{\partial w^*(s)}{\partial A} - \frac{\partial w^*(s)}{\partial A} S(s) - w^*(s) \frac{\partial S(s)}{\partial w^*(s)} \frac{\partial w^*(s)}{\partial A} \right] = \\ &= \Lambda(A,E)^{1-\alpha} + \sum_s \left[\frac{1+\tau}{\tau} w^*(s) \frac{\partial S(s)}{\partial w^*(s)} \frac{\partial w^*}{\partial A} - \frac{\partial w^*}{\partial A} S(s) - w^*(s) \frac{\partial S(s)}{\partial w^*(s)} \frac{\partial w^*(s)}{\partial A} \right] = \\ &= \Lambda(A,E)^{1-\alpha} - \sum_s \frac{\partial w^*}{\partial A} S(s) \left[\frac{1+\tau}{\tau} \frac{w^*}{S(s)} \frac{\partial S(s)}{\partial w^*} - 1 - \frac{w^*}{S(s)} \frac{\partial S(s)}{\partial w^*} \right] = \\ &= \Lambda(A,E)^{1-\alpha}\end{aligned} \tag{30}$$

The last passage is due to the fact that τ is the elasticity of labour supply. Now the cross derivative is:

$$\frac{\partial \Pi}{\partial A \partial E} = (1-\alpha)\Lambda(A,E)^{-\alpha} \sum_s A(s) \left[\frac{\partial S(s)}{\partial w^*} \frac{\partial w^*}{\partial E} + \frac{\partial S(s)}{\partial E} \right] \tag{31}$$

Under Assumption 1, the compensating differential is negative so from equation (26) we know that

the sum on the RHS is positive. This is equivalent to say that when workers like sustainability then raising sustainability increases the total workforce efficiency. We conclude then that the cross derivative is positive and thus demonstrate the proposition.

□

B Empirical Analysis Details.

B.1 Sample Selection

The main variable of interest for our empirical research design is gross salary in constant euros, which we divide by the number of hours worked to obtain a measure of hourly wages. We filter out all observations that have missing values (only 3) or null gross salary (0 observations). Also, we select individuals between 25 and 55 years of age to avoid confounding effects due to the start and end of careers (student jobs, retirement specificities, etc.).

It is important to mention that the variable for number of hours in our dataset indicates the total number of hours paid according to the contract, but it may not reflect the actual number of hours worked. There is significant variability in the relationship between the number of hours and pay duration. For example, people who worked year-round have anywhere between 0 and 6,000 hours worked. Even when selecting only individuals that are reported as full-time employees, there remains considerable dispersion. For this reason, we use both the number of hours and employment duration (in days) together to select only workers who worked at least one week in the entire year and had a total number of hours paid per week between 35 and 44, which are the minimum and maximum limits allowed under French law for a full employment contract. This results in a much more regular relationship between hours worked and employment duration.

In our dataset, observations are already selected to ensure a single entry per year per individual per plant. Yet the sample still contains about 2,600 repeated observations, where the same workers appear in two different firms in the same year. We could simply select the worker-firm-year observation that has the longest duration or the highest pay but a quick check suggests that this could lead to losing many moves across firms in the sample. For example, suppose there is an individual who worked for firm A in 2017, still worked for A in 2018 but switched to B in the same year and finally moved to firm C in 2019. If we keep only the longest or the best paid job we might pick A for 2018 as well and loose

the information about the intermediate connection through B. After a quick check, the number of double observations are 1,148, for a total of 573 potential connections that we might loose. Therefore we filter these observations in order to always keep the intermediate link (firm B in the example). To break all remaining ties, we select jobs with the latest start date in the year or the first firm by unique identifier in case the start date is the same.

B.2 Definition (17) and derivation of fixed point equation.

Remember that solving the model leads to the following system of equations:

$$Y_j = A_j \left(\sum_s A(s) S_j(s) \right)^{1-\alpha} \tag{13}$$

$$w_j(s) = \frac{\tau}{(1+\tau)} (1-\alpha) A_j \left(\sum_{s'} A(s') S_j(s') \right)^{-\alpha} A(s) \tag{14}$$

$$S_j(s) = N(s) \frac{[w_j(s) G(s, E_j) B_j(s)]^\tau}{\sum_{j'} [w_{j'}(s) G(s, E_{j'}) B_{j'}(s)]^\tau} \tag{15}$$

$$C_j'(E_j) = \sum_s \frac{w_j(s)}{\tau} \frac{\partial S_j(s)}{\partial E_j} \tag{16}$$

Let us show why defining H_j as in (17), i.e. $H_j = \sum_s A(s) D(s) \left[\frac{\tau(1-\alpha)}{(1+\tau)} A(s) G(s, E_j) B_j(s) \right]^\tau$ is particularly helpful. Define $D(s)$ as in Section 6 (omitting the time subscript for readability), i.e. $D(s) = \frac{N(s)}{\sum_{j'} [w_{j'}(s) G(s, E_{j'}) B_{j'}(s)]^\tau}$. The term $D(s)$ then depends exclusively on s and represents an aggregate indicator of offered utility by all firms $j', \in \{1, \ldots, J\}$ in the market for workers of type s.

Then (15) becomes $S_j(s) = D(s)[w_j(s)G(s,E_j)B_j(s)]^\tau$. We can plug the expression into (14) to get:

$$w_j(s) = \frac{\tau}{(1+\tau)}(1-\alpha)A_j\left(\sum_{s'}A(s')D(s')[w_j(s')G(s',E_j)B_j(s')]^\tau\right)^{-\alpha}A(s) \quad \leftrightarrow$$

$$\leftrightarrow \quad A(s)D(s)[w_j(s)G(s,E_j)B_j(s)]^\tau =$$

$$= A(s)D(s)\left[\frac{\tau}{(1+\tau)}(1-\alpha)A_j\left(\sum_{s'}A(s')D(s')[w_j(s')G(s',E_j)B_j(s')]^\tau\right)^{-\alpha}A(s)G(s,E_j)B_j(s)\right]^\tau \quad \rightarrow$$

$$\rightarrow \quad \sum_s A(s)D(s)[w_j(s)G(s,E_j)B_j(s)]^\tau =$$

$$= \sum_s A(s)D(s)\left[\frac{\tau}{(1+\tau)}(1-\alpha)A_j\left(\sum_{s'}A(s')D(s')[w_j(s')G(s',E_j)B_j(s')]^\tau\right)^{-\alpha}A(s)G(s,E_j)B_j(s)\right]^\tau \quad \leftrightarrow$$

$$\leftrightarrow \quad \left[\sum_s A(s)D(s)[w_j(s)G(s,E_j)B_j(s)]^\tau\right]^{1+\tau\alpha} = \sum_s A(s)D(s)\left[\frac{\tau(1-\alpha)}{(1+\tau)}A_jA(s)G(s,E_j)B_j(s)\right]^\tau \quad \leftrightarrow$$

$$\leftrightarrow \quad \left[\sum_s A(s)S_j(s)\right]^{1+\tau\alpha} = A_j^\tau \underbrace{\sum_s A(s)D(s)\left[\frac{\tau(1-\alpha)}{(1+\tau)}A(s)G(s,E_j)B_j(s)\right]^\tau}_{H_j} \tag{32}$$

As we can see, H_j would depend directly on preferences only through $G(s,E_j)$. Of course, $D(s)$ still contains terms $w_j(s)$ and $G(s,E_j)$, but these will be aggregated at the level of the market for workers of skill s. Focusing on the RHS (32) and definition (17), we can intuitively think of H_j as the relative importance of individual specific factors (both worker type productivity and preferences) with respect to the market aggregate utility indicator $D(s)$, summed across markets for worker types. Looking at the LHS of (32), we can also think of H_j as the relative importance of total workforce productivity with respect to firm-specific productivity.

Let us now derive from the system of equations a fixed point correspondence in H_j. It is immediate from the last expression (32) and equation (13) that H_j also satisfies:

$$\left(\frac{Y_j}{A_j}\right)^{\frac{1+\tau\alpha}{1-\alpha}} = A_j^\tau H_j \tag{33}$$

But, combining the production equation (13) respectively with the wages equation (14) and with the supply equation (15), we obtain:

$$w_j(s) = \frac{\tau}{(1+\tau)}(1-\alpha)A_j\left(\frac{Y_j}{A_j}\right)^{-\frac{\alpha}{1-\alpha}}A(s) \tag{34}$$

$$\left(\frac{Y_j}{A_j}\right)^{\frac{1}{1-\alpha}} = \sum_s A(s)N(s)\frac{[w_j(s)G(s,E_j)B_j(s)]^\tau}{\sum_{j'}[w_{j'}(s)G(s,E_{j'})B_{j'}(s)]^\tau} \tag{35}$$

Putting these two expression together:

$$\begin{aligned}\left(\frac{Y_j}{A_j}\right)^{\frac{1}{1-\alpha}} &= \sum_s A(s)N(s)\frac{\left[\frac{\tau}{(1+\tau)}(1-\alpha)A_j\left(\frac{Y_j}{A_j}\right)^{-\frac{\alpha}{1-\alpha}}A(s)G(s,E_j)B_j(s)\right]^\tau}{\sum_{j'}\left[\frac{\tau}{(1+\tau)}(1-\alpha)A_{j'}\left(\frac{Y_{j'}}{A_{j'}}\right)^{-\frac{\alpha}{1-\alpha}}A(s)G(s,E_{j'})B_{j'}(s)\right]^\tau} \quad \leftrightarrow \\ \leftrightarrow \quad \left(\frac{Y_j}{A_j}\right)^{\frac{1+\tau\alpha}{1-\alpha}} &= \sum_s A(s)N(s)\frac{[A_jG(s,E_j)B_j(s)]^\tau}{\sum_{j'}\left[A_{j'}\left(\frac{Y_{j'}}{A_{j'}}\right)^{-\frac{\alpha}{1-\alpha}}G(s,E_{j'})B_{j'}(s)\right]^\tau}\end{aligned} \tag{36}$$

This defines a fixed point equation in Y_j. To show how we can express it as a function of H_j instead, it is sufficient to use (33) to get:

$$H_j = \sum_s A(s)N(s)\frac{[G(s,E_j)B_j(s)]^\tau}{\sum_{j'}\left[A_{j'}\left(A_{j'}^\tau H_{j'}\right)^{-\frac{\alpha}{1+\tau\alpha}}G(s,E_{j'})B_{j'}(s)\right]^\tau} \tag{37}$$

Ideally, we want to show that there exists a solution to this equation and that it is unique, using a fixed point theorem.

B.3 Interpretation of TV-AKM Regression

Let us start from equation (23):

$$\psi_{jt} = a_1 \log A_j - a_2 \log \sum_s A(s)D_t(s)\left[a_3 A(s)G(s,E_{jt})B_j(s)\right]^\tau \tag{23}$$

Define weights $\omega_{jt}(s) = A(s)^{1+\tau} D_t(s) a_3^\tau B_j(s)^\tau$. Then:

$$\begin{aligned}\psi_{jt} &= a_1 \log A_j - a_2 \log \sum_s \omega_{jt}(s) G(s, E_{jt})^\tau = \\ &= a_1 \log A_j - a_2 \log \sum_s \frac{\omega_{jt}(s) G(s, E_{jt})^\tau}{\sum_s \omega_{jt}(s)} - a_2 \log \sum_s \omega_{jt}(s) \leq \\ &\leq a_1 \log A_j - a_2 \tau \sum_s \frac{\omega_{jt}(s) \log G(s, E_{jt})}{\sum_s \omega_{jt}(s)} - a_2 \log \sum_s \omega_{jt}(s)\end{aligned} \tag{38}$$

where the last inequality is due to the concavity of the logarithmic function and Jensen's Inequality. Ignoring the effect of E_{jt} on $\omega_{jt}(s)$, the derivative of the RHS with respect to E_{jt} is approximately:

$$-a_2 \tau \sum_s \frac{\omega_{jt}(s)}{\sum_s \omega_{jt}(s)} \frac{G'(s, E_{jt})}{G(s, E_{jt})} \tag{39}$$

Supposing non-ESG amenities B_j are separable in time and firm components, firm and year fixed effects (approximately) control for the last term of the equation. Hence, approximating the relationship between ψ_{jt} and E_{jt} with a linear function will result in the coefficient on E_{jt} being proportional to a weighted average of the relative rate of change of workers' preferences $G(s, E_{jt})$ across worker types s, if the rate of change does not depend on E_{jt}.

Assumption V. *The rate of change of worker preferences for ESG does not depend on E_jt, i.e. there exists a function $f(s,t)$ such that $\frac{G'(s,E_{jt})}{G(s,E_{jt})} = f(s,t)$ for all s and all t.*

Under Assumptions I, II and V, a regression of year-firm fixed effects on ESG Scores will be informative about the sign of the compensating differential associated to corporate sustainability. It will also inform about the workers' preferences for ESG $G(s, E_{jt})$, in aggregate. In particular, its sign will be negative if and only if at least for some worker type s, $G'(s, E_{jt}) > 0$.

Notice that an example of such preferences is $G(s, E_{jt}) = \exp(\gamma_{st} E_{jt})$. In this case, equation (23) becomes:

$$\psi_{jt} = a_1 \log A_j - a_2 \log \sum_s \omega_{jt}(s) \exp(\gamma_{st} E_{jt})^\tau \tag{40}$$

As a consequence:

$$\frac{\partial \psi_{jt}}{\partial E_{jt}} = -a_2 \frac{\sum_s \omega_{jt}(s)\tau \exp(\gamma_{st} E_{jt})^\tau \gamma_{st}}{\sum_s \omega_{jt}(s) \exp(\gamma_{st} E_{jt})^\tau} \tag{41}$$

which is a again weighted average of γ_{st}. A linear approximation of the relationship between ψ_{jt} and E_{jt} then gives directly a coefficient which is proportional to a weighted average of γ_{st}. In particular, this will be negative if and only if at least some γ_{st} is positive.

Alternatively, and perhaps more realistically, we can approximate the relationship between ψ_{jt} and E_{jt} with a log-linear relationship, provided the rate of change is proportional to $\frac{1}{E_{jt}}$. This is the case with the functional form specified in Assumption III.

C Regression Tables

Table 8: Full results from TV-AKM and Enhanced AKM Specification.

			Firm FE			log Wage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ESG Score	0.16**	-0.01					
	(0.07)	(0.04)					
ESG Score × 2004			0.21***	0.16***	0.13**	0.13***	0.08***
			(0.05)	(0.04)	(0.05)	(0.02)	(0.02)
ESG Score × 2005			0.15**	0.12**	0.09	0.08	0.04
			(0.05)	(0.05)	(0.06)	(0.05)	(0.04)
ESG Score × 2006			0.01	0.01	0.02	0.06	0.03
			(0.03)	(0.03)	(0.03)	(0.04)	(0.03)
ESG Score × 2007			-0.00	-0.02	-0.01	0.03	0.01
			(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
ESG Score × 2008			-0.06	-0.05	-0.08	0.04	0.03
			(0.10)	(0.09)	(0.10)	(0.02)	(0.03)
ESG Score × 2009			-0.12*	-0.12*	-0.12*	0.05	0.04
			(0.06)	(0.06)	(0.07)	(0.04)	(0.04)
ESG Score × 2010			0.08*	0.07*	0.04	0.15***	0.12***
			(0.04)	(0.03)	(0.04)	(0.05)	(0.06)
ESG Score × 2011			0.03	-0.00	-0.02	-0.10**	-0.12**
			(0.05)	(0.04)	(0.04)	(0.03)	(0.03)
ESG Score × 2012			-0.04	-0.06	-0.06	-0.22***	-0.24***
			(0.04)	(0.04)	(0.04)	(0.07)	(0.07)
ESG Score × 2013			-0.13***	-0.14***	-0.16***	-0.25***	-0.28***
			(0.04)	(0.04)	(0.04)	(0.05)	(0.06)
ESG Score × 2014			-0.02	-0.05	-0.07	-0.24***	-0.30***
			(0.06)	(0.06)	(0.06)	(0.09)	(0.10)
ESG Score × 2015			-0.10	-0.11	-0.11	-0.19***	-0.24***
			(0.07)	(0.07)	(0.07)	(0.05)	(0.06)
ESG Score × 2016			-0.14**	-0.15***	-0.18***	-0.15**	-0.20**
			(0.05)	(0.05)	(0.05)	(0.05)	(0.06)
ESG Score × 2017			-0.15*	-0.18**	-0.20**	-0.19**	-0.25**
			(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
ESG Score × 2018			-0.11	-0.14	-0.18	-0.26**	-0.30**
			(0.12)	(0.11)	(0.11)	(0.10)	(0.11)
ESG Score × 2019			-0.14	-0.17	-0.22	-0.30**	-0.35**
			(0.12)	(0.12)	(0.13)	(0.12)	(0.13)
ESG Score × 2020			-0.13	-0.16	-0.21	-0.32*	-0.38*
			(0.16)	(0.16)	(0.16)	(0.13)	(0.15)
ESG Score × 2021			-0.18	-0.23	-0.26	-0.34*	-0.41*
			(0.17)	(0.17)	(0.17)	(0.13)	(0.14)
First stage controls						*Controls*	
Experience				Y	Y		Y
Second stage controls							
Year FE		Y	Y	Y	Y	Y	Y
Firm FE		Y	Y	Y	Y	Y	Y
Size					Y		
Clustered SE			Year & Firm	Year & Firm	Year & Firm	Year & Firm	Year & Firm
Observations	348	348	348	348	387	438,128	438,058
R-squared	0.04	0.96	0.96	0.94	0.94	0.91	0.91

Notes: See notes in Table 3. Standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 9: Full results from R-AKM.

	Year-Firm FE			Individual FE	
	(1)	(2)	(3)	(4)	(5)
ESG Score	0.19	0.42		0.37	
	(0.14)	(0.24)		(0.21)	
ESG Score × 2005			-0.59*		0.47**
			(0.30)		(0.21)
ESG Score × 2006			0.38		0.43**
			(0.55)		(0.20)
ESG Score × 2007			-0.21		0.38*
			(0.63)		(0.21)
ESG Score × 2008			0.34		0.50**
			(0.62)		(0.21)
ESG Score × 2009			1.3*		0.34
			(0.65)		(0.21)
ESG Score × 2010			0.71		0.41*
			(0.51)		(0.21)
ESG Score × 2011			1.8**		0.39*
			(0.75)		(0.20)
ESG Score × 2012			0.92		0.46**
			(0.88)		(0.20)
ESG Score × 2013			0.96**		0.46**
			(0.45)		(0.20)
ESG Score × 2015			6.5***		0.72***
			(0.39)		(0.22)
ESG Score × 2016			0.62		0.32
			(1.1)		(0.20)
ESG Score × 2017			-0.20		0.41*
			(0.52)		(0.21)
ESG Score × 2018			-0.37		0.44*
			(0.47)		(0.22)
ESG Score × 2019			-0.35		0.46**
			(0.48)		(0.20)
ESG Score × 2020			-1.2*		0.37*
			(0.60)		(0.20)
ESG Score × 2021			-1.2**		0.36*
			(0.58)		(0.20)
Intercept	-0.70			1.6*	1.4
	(0.58)			(0.93)	(0.89)
Second stage controls					
Year FE		Y	Y		
Firm FE		Y	Y		
Clustered SE			Year & Firm		Year & Firm
Observations	237	237	237	290,695	290,695
R-squared	0.008	0.57	0.61	0.02	0.14

Notes: The dependent variables are estimated fixed effects from the AKM regression or log wages. Independent variables are in logarithms. Year 2014 is missing because no employee movement was observed for the reference firm in 2013-2014. Standard errors in parentheses.

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

D Additional Simulation Results

Estimated μ_{sk} for second period.

s \ k	1	2	3
1	2.00	2.54	3.06
2	2.41	2.92	3.58
3	3.21	3.31	4.28

True μ_{sk} for second period.

s \ k	1	2	3
1	1.90	2.39	3.01
2	2.42	2.89	3.48
3	3.15	3.60	4.18

Estimated σ_{sk} for second period.

s \ k	1	2	3
1	0.11	0.14	0.09
2	0.08	0.28	0.13
3	0.05	0.32	0.10

True σ_{sk} for second period.

s \ k	1	2	3
1	0.10	0.10	0.10
2	0.10	0.15	0.20
3	0.10	0.18	0.25

Estimated type proportions.

k → k′ \ s	1	2	3
1–2	0.66	0.33	0.01
1–3	0.27	0.36	0.36
2–1	0.50	0.43	0.07
2–3	0.47	0.27	0.27
3–1	0.31	0.33	0.36
3–2	0.37	0.17	0.46

True type proportions.

k → k′ \ s	1	2	3
1–2	0.67	0.33	0.00
1–3	0.27	0.36	0.36
2–1	0.50	0.50	0.00
2–3	0.47	0.40	0.13
3–1	0.31	0.38	0.31
3–2	0.60	0.25	0.15