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Does it pay to be green? An exploratory analysis of wage differentials between green and non-green industries

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Abstract

Purpose – This paper investigates the potential wage impacts of a shift to more environmentally sustainable production patterns.

Design/methodology/approach – The empirical analysis is carried out using labour force survey data and interval regressions.

Findings – Estimates at the individual level suggest that small wage differentials exist: individuals employed in green industries earn about seven per cent more than those working in non-green industries.

Originality/value – To date, very little is known about the characteristics of jobs in the green industry and by extension, the labour force effects that can emerge or change as a result of transitioning towards a greener economy. While exploratory in nature, this analysis seeks to shed light on an underdeveloped area of research, namely, wage inequalities associated with transitioning towards green growth.

Keywords Green economy, Greening, Green jobs, Wage differentials, Intra-industry wages

Paper type Research paper

1. Introduction

It is widely accepted that the path to development must address growing environmental issues. Nearly, 200 countries have ratified the Paris Agreement (United Nations Treaty Collections, 2020), an agreement with the central aim of strengthening the global response to the threat of climate change, with participating countries committing to keep global warming below 2^0C over pre-industrial levels. The 2030 Agenda for Sustainable Development (adopted by the United Nations in 2015) has reaffirmed the international consensus on the importance of addressing the environment with goal 13 out of 17 being "Take urgent action to combat climate change and its impact" (United Nations, 2018).

While neither the Paris Agreement nor goal 13 of the Sustainable Development Goals provide blueprints as to how countries can achieve their commitments, it is unlikely that these targets will be achieved without government intervention in energy markets and concerted efforts by the private sector (Clemencon, 2016). One approach that has been put forward as a means of achieving these objectives is the notion of green growth. This concept attempts to make growth more resource-efficient, cleaner and resilient (Hallegatte *et al.*, 2011). Within the United Nations Environment Programme (UNEP), the green economy is seen as a road towards the concept of sustainable development (UNEP, 2011). Specifically, the environment is not only seen as an important input into economic output but also a driver of economic growth. In this way, the discussion is not the environment vs the

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economy, but the environment as a vital part of the economy and the economy as a critical component to protecting the environment. The link between the green economy and sustainable development is very much incorporated into the UNEP's definitions of the green economy, that is

> One that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities (UNEP, 2010a).
>
> A green economy is a system of economic activities related to the production, distribution and consumption of goods and services that results in improved human well-being over the long term, whilst not exposing future generations to significant environmental risks and ecological scarcities (UNEP, 2010b).

The shift towards greener forms of production, distribution and consumption raises questions about the labour market implications of green growth. On the one hand, green growth is often associated with technological progress, increased investment in infrastructure and the development of value chains (Altenburg and Assmann, 2017; Tobias *et al.*, 2017). It also provides the opportunity to create new jobs with new employment profiles and enhance the occupation skills of current profiles. At the same time, changes in production modes and technologies towards cleaner modes could result in reduced labour, depending on the extent to which labour can be substituted with other production inputs (Chateau *et al.*, 2018). Furthermore, green growth policies are likely to reduce the demand for polluting final and intermediate production goods and by extension, labour demand in the brown sectors (Chateau *et al.*, 2018). Taken together, the net impact of greening on total employment is unclear, and empirical results to date have been mixed. For instance, studying companies in China, Mishra and Smyth (2011) found that environmental regulations had negative labour market effects, pushing down workers' wages by almost 20%. In contrast, Bezdek *et al.* (2008) found that environmental protection legislation had a positive net effect on employment and economic growth in the United States. Lehr *et al.* (2012) also find benefits associated with greening. The authors investigated the labour market implications of Germany's large investment in the area of renewable energy. Using different assumptions in relation to fossil fuel prices, renewable energy investment and international trade, the authors report that the expansion in renewable energy will have positive new employment effects until 2030. Little is also known about the characteristics of jobs in the green industry (notably, hours and wages) and the extent to which they differ from non-green jobs. This paper attempts to address the aforementioned gap in the literature, focusing on the wage differentials between green and non-green industries.

Why would wages differ between green and non-green industries? The literature on wage determination suggests that worker productivity characteristics and task descriptions do not solely determine wages: wages are also affected by industry features (Le *et al.*, 2018; Gannon *et al.*, 2007). While the exact reason for industry wage differentials remains unresolved, some explanations have been put forward. Some authors suggest that true-wage differentials exist. For instance, some authors opine that intra-industry wage differentials occur due to rent sharing, whereby firms share profits above the level that results from paying all factors their market rates with workers (Benito, 2000). Dechezleprêtre *et al.* (2019) reviewed the empirical evidence on the links between firm environmental performance and its economic or financial performance over the last decade. These authors report strong evidence of positive and statistically significant correlations between environmental performance and firm performance, as measured by profitability indicators and stock market returns. If green firms are more profitable and opt to engage in rent sharing then the salaries of workers in green industries would be comparatively higher than those in non-green industries.

However, a more popular explanation for wage differentials across industries is related to differences in (unmeasured) labour quality or skills. Specifically, some authors suggest that intra-industry wage gaps could be due to differences in labour quality not captured by datasets, whereby the unobserved skills of the labour force may not be randomly distributed among industries. Some industries may disproportionately draw more high ability workers than others and so pay higher wages on average (Gibbons and Katz, 1992). Alternatively, some industries may differ in the value placed on worker endowments, such as natural ability and cognitive skills. As such, the wages paid in industry A may be higher than that for industry B, if industry A requires superior or specialised skills.

Currently, there is some debate as to whether "green" skills [1] represent a completely new set of skills. ECROYS (2008) found that specific skills will be needed for green growth, among which are knowledge of sustainable material and environmental assessment skills, which would require specific training and educational qualifications. Other studies suggest that the rise of green growth will require a mix of traditional and new green skills. Consoli *et al.* (2016) compared the skills required for green jobs and non-green jobs. The authors report that green jobs are characterised by higher levels of non-routine cognitive and interpersonal skills. Similarly, Bowen *et al.* (2018) also report skill-specific differences in green and non-green jobs. Taken together, if green industries indeed employ workers specialised skills, one could find that these industries pay higher wages to observationally equivalent workers.

Though many uncertainties about the cause of intra-industry wage gaps remain, the existence of systematic wage differentials across industries is well documented in the economic literature (Gannon *et al.*, 2007; Benito, 2000). It is thus not far-fetched to assume that there could be wage differentials between green and brown industries. Against this backdrop, this study seeks to explore wage gaps between green and non-green industries. The paper, while exploratory in nature, adds to our understanding of the labour market implications of greening, which should be very useful for countries as they attempt to green their economies in the future.

The empirical analysis is carried out using Barbados as a case study. The study employs data from the Barbados labour force survey for the period 2004–2014. With this dataset, we can evaluate the impact of the greening on wages after controlling for crucial wage determinants such as personal characteristics, human capital endowments and employment characteristics. As the database spans the period 2004–2014, we are also able to evaluate how the green–brown industry differentials evolved, mainly the impact of greening on wages pre and during the global financial crisis.

The remainder of this paper is structured as follows. Section 2 provides a brief overview of green developments in Barbados, while Section 3 provides a description of the data and methodology employed. Section 4 gives a summary of the empirical results. Finally, Section 5 summarises the main findings and provides some policy implications emanating from the study.

2. Greening developments in the Barbadian economy

Barbados is a small island developing Caribbean state. Like many small island states, Barbados has limited natural resources, limitations on import substitution possibilities, small domestic markets and weak inter-industry linkages (Briguglio, 1995). In spite of these challenges, Barbados is currently classified as a high-income country (World Bank, 2020) with very high levels of human development (United Nations Development Programme, 2020). In fact, Barbados' human development index score is 0.814 in 2020, making Barbados one of most developed countries in Latin America and the Caribbean.

Barbados has always incorporated green economy concepts into its production and consumption. For 300 years, windmills were used to grind sugarcane, and the island has one

of the highest penetration rates for solar panel water heaters, with the technology being used by both households and business, particularly those in the tourism industry (Headley, 1997; Langniss and Ince, 2004). Moore (2013) also notes that the island has a comparative advantage in a number of green goods and services and puts forward these as opportunities to stimulate growth.

Barbados has committed to making its economy solely reliable on renewable energy by 2030 as well as becoming "the most environmentally advanced green country in Latin America and the Caribbean". This transition has been supported by a number of tax incentives and policies that encourage both sustainable consumption and production. These incentives include the following:

(1) Reduced excise taxes on electric vehicles,

(2) Duty-free access for any machinery used to produced energy from a renewable source of energy,

(3) $5,000 deduction for income tax purposes for environmentally preferred products,

(4) $5,000 deduction from taxable income for energy audits or retrofitting of premises to produce electricity from sources other than fossil fuels,

(5) Deduction of interest paid on loans for corporate tax purposes,

(6) Deduction of costs associated with staff training for income tax purposes and

(7) Writing-off the costs associated with research and development expenditures for income tax purposes.

The island has also outlined a national strategy for greening its economy in the study of Moore *et al.* (2012) that involves focussing efforts on the key industries in the economy and identifying how the cross-cutting issues of water, waste and energy can be integrated within these industries.

The green economy strategy also called for identifying finance and investment opportunities, implementing a supportive fiscal policy framework, developing standards and regulations, revising government procurement policies and developing partnerships between government and the private sector. In 2018, the island announced the Public Sector Smart Energy Programme (PSSEP) that will retrofit 16 government buildings with photovoltaic systems. These systems will generate approximately 4.5MW of electricity annually and save 3.66 barrels of oil per year [2].

Given the significant investments taking place in the green economy on the island, it is therefore not surprising that this sector of the economy is generating a number of new jobs. The International Labour Office (2018) estimates over 15% of jobs in Barbados are in green industries. This expansion in the number of green jobs is supported by the Barbados Education Policy, which speaks to the need to expand skills in the areas of sustainable development. Barbados therefore serves as the ideal country to investigate this issue of the green wage gap, given its long history of green growth and plans to build on this legacy in the future.

3. Data and methods

3.1 Data

An essential step in the analysis involves classifying industries as green and non-green. Disentangling green industries from the rest of the economy is a somewhat tricky task. It is possible to simply identify industries that have green characteristics: agriculture, manufacturing, construction, installation and maintenance, as well as scientific and

technical, administrative and service (UNEP, 2008). Alternatively, one can utilise the approach put forward by the International Labour Organization, where green jobs are those that reduce the environmental impact of enterprises and economic sectors to levels that are considered sustainable. [3] As the greening process is not a fixed point, a green job could be partially related to greening. So, a job that helps a firm to reduce its use of resources could be classified as green even though the firm's final product is not green (Georgetown University, 2015). Against this backdrop, Moore (2017) defines green industries as those industries that reduce the demand for resources or help to remediate the outputs of other industries. We follow suit in this paper. Specifically, Moore (2017) used this definition and pooled cross-section data from the Barbados Continuous Labour Force Sample Survey (CLFSS) [4] over the period 2004–2014 to classify industries as green and non-green for Barbados [5]. We employ Moore (2017)'s database in this study [6]. The raw database consisted of 142,848 observations. As we are interested in wages, our sample is limited to the portion of employed persons who stated their salaries, thereby yielding an analytical sample of approximately 86,000 observations.

3.2 Model specification and variable description

To formally investigate the green wage gap at the individual level, we augment a traditional wage equation with a green industry variable. Specifically, the model used in this study is as follows:

$$\begin{aligned}\ln w_{it} = {} & \beta_0 + \beta_1 G_{it} + \beta_2 \text{Age}_{it} + \beta_3 \text{Sex}_{it} + \beta_4 \text{Marital status}_{it} + \beta_5 \text{Education}_{it} + \beta_6 \text{Training}_{it} \\ & + \beta_7 \text{Experience}_{it} + \beta_8 \text{Occupation}_{it} + \beta_9 \text{Employment type}_{it} \\ & + \beta_{10} \text{Employment status} + \beta_{11} \text{Time}_t + \varepsilon_{it}\end{aligned} \tag{1}$$

The dependent variable ($\ln w_{it}$) is the log of average weekly earnings for each individual i in period t. The CLFSS database uses 11 mutually exclusive categories (in BB dollars) to code earnings: (1) 1 to 199 (2) 200 to 299; (3) 300 to 399; (4) 400 to 499; (5) 500 to 599; (6) 600 to 699; (7) 700 to 799; (8) 800 to 899; (9) 900 to 999; (10) 1,000 to 1,300 and (11) over 1,300. The main independent variable is the green variable (denoted as G in Equation 1), which is binary and takes on a value of 1 if the individual worked in a green industry and 0 otherwise.

The literature suggests that an individual's wage depends on a host of variables beyond the industry in which one works. Our model thus includes a subset of control variables. We drew heavily on theory to build our empirical model, but we were constrained by variables included in the database. Nonetheless, we were able to control for the traditional determinants of wages such as individual's age, sex, marital status, education, experience, job-training, occupation, employment type and employment status. The study also controls for fixed time effects (Time), which capture structural change over time. It is important to point out that all control variables are categorical except age, reflecting the structure of the labour force survey items.

Human capital variables are arguably the most commonly used variables in wage equations (Jackman and Bynoe, 2014). Human capital theory maintains that there is a positive relationship between human capital and worker productivity and by extension, wages. Specific research on Barbados suggests that there are positive returns to human capital (Jackman and Bynoe, 2014; Griffith, 2001; Coppin, 1996). In this study, the impact of human capital is captured by the education, experience and training variables. The education variable represents the highest level of education completed and is captured by a five-category variable: (1) compulsory schooling in Barbados is the base (that is, primary and/or secondary); (2) post-secondary; (3) university; (4) other and (5) not stated. Training is captured via a three-category variable

denoted as (1) trained (reference category); (2) not trained and (3) not stated. Work experience is represented by a seven-category variable: (1) under 1-year (base); (2) 1–5 years; (3) 6–10 years; (4) 11–15 years; (5) 16–20 years; (6) over 20 years and (7) not stated.

Personal characteristics (such as sex, age and marital status) also matter. After human capital, the next most commonly used determinant of wages is sex. Indeed, a burgeoning body of literature suggests that there are often gender gaps in wages (Blau and Khan, 2017), a gap that often cannot be explained by differences in observable characteristics of workers. Empirical work by Bellony *et al.* (2010) suggests that in Barbados, even after accounting for key determinants of earnings, a significant gender gap remains. These authors also report that the unexplained component of the gap (often used as a proxy for discrimination) ranges from 15.3 to 26.7%. Labour economists also document differences by marital status for both men and women (Blackburn and Korenman, 1994; Juhn and McCue, 2017). Becker's model of household specialisation and division of labour has been used to explain the association between marriage and earnings (Becker, 1981). Under this framework, households gain from specialisation, and as such, one spouse specialises in market work and the other in household work. Given the historical advantages of men in the labour market, the model predicts an earnings premium for married men and an earnings disadvantage for married women. In this study, age is measured as the age of the respondent in years, sex is a dichotomous variable, where the reference category is male, and marital status is represented by a three-category variable: (1) never married (base category), (2) married and (3) other.

There is also evidence to suggest that employment characteristics are significant determinants of wages. Specifically, the literature suggests that differences in wages can be found across occupations (Haupt and Ebner, 2020; De Byer and Knight, 1989), between the public sector and private sector (Tansel *et al.*, 2020; Depalo *et al.*, 2015) and between full-time and part-time workers (Antonie *et al.*, 2020). The role of employment characteristics in wage determination in Barbados is captured by the occupation, employment type and employment status variables. Occupation captures ten occupational categories: (1) legislators and senior officers (reference category); (2) professionals; (3) technicians and associate professionals; (4) clerks; (5) service/shop workers; (6) skilled agricultural workers; (7) craft and related workers; (8) plant and machine operators and assemblers; (9) elementary occupations and (10) not stated. Employment type is a binary variable that represents whether or not workers are employed on a full-time basis (base category) or a part-time basis, and employment status is a four-category variable defined as (1) private-sector employee (base category); (2) public sector employee, (3) self-employed and (4) other.

3.3 Estimation approach

The nature of the dependent variable limits the choice of statistical models that can be used to estimate Equation (1) above. As noted earlier, the dependent variable is interval coded, and so we are modelling an outcome for which the exact values are not observed, only the interval containing that value. While the choice to use intervals to code income is often motivated by concerns about confidential and reporting bias (Reilly and Bellony, 2009), it does present a constraint concerning the methods. For this type of data, non-linear models (namely interval regression) are needed, as the standard ordinary least squares approach may yield inconsistent parameter estimates. In this paper, we employ an interval regression to estimate Equation (1). Interval regressions are a generalisation of censored regressions and allow an individual to predict the value of the outcome variable, even though one cannot observe their exact values (Stewart, 1983; Cameron and Trivedi, 2010).

4. Empirical results

Table 1 presents some descriptive statistics. Between 2004 and 2014, a plurality of persons in the sample reported earned between BB $400 and $600 weekly, and 27.3% of persons

Variable	Per cent (%)	Variable	Per cent (%)
Average weekly earnings		*Training*	
1 to 199	4.04	Yes	54.91
200 to 299	12.95	No	44.81
300 to 399	19.9	Not stated	0.28
400 to 499	18.01	*Occupation*	
500 to 599	12.52	Legislators and senior officers	8.75
600 to 699	7.29	Professionals	12.11
700 to 799	5.58	Technicians and assoc. profession	9.44
800 to 899	4.78	Clerk	12.31
900 to 999	2.48	Service/shop workers	17.95
1,000 to 1,300	6.77	Skilled agricultural workers	2.78
Over 1,300	5.68	Craft and related workers	13.09
Green industry variable		Plant and machine operators and assemblers	5.78
Non-green industry	72.74	Elementary occupations	17.69
Green industry	27.26	Not stated	0.09
Gender		*Employment status*	
Male	51.39	Private employee	62.30
Female	48.61	Government employee	21.78
Marital status		Self-employed	14.53
Never married	61.57	Other	1.32
Married	31.06	Not stated	0.08
Other	7.37	*Time effects*	
		2004	10.81
Education		2005	6.84
Compulsory schooling	65.16	2006	10.6
Post-secondary	22.31	2007	10.23
University	11.1	2008	10.25
Other	0.78	2009	9.9
Not stated	0.65	2010	9.18
Experience		2011	8.56
Under 1 year	9.19	2012	8.05
1–5 years	29.89	2013	8.04
6–10 years	21	2014	7.55
11–15 years	12.22	*Continuous variable*	*Mean (std. dev.)*
16–20 years	7.27	Age	41.58 (12.74)
Over 20 years	19.28		
Not stated	1.14		

Table 1.
Summary statistics (2004–2014)

could be classified as working in a green industry. Figure 1 plots the distribution of earnings by industry in 2004 and 2014. The plot hints that the green gap may have narrowed over time. In 2004, persons working in green industries had a clear earnings advantage. Individuals employed in non-green industries dominated the lower end of the earnings distribution. In contrast, those in the green industry dominated the middle to the upper echelon of the earnings distribution. By 2014, the gaps had narrowed significantly, hinting that the green-wage premium may not be time-invariant.

Table 2 presents the interval regression analysis of the green–brown wage differentials. All control variables were statistically significant. With respect to the variable of interest, the coefficient on the green industry variable is positive and statistically significant, yielding evidence of a small green industry earnings premium (see Table 2). Specifically, after controlling for various worker endowments (which often explain wage differences), persons working in the green industries earn 7.0% more than their equivalents working in non-green industries.

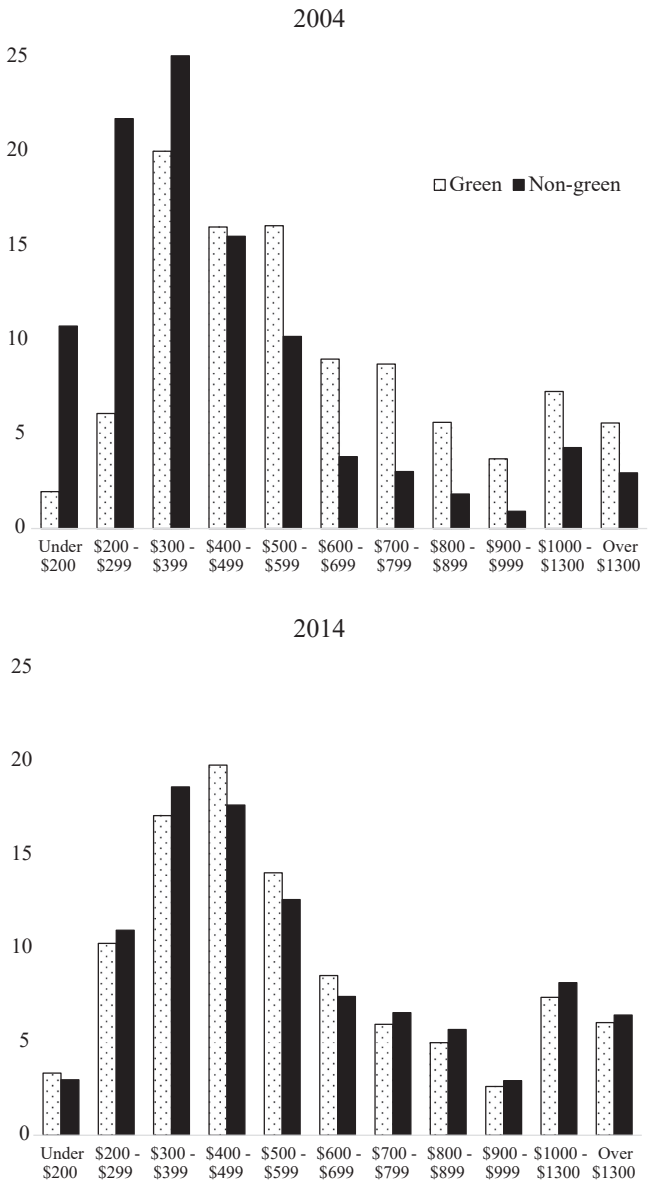

Figure 1.
Earnings by industry between 2004 and 2014

A point hitherto unexplored in this subsection concerns the evolution of the green industry premium between 2004 and 2014. Our preliminary analysis of the distributions of earnings across sectors in the methodology section hinted that the green-wage gap narrowed between 2004 and 2014 (see Figure 1). It is possible that adverse spillover effects from the global financial crisis (whose impact on the Barbadian labour market started in late 2008 and continued throughout the review period) [7] could have altered labour market dynamics. To formally assess the evolution of the green wage gap over the period, we re-estimate Model 4

Variable	Coefficient	Standard errors
Green industry	0.070***	0.004
Controls		
Female	−0.186***	0.003
Age	0.001***	0.000
Marital status (ref: never married)		
Married	0.110***	0.003
Other	0.071***	0.005
Education (ref: compulsory schooling)		
Post-secondary	0.188***	0.004
University	0.270***	0.005
Other	0.103***	0.015
Not stated	0.022	0.017
Experience (under1 year)		
1–5 years	0.115***	0.005
6–10 years	0.204***	0.005
11–15 years	0.252***	0.006
16–20 years	0.265***	0.007
Over 20 years	0.294***	0.006
Not stated	0.203***	0.013
Training (red: yes)		
No	−0.102***	0.003
Not stated	0.001	0.025
Occupation (ref: legislators and senior officers)		
Professionals	−0.045***	0.006
Technicians and associate professionals	−0.282***	0.006
Clerk	−0.369***	0.006
Service/shop workers	−0.579***	0.006
Skilled agricultural workers	−0.702***	0.009
Craft and related workers	−0.536***	0.006
Plant and machine operators and assemblers	−0.533***	0.007
Elementary occupations	−0.720***	0.006
Not stated	−0.268***	0.043
Employment type (ref: full time)		
Part-time	−0.427***	0.007
Not stated	−0.099	0.187
Employment status (ref: private employee)		
Government employee	0.128***	0.004
Self-employed	−0.003	0.004
Other	0.136***	0.012
Not stated	−0.060	0.047
Time effects		
2004	0.036***	0.006
2005	0.063***	0.006
2006	0.099***	0.006
2007	0.124***	0.006
2008	0.139***	0.006
2009	0.162***	0.006
2010	0.162***	0.006
2011	0.176***	0.006
2012	0.186***	0.006
2013	0.181***	0.006
2014	0.036***	0.006
Constant	6.275***	0.009

Table 2.
Results

Note(s): (1) ***, **, * indicate significance at the 1, 5 and 10% level of testing
(2) Robust standard errors are provided in parentheses

(that is, the full specification) this time around allowing for the interaction of the time and the green industry variable. The interaction term is statistically significant, indicating that the regression coefficient estimates for the green industry variable vary over time even after controlling for our independent variables. These relationships are illustrated in Figure 2, which plots the linear prediction of the natural logarithm of weekly earnings for persons employed in the green and non-green industries as time progresses. The figure shows that the green wage gap contracted over the period. Between 2004 and 2009, there is strong evidence of a green-wage premium. By 2010, the green-wage premium disappeared, and salaries across the two industries remained on par after that. The fallout from the crisis appears to have been borne mainly by those working in the green industry. Based on Figure 2, the predicted wages of those in the green industry fell significantly since 2010 and failed to return to the pre-2010 level. Meanwhile, growth earnings of those employed in non-brown industries slowed significantly but did not decline in the wake of the crisis, leading to a narrowing of the green wage gap.

5. Discussion and conclusions

As economies around the world attempt to meet their carbon emission targets set by the Paris Climate Agreement, greening is likely to be an emerging global trend at both the country and firm level. The emergence of these green industries is likely to have effects on the labour market, both in terms of the type of jobs available and wages paid to employees in green and non-green industries. Based on these anticipated changes in the labour market, this paper, therefore, evaluates whether or not a shift to more environmentally sustainable production patterns is likely to have adverse wage effects on workers in these industries. The study evaluates this problem using a micro-database for Barbados, an island that has been actively pursuing green economy policies for over ten years.

The study utilised data from the labour market survey data and provides estimates of individual wages based on the industry in which they work. From this database, the study is able to evaluate trends in reported relative wages for green industries over the period

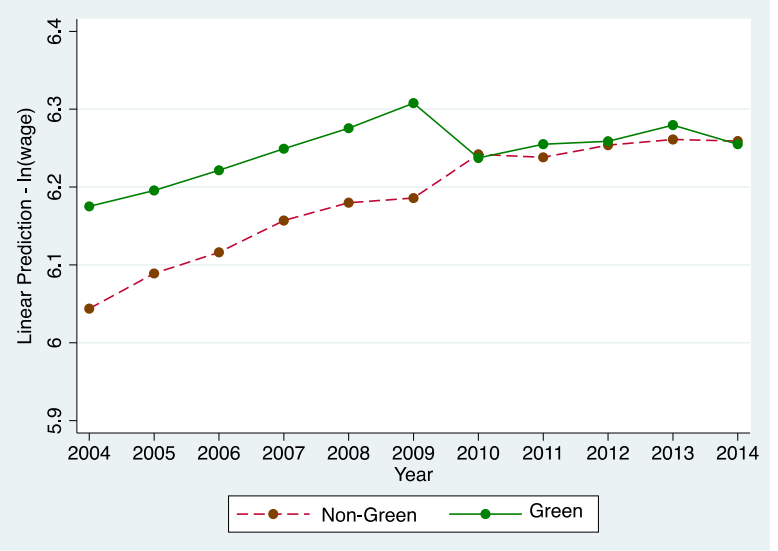

Figure 2.
Effect plots for the interaction of the time and green industry variables

2004–2014. The results suggest that persons working in green industries earn a premium, even after controlling for popular wage determinants such as occupation, human capital and gender. Our findings are in line with other studies in labour economics that suggest wages differ across industries (Le *et al.*, 2018). Labour economists often draw on a theory of industry-specific productivity and wages to explain how industries can influence wages and what factors influence the choice of industry. In particular, such studies evaluate the factors where worker endowments interact with industry to determine wages, and there is some sorting of workers into industries according to worker quality. Indeed, wage differentials due to differences in the skills of workers have been one of the most significant global trends of the 21st century. Following Katz and Murphy (1992), the differences in wages between two groups of workers with different skills can be modelled using a constant elasticity of substitution production function with two labour inputs:

$$Y_t = \left[\alpha_t (aN_s)_t^{\rho}\right]^{1/\rho} + (1-\alpha_t)(bN_u)_t^{\rho}]^{1/\rho}$$

where Y is output, N_s is skilled labour, N_u is less skilled labour, a and b are parameters representing the skilled and less skilled augmenting technological change, α is the skilled labour share and ρ is a parameter determining the elasticity of substitution between skilled and less-skilled labour. If less skilled and skilled workers are paid their marginal products, the relative wage equation can be written as follows:

$$\ln\left(\frac{W_s}{W_u}\right) = (1/\sigma)[D_t - \ln(N_s/N_u)]$$

where $\sigma = 1/(1-\rho)$, $\frac{W_s}{W_u}$ is the relative wage of skilled and less-skilled workers and D_t is a relative demand index for skilled workers. Under this framework, one plausible explanation for the wage differential could be that green industries require different skills than non-green industries, skills that would not be captured in the typical labour force survey and possibly attract greater wages. There is work to suggest that the skills needed for green jobs differs from those needed for non-green jobs (Bowen *et al.*, 2018), with some studies suggesting that green jobs require more high end skills than non-green jobs (Phung, 2019; Consoli *et al.*, 2016). While our database does not allow us to evaluate differences in skills across the two industries, we can look at differences in educational qualifications. Specifically, over the period 2004–2014, 21.24% of persons working in the green industry earned a degree or some professional designation, while for the non-green sector, the share was 8.89%. It is plausible that the green industry calls for higher-level qualifications as they require greater sophisticated skills, some of which were not captured in the labour force survey. The presumed difference in skills required could be driving the premium observed.

Our findings also suggest that green industries were more significantly affected by the recession. It is entirely plausible that wages in green industries would be more severely affected by the recent recession. Work by Bynoe and Jackman (2014) suggests that the recession brought about drastic changes in the financial positions of Barbadian households, which in turn led to a decline in household expenditure. As households reduced their expenditure, they may have also substituted green products for cheaper non-environmentally sustainable products. This substitution could have put pressure on green firms to reduce the green price premium. As the green price premium falls, then wages in these industries should also be expected to decline or stagnate, leading to a narrowing of the green wage gap.

The findings reported in the study have important labour market policy implications. For green industries, policymakers will need to put policies in place to help workers in non-green industries transition to green industries. This might mean helping with educational loans,

providing grants or giving incentives to companies that help to retool their employees. Transitioning the labour force from non-green to green industries might result in inequality and labour market rigidities if workers are not able to easily transition from non-green to green industries. Less-skilled employees, in particular, might be more at risk given that green jobs might require specialist skills.

While workers in green industries appear to earn a wage premium from being employed in these jobs, it is also essential that workers can easily transition from one green industry to another green industry. The results provided in this study suggest that declines in overall economic activity seem to have a comparatively more significant impact on green industries than non-green industries. These workers, while employed in these industries, might receive better compensation but might also be more likely to face uncertain job prospects. Viewed from this perspective, the wage premium might simply be a compensation for the risk of taking a job in a green industry. This risk can, however, be reduced if it is easy to transition from one industry to another, whether it is green or non-green.

Though the present study calls attention to an underdeveloped area of research, it is not without limitations. We used pooled cross-sectional data and so, had to rely on observed characteristics as opposed to being able to compare the same individuals over time, possibly using person-level fixed effects. The data captured in the survey were limited, and we were only able to control for traditional dimensions of human capital such as formal education, work experience and on-the-job training. We were also unable to control for other factors such as cognitive skills and interpersonal skills that some researchers suggest fit the peculiarities of green industries (Consoli *et al.*, 2016). Finally, the wage variable was an interval coded dependent variable. While the Barbados Statistical Service's choice to use intervals to code wages was primarily motivated by concerns about confidentiality and reporting bias, it did present a constraint concerning the type of empirical analysis we could carry out. It is quite possible that the model specification could have impacted the results. With these limitations, this study only serves as a first step into wage differentials in green and non-green industries. Further research should be undertaken to complement this research and possibly address some of the limitations of this study. An important area for future research would be to analyse if green wage premiums exist in other countries, which would assist in confirming the findings of this study. Indeed, the scale of intra-industry wage differentials has been shown to differ across countries (Gannon *et al.*, 2007). An extremely promising route would be cross-country comparisons of the green–brown wage differentials using comparable data. The more we know about the impact of greening on the labour market, the more likely it is that effective programmes and strategies can be developed and implemented, so that societies can maximise the gains from greening and limit losses.

Notes

1. Martinez-Fernandez *et al.* (2013) propose that green skills are "the skills needed by the workforce in order to help the adaptation of the products, services and processes to the changes due to climate changes and to environmental requirements and regulations".
2. https://www.barbadosadvocate.com/news/green-economy-push
3. https://www.ilo.org/global/topics/green-jobs/lang–en/index.htm
4. The survey is conducted quarterly by the Barbados Statistical Service and is the official source of labour market data in Barbados. The CLFSS is used to generate labour market statistics of the population of Barbados aged 15 and over, such as the unemployment rates and labour force participation rate.
5. Details can be found in Moore (2017).
6. At the time of writing, we were unable to obtain any data beyond 2014.

7. For example, in 2008, the unemployment rate in Barbados moved from 7.4% in 2007 to 8.1%. Between 2008 and 2014, the unemployment rate continued to climb and reached 12.3% by the end of 2014.

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