Journal of Cleaner Production 214 (2019) 696–704

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Understanding labour exploitation in the Spanish agricultural sector using an agent based approach

Thomas Chesney [a, *], Keith Evans [b], Stefan Gold [c], Alexander Trautrims [a]

[a] Nottingham University Business School, University of Nottingham, UK
[b] University of Nottingham, UK
[c] Faculty of Economics and Management, University of Kassel, Germany

ARTICLE INFO

Article history:
Received 21 February 2018
Received in revised form
3 September 2018
Accepted 27 December 2018
Available online 29 December 2018

Keywords:
Spanish agriculture
Diffusion of slavery
Agent based model
Unethical labour practices

ABSTRACT

Using an agent-based model we explore the model of slavery in modern business developed by Crane (2013). Taking the Spanish agricultural sector—specifically the area of Campo de Dalías in Almería where much of Europe's vegetables are grown—as a case, we find that labour exploitation flourishes in communities of like-minded companies that do not care about mainstream norms. We confirm which socio-economic aspects of labour demand/supply lead to slavery, while challenging the assumption that markets which are dominated by few employers are more prone to exploiting workers. We find that, regarding isolation and connectedness of employers, cluster effects and intense inter-employer communication are particularly effective drivers of underpayment if the cluster is homogenous in terms of wage level and if it is isolated from law-abiding employers. This means that employers tend to confirm and reinforce each other in their illegal behaviour, thus creating enclaves in which non-standard norms prevail and worker exploitation is regarded as legitimate. On the other hand, we see that breaking the isolation of employees among each other only increases pay levels if there are law-abiding employers, pointing to the potentially beneficial role social business and entrepreneurs, state-owned companies, or public entrepreneurs could play for transforming labour conditions of entire markets.

© 2019 Elsevier Ltd. All rights reserved.

1. Introduction

Despite numerous laws prohibiting the practice, slavery still exists in a number of forms today including chattel slavery, which is probably what most people think of when they hear the term. More common are debt bondage, where people borrow money and must work for the lender to re-pay it; and contract slavery, which masquerades as legitimate work but the promised pay and conditions are not fulfilled (Bales et al., 2010). This paper considers contract slavery, with slavery defined as being paid less than the minimum wage[1]

In his theory of modern slavery as a management practice, Crane (2013) mentions the use of slave labour in the Spanish agricultural industry. According to the European Union's Farm Structure Survey (Union, 2010) Spain has 989,800 agricultural holdings; Spanish farms employ a permanent workforce of 2.2 million people (including family members), equivalent to 9.8% of Spain's total economically active population. However, this permanent workforce is supplemented by temporary labour that is hired formally and informally as needed. The Foundation (2016) estimates a number of 8400 slaves in Spain although it should also be noted that modern slavery is only the most extreme form on a wider spectrum of labour exploitation. Agriculture is high risk for modern slavery due to manual processing and labour being a high proportion of the production costs (Bales and Trodd, 2013) and its informal and temporary employment practices (Gold et al., 2015). In a deeper analysis of one particular case, Lawrence (2011) reports that illegal migrant workers from Africa working on fruit and vegetable farms in Almería are routinely paid less than half the legal minimum wage, under threats to report them to the police if they complain. Almería has become a major source of fresh produce, and its greenhouses are used to grow food all year round. There are an estimated 40,000 ha of greenhouses in Campo de Dalías, the largest concentration in the world (Szajkowska, 2012). Views of the region from Google Earth show it to be almost completely white by being

* Corresponding author.
E-mail addresses: thomas.chesney@nottingham.ac.uk (T. Chesney), keith.evans@nottingham.ac.uk (K. Evans), gold@uni-kassel.de (S. Gold), alexander.trautrims@nottingham.ac.uk (A. Trautrims).

[1] Therefore we are really discussing sweatshop labour.

https://doi.org/10.1016/j.jclepro.2018.12.282
0959-6526/© 2019 Elsevier Ltd. All rights reserved.

covered in plastic, earning it the nickname 'Costa del Polythene'. Over 2.7 million tonnes of produce are grown on its plains each year, accounting for over €1.2 billion in economic activity.[2]

Lawrence (2011) describes the experience of one immigrant in Almería. The man arrived illegally in southern Spain from Morocco in 2004 to work in the greenhouses, having paid €1000 to smugglers to bring him in a fishing boat. In 2004 he could earn €30 for 8 h' labour. In 2011 he considered himself "lucky" if he could make €20 a day. The legal minimum wage for a day's work is more than €44. The situation of migrants working in Almería got so desperate that the Red Cross and other charities began to hand out free food to many thousands of them.

Based specifically on the Almería case, and drawing on analyses by Acemoglu and Wolitzky (2011) we build an agent-based model to explore the Almería case and the implications of Crane's theory. Many analyses of our model are possible but here we concentrate on the diffusion of slavery and anti-slavery practices through the industry, an investigation of socialisation both among workers and among employers, an examination of the effects of employer number and size, and how to fight slavery through inspection.

2. Background

Labour exploitation is an inherent and general risk in today's capitalist system that is fuelled by a vast pool of young people (Marras, 2003)and that strives for efficiency gains by reducing costs for inputs of materials, capital and labour. While this principal inclination holds across all industries, there are industry sectors and world regions where workers are more vulnerable to exploitation (Munter and Lindblom, 2017), as for example the agricultural or small-scale mining sector and developing world regions with high levels of resource-poor people (Alsamawi et al., 2017; McKay, 2017; Sousa et al., 2011); taking one case, Sozinho et al. (2018) highlight the historical association of the Brazilian sugarcane industry with labour and human rights abuses such as labour exploitation including forms of forced and slave labour. There are also areas in industrialized countries where a high percentage of exploitation prone individuals (i.e. trafficked people or refugees) gather, as for example Southern Spain and the South of the United States (Izcara Palacios and Yamamoto, 2017). Although there are still fervent debates around the exact meaning, usefulness and use of the term "modern slavery" [e.g. 17], it is largely unambiguous that variants of contemporary slavery represent severe forms of labour exploitation. So far the management literature has largely neglected these phenomena of slavery, but recently a few scholars have started to conceptualize and build theory from a distinct business angle, by addressing modern slavery as a management practice (Crane, 2013), and as a side effect of domestic or international supply chains, unwanted but difficult to tackle (Gold et al., 2015; New, 2015; Stevenson and Cole, 2018).

Fighting labour exploitation in its severest forms is directly aligned with the Sustainable Development Goals (SDGs) as proposed by the United Nations, namely the goal of promoting inclusive and sustainable economic growth, employment and decent work for all (Goal 8), but also the goal of ending poverty in all its forms (Goal 1). Simultaneously, labour explotation indirectly impedes the achievement of a couple of further SDGs such as good health and well-being (Goal 3), reduced inequalities (Goal 10), responsible consumption and production patterns (Goal 12), but also environmental goals such as climate action (Goal 13) or the sustainbale use of marine and terrestrial eco-systems (Goal 14 and 15). Abolishing labour exploitation is also embedded in key business guidelines. The United Nations Global Compact, for example, addresses major violations of decent work through principle 4 (elimination of forced labour) and principle 5 (abolition of child labour), very similar to the stipulations of the OECD Guidelines for Multinational Enterprises. Other guidelines such as the CAUX Principles preclude labour exploitation by emphasizing the dignity of every employee and the rightfulness of employees to represent their interests. Similarly, research on sustainability of agrifood production systems acknowledges labour exploitation as serious problem and refer to the key issues of labour rights (Gold et al., 2017), compensation, and the abolition of illigal labour such as forced, bonded and child labour (Maloni and Brown, 2006). Missimer et al. (2017) define a socially sustainable society as one in which people are not subject to structural obstacles to health, influence, competence, impartiality and meaning-making. The objective of health may be compromised by labour exploitation for example through excessive working hours, unsafe work conditions, abuse of workers, forced and child labour as well as insufficient compensation. This goes in line with Staniškienė and Stankevičiūtė (2018) who found that from an employee perspective, fair employment practices including worker compensation and health and safety are important and highly correlated constituents of social sustainability.

Although Hahn et al. (2010) emphasize and conceptualize the existence of trade-offs and conflicts between the economic, social and environmental dimension of sustainability (Hahn et al., 2010), there is still common ground that there are multiple win-win relationships and that in principle all dimensions of sustainability are to be addressed simultaneously and equitably (Dyllick and Hockerts, 2002). It has been pointed out by Bales (2016) that there is a vicious circle between severe forms of labour exploitation and environmental degradation, as exploitative business models often destroy the environment—locally and beyond—which deprives communities of the opportunity to make a decent living. This makes population groups vulnerable to become enslaved and to be forced to wreck the environment further.

The interlinkage between slavery and labour exploitation and environmentally unsustainable behaviour is increasingly evidenced in research. Bales (2016) for example argues in his book Blood and Earth that if slaves were a country, they'd be the world's third largest emitter of CO2 after China and the US. Slave villages in Brazil can be easily differentiated from free villages on satellite images as slaves live intrinsically unsustainably and for example do not establish community routines for waste disposal. Boyd et al. (2018) and Luby et al. (2015) show that a clear link between exploitation and polluting production methods can be made and identified through remote sensing; vice versa, a deterioration of the natural environment puts economic pressures on communities that make them more vulnerable to exploitation.

Against this background it is of particular interest to understand how slavery and other forms of severe labour exploitation may persist although being outlawed by legal systems around the world and despised by mainstream norms. Drawing on institutional theory and the strategic capabilities literature, Crane (2013) attempts to explain how this happens, focusing on how organisations that use slavery exploit particular competitive and institutional conditions from which slavery emerges, insulate themselves from forces that work against slavery, and sustain the conditions that enable slavery to survive. In his framework, the determinants of the likelihood of slavery are broken down into conditions related to the industry context and conditions related to the broader institutional context involving regulative, normative and cultural cognitive systems. This context encapsulates socioeconomic, geographical, cultural and regulatory factors. The framework that Crane develops leads to a number of propositions that explain the practice of

[2] Source: http://geographyfieldwork.com/CostadelPolythene.htm.

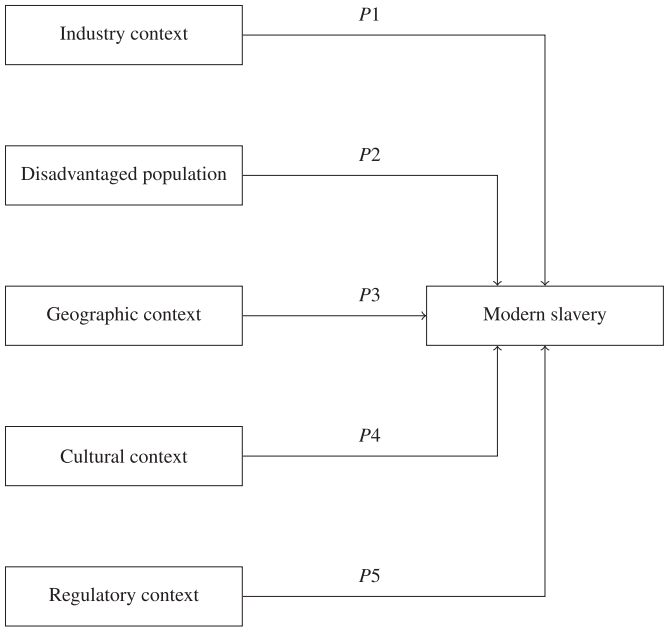

Fig. 1. Crane's propositions as considered in our agent model.

slavery; in the following, we present the five enabling conditions that increase the likelihood of slavery according to Crane (2013).

The propositions are as follows, illustrated in Fig. 1[3]:

Proposition 1. *A conducive industry context* (*namely, high labor intensity, low value distribution, high elasticity of demand, low industry legitimacy, and high regional clustering*) *will lead to a greater likelihood that enterprises will adopt slavery.*

Proposition 2. *The availability of a socio-economically disadvantaged population* (*namely, high* [*relative*] *poverty, low education, and high unemployment*) *will lead to a greater likelihood that enterprises will adopt slavery.*

Proposition 3. *A conducive geographic context* (*namely, high geographic isolation of the enterprise and high physical/political/psychological distance of workers*) *will lead to a greater likelihood that enterprises will adopt slavery.*

Proposition 4. *A supportive cultural context* (*with respect to traditions, entrenched inequalities, and religious beliefs*) *will lead to a greater likelihood that enterprises will adopt slavery.*

Proposition 5. *An accommodating regulatory context* (*characterized by weak governance and low issue attention with respect to slavery*) *will lead to a greater likelihood that enterprises will adopt slavery.*

Crane's first proposition features a conducive industry context. Factors making an industry conducive are high labour intensity, unfavourable value distribution along supply chains, high elasticity of labour demand, low industry legitimacy, and high regional clustering. This means that slavery is more likely to be found in labour-intense non-technological work such as agriculture, brick-making, mining, garment and textiles, domestic service, or forest clearing (Bales and Trodd, 2013). Furthermore, distribution inequity of risks and rewards along the supply chain may incite enterprises to radically decrease labour costs in order to stay profitable (Trienekens11 Trienekens, 2011). In a similar way, high elasticity of labour demand may make companies strive for their business goals in terms of profit margin and market share by pushing down labour costs beyond legal limits. Here criminal entrepreneurs may exploit business opportunities that are categorically foreclosed for others and lead to a net social loss (Hall et al., 2012). Low legitimacy of industry, such as domestic work, illegal mining (Sousa et al., 2011), sex work (Ham and Gilmour, 2017), and other work that is deemed illegitimate (Bitektine, 2011), together with regional clustering, increases the cohesion within the group of criminal peers (cf. (Spector and Lane, 2007)) and hence the likelihood of occurrence of slavery.

The second proposition suggests that a pool of socioeconomically disadvantaged population, i.e. poor, badly-educated and unemployed people, leads to a greater likelihood of slavery (Crane, 2013). It has been widely acknowledged in research and policy reports that indeed economic and social exclusion of people are the breeding ground for crime, corruption (Hall et al., 2009)and human right violations such as slavery (e.g., (Plant and Geneva, 2007; Lagon, 2008; Veritè, 2011; Barrientos et al., 2013; CIPS, 2013; Adesina, 2014),). Although the traditional link between race and slavery has lost most of its importance, race, ethnicity and religion may still play some role in excluding people from proper societal and economic participation and hence forces people into slavery (Bales et al., 2009).

Crane's third proposition suggests that a conducive geographic context will lead to a greater likelihood of slavery. Geographic isolation shelters slaveholders from external intervention; therefore slavery often occurs in remote areas that are difficult to access, such as rainforest or mountainous areas, or areas that are shielded by circumstances of armed conflicts (Gold et al., 2015). In addition, distance of workers enhances their vulnerability to be exploited as slaves; distance may refer to sheer physical distance of trafficked people from their home place, political distance if national borders have been crossed (even more if crossed illegally), regulatory distance when commmunities are situated in remote areas (Sousa et al., 2011), and psychological distance from their social and communal ties and other constituents of their self-identity (Crane, 2013).

As fourth proposition, (Crane, 2013), suggests the supportive cultural context to be an important driving force for the occurrence of slavery. Such a supportive cultural context refers to norms, religious beliefs and other deeply-rooted convictions regarding the acceptability and legitimacy [cf. 11] of exploiting certain minority or marginalized groups. Such cultural context based on informal rules and norms can exert lots of power (Dixit, 2015) even if it clashes with formal rules as for example manifested in national legal systems [cf. 51].

Finally, Crane's fifth hypothesis suggests that an accommodating regulatory context and insufficient enforcement of regulation supports the adoption of slavery - in the same way as other crimes such as corruption (Silvestre et al., 2018). Where governance and democratic rights are only weakly set in place and ineffectively executed, slavery cannot be suitably contained and may spread if driven by 'criminal entrepreneurs' (Davey et al., 2015) and supported by other socio-economic context factors. The effectiveness of governance is also influenced by 'issue attention' (Crane, 2013) on the political agenda, i.e. the devotion and resources committed to enforcing anti-slavery legislation and mitigating the conditions facilitating slavery. As slaves are often illegal immigrants or otherwise politically marginalized people, their political power and voice are minor to non-existent (Hart and Sharma, 2004) and society cannot easily evaluate the effectiveness of a government's anti-slavery policies and measures since it is not readily visible. This

[3] We focus on the macro contingency factors that drive slavery, which Propositions 1 to 5 concern. Propositions 6 and 7 are more organisational and we therefore do not consider them here.

constitutes a violation of the second social sustainability principle proposed by Missimer et al. (2017)and labelled "influence", saying that people should be able, in general, to shape the social systems they are part of by participation.

While these propositions gain authority by being anchored in institutional theory (Scott, 2013), and they seem in large parts intuitively valid from a common sense perspective, they still warrant more in-depth investigation to corroborate and enhance the conceptualisation and understanding of what conditions make slavery persist or develop in certain areas. It is indeed this dynamic perspective that Crane (2013) considers only implicitly, that appears to be fruitful for understanding how conditions of slavery and other forms of labour exploitation spread throughout a regional industry or other sector, and for concluding by which means—in terms of business practices and policy settings—unethical and unsustainable business practices can be confined. This angle links to emerging research on how unethical business practices develop and spread over time (Kulik et al., 2008), such as dynamics of corrupt routines in the private sector (Frost and Tischer, 2014; Silvestre et al., 2018) or key drivers and interdependencies of unsustainable commercial activities (Sverdrup et al., 2017). Our agent-based model for investigating the conditions under which labour exploitation persists in the agricultural sector of Southern Spain, follows on similar modelling work that tries to understand the development and implications of (un-)sustainable business conduct (Liu and Ye, 2012) or the development of an industrial symbiosis, i.e. a dynamic collaborative network of industrial actors (Ghali et al., 2017).

3. The model

The use of agent-based models in the social sciences is not common but is established (Ladley et al., 2015; Borrill and Tesfatsion, 2011; Van Hemel et al., 2008; Midgley et al., 2007; Gilbert and Troitzsch, 2005; Macy and Willer, 2002) and a robust philosophy underpins its use (Winsberg, 2010). See for instance Amini et al. (2012). Our approach to developing the model of the Almería agricultural case is based largely on the work of Bainbridge (2006) and Epstein (2002) .[4] We develop the model to investigate the propositions put forward by Crane (2013).

There are two types of agent: employers and workers. An employer's objective is to employ the workforce they require at a minimum cost. Employers can change the amount of money they pay as a percentage of full minimum wage. Employees can accept or refuse an offer of work, and can eventually leave the area to do something else if they have been out of work for a long enough time or if they cannot earn enough.

There are links between employers representing lines of communication between neighbouring farms, and links among workers representing workers meeting and sharing information with each other. Employers have a 'workers needed' constant which is the number of employees they need in each time period and a workforce w variable which stores the number of employees they actually have in a time period. Workers needed is dictated by exogenous industry forces. They have an array l which stores their legitimacy of pay. This determines how much they pay their employees. They have a profit variable to store their revenue. Employers have variable links to other employers and a heteronomy constant h which is a measure of how much influence neighbouring employers have on how much is paid. Lastly employers have a vision which is how far they are able to 'see' in order to employ workers. The model is not strictly spatial – the agents do not walk to work for instance; vision is simply a way of ensuring that employers are not always able to employ workers from each of the four areas where workers stay and is stored as a percentage of the area (Almería) within which any employees can be offered work.

Each time period represents one work cycle (a 'day') meaning that all decisions to offer and accept work are made in each time period and pay and revenue is calculated for that time. Each day, employers can employ a workforce of up to size w. Employers ask workers if they want to work and workers can refuse. Employers should pay every worker a minimum wage but some pay less than this by making unreasonable reductions or simply by downright illegality. The decision on what to pay comes from their perceived legitimacy of paying under the minimum wage, which is determined by 1) what neighbouring employers pay and 2) whether they are able to employ their full workforce from their potential workforce, which is the number of workers within their locality. Employers' heteronomy h moderates both of these.

An employer's perceived legitimacy of pay is stored in an array l of 4 numbers representing the legitimacy of four levels of pay: full minimum wage, and 80%, 60% and 40% of minimum wage. The choice of what an employer will pay is whichever of the four memory 'slots' in the array contains the highest number. At the start these numbers are set randomly but over time will come to be shaped by the two determinants listed above in the following two ways:

Let $l_1 = 1$ be the position in the array representing a choice of 40% of minimum wage, $l_2 = 2$ be 60%, $l_3 = 3$ be 80%, and $l_4 = 4$ be 100%. Then the initially random number in one of these slots l_* is increased by that agent's heteronomy h with

$$l_* = l_{max} - \left\| \frac{\sum_{i=1}^{n} l_{max} - l_i}{n} \right\|$$

where l_{max} is the slot in l which stores the highest number, n is the number of neighbours and l_i is the choice of neighbour i.

In plain terms this means that if an employer's neighbours pay more than him, his perception of the legitimacy of paying more will increase (which is the same as his perception of the legitimacy of paying less will decrease). If his neighbours pay less than him, his perception of the legitimacy of paying less will increase. If some neighbours are paying more and some less it is possible these will cancel out and his perception of the legitimacy of what he is currently doing will increase. The higher his heteronomy then the larger will be his neighbours' impact on his perception. Eventually the change in his perception of legitimacy may impact on behaviour if l_* becomes l_{max}. It is assumed that employers share information about their wages freely with their neighbours.

At the end of each day employers do not examine their revenue directly but rather consider their employees, as it is through their employees that they generate revenue. On any day, if w reaches the maximum workforce an employer can possibly employ and l_{max} is that employer's choice, then if $l_{max} > 1$ (i.e. he is not already paying the least possible), the value in slot $l_{max} - 1$ is increased by h. If w is less than the maximum and $l_{max} < 4$ (i.e. he is not already paying the maximum), the value in slot $l_{max} + 1$ is increased by h. In plain terms this means that if an employer can fill his workforce then he might start to think that he can get away with paying less. If he cannot, he might consider paying more.

When employees decide whether to accept an offer of work, two things are considered: how long they have been out of work and their experience of the employer. Unemployed workers will accept

[4] Bainbridge uses a variance function to capture how intensely people believe in a god; we use a max function to capture how legitimate people believe it is to pay less than minimum wage. Epstein models citizens and police who decide to riot and arrest rioters respectively; we model employers and workers who decide whether to make and accept an offer of employment.

an offer of employment if they did not work yesterday (days not working $d > 1$). If things get so desperate ($d > T$ where T is a variable threshold) then a worker will leave the industry to do something else, which could be going to a foodbank/other charity or—perhaps more unlikely—returning home.

The modeller can set workers to be able to move or not. If workers are allowed to move they can meet workers in other areas who may report better wages. If this happens the worker will move to the new area (which may put them within the vision of more employers).

Each day there is a probability p_i that an inspector assesses an employer and, if they are paying slave wages, shutting them down and being removed from the simulation upon which a new employer takes their place.

Employers learn what to pay workers based on the formulae above. Workers remember good or bad experiences from working with employers and share these with other workers. A worker's experience of an employer could either be direct, from working for them in the past, or it could come from someone they know. Each worker stores their experience as the percentage of the minimum wage they were paid by that employer (or a flag value if they have not previously worked for that employer). When workers meet to share information, an average is taken of one worker's personal experience and the experience of the worker they are meeting (their 'contact'). If the contact has experience but the worker does not, then the worker simply accepts the contact's word and sets their experience equal to their contact's. Each worker has a tolerance level for low pay stored as a percentage. They will accept any offer of work from an employer who they believe from experience will pay at least as high a percentage of the minimum wage as their tolerance.

The simulation is set with n workers and m employers, and no one is initially employed. At the start, a randomly selected employer begins the process by asking workers within his vision whether they will work for the day.

3.1. Validation

The model was validated by examining how well it captures Crane's propositions. Each proposition is now presented and then a short analysis given of how the model's behaviour matches it. For the validation, we used the following as our baseline parameter settings:

1. There is one job for all workers,
2. There is zero chance of inspection,
3. Workers are not free to move from area to area (from slum to slum),
4. Employers have large enough vision to see all workers (their 'locality' is the entire space, that is, all the slums),
5. Each employer makes links with two others,
6. Each day, workers get to meet four other workers from their area,
7. Workers have a tolerance for low pay of 0.8.

We examine average pay after 200 days to allow the system to settle into its behaviour, and take an average over 100 simulations. Table 1 shows the results of the statistical tests used; Fig. 2 illustrates the validation.

Proposition 1. *A conducive industry context (namely, high labour intensity, low value distribution, high elasticity of demand, low industry legitimacy, and high regional clustering) will lead to a greater likelihood that enterprises will adopt slavery.*

This is largely a super-proposition that is explored in more detail in the propositions that follow. We consider it to be axiomatically correct and do not consider it in the validation.

Table 1
Results of t-tests to compare variables under conditions as predicted by the propositions for the model validation.

Parameter	Baseline	Intervention	t	p
Proposition 2				
Jobs per worker	0.33	0.58	−3.3	0.002
Proposition 3a				
Workers can move	0.36	0.40	−1.0	0.318
Proposition 3b				
Isolation of employers	0.36	0.44	−2.2	0.030
Proposition 4				
Legitimacy of low pay	0.33	0.10	−14.2	0.000
Proposition 5				
Chance of inspection	0.49	0.80	−5.6	0.000

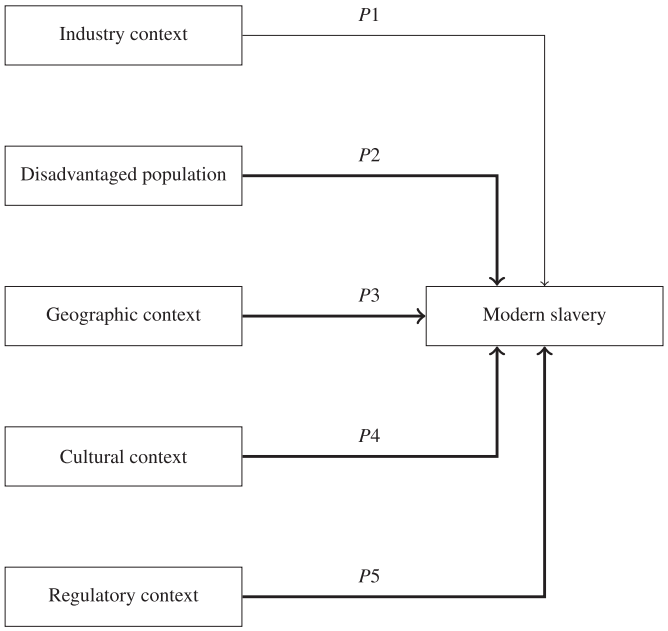

Fig. 2. Illustration of the model validation. Thick lines show the propositions that were tested and supported.

Proposition 2. *The availability of a socio-economically disadvantaged population (namely, high [relative] poverty, low education, and high unemployment) will lead to a greater likelihood that enterprises will adopt slavery.*

The model does not consider education. Poverty and affordable credit are included together as impacting on the decision to refuse an offer of work. High unemployment is modelled by adjusting the number of jobs in the industry per worker and the proposition is supported. When the number of jobs per person increases, average pay increases and vice versa, as predicted by the proposition.

Proposition 3. *A conducive geographic context (namely, high geographic isolation of the enterprise and high physical/political/psychological distance of workers) will lead to a greater likelihood that enterprises will adopt slavery.*

This proposition was only partially supported. When workers are free to move to locations where better wages are available, average pay increases, as predicted by the proposition, although the result was not statistically significant. This is labelled 'Proposition 3a' in Table 1. However, when the number of links among

employers increases, that is, when they are not isolated (labelled 'Proposition 3b') wages tend to rise.

Proposition 4. *A supportive cultural context (with respect to traditions, entrenched inequalities, and religious beliefs) will lead to a greater likelihood that enterprises will adopt slavery.*

This is captured in the model by each employer's legitimacy array. When the legitimacy of paying less increases, wages decrease, in line with the proposition.

Proposition 5. *An accommodating regulatory context (characterized by weak governance and low issue attention with respect to slavery) will lead to a greater likelihood that enterprises will adopt slavery.*

A regulatory context is included in the model as the chance of inspections. For this test when employers are found to employ workers at slave wages they receive a fine for a set number of days, which impacts on average pay as predicted by the proposition.

4. Analysis

4.1. Philosophy of simulation

We take seriously the view of Borrill and Tesfatsion (2011), that agent-based modelling is an appropriate mathematics for the social sciences. We treat our agent-based model (ABM) as the phenomenon under study: we set parameters, give the initial conditions as a set of inputs, and run the ABM to generate the output. We treat that output as we would treat data generated by experiment, using graphical techniques and linear regression to analyse the results. We analyse the output both against time and as a snapshot at days $d = 200$, as we did for the validation. All of these approaches are common in social science.

We are exploring the implications of Crane's propositions when the entire model is run, unlike during validation where we hold constant the parts of the model that we are not validating. We are interested in what emerges from the model, when all the rules are run together, and may interact and moderate each other in unpredictable ways (in fact this is something we want to see). Therefore results shown in our analysis here may seemingly contradict the validation. This is the nature of agent models and is discussed at length in Section 5.1.

4.2. Determinants of slavery

We first examine the determinants of slavery using average final pay paid by employers as our measure of slavery (Table 2). The table shows our main results and we discuss it in the following subsections, running additional analyses as necessary to delve deeper. The headline is that links between employers and availability of workers appear as statistically significant and are important determinants of slavery: As socialisation among employers (links) and availability of workers increase, pay decreases.

The diffusion of slavery is first determined by the number of workers available. This is captured in the employer vision variable (which is a measure of how many workers an employer can access each day). The more workers they have access to, the more likely it is that they pay less than minimum. Next, links between employers allow slavery to diffuse (more links leads to less pay). This is contrary to Proposition 3 which states that high geographic isolation of the enterprise will lead to slavery. The reason is that poor conditions can become normalized in an isolated enterprise. However the reverse of this—that poor practise will become difficult to justify when surrounded by good practise—can only apply if good practise exists. Otherwise poor practise will only become embedded: an employer being linked to a slaver allows their bad practices to spread.

We can isolate how much of a difference a group of responsible and irresponsible employers make by manipulating the legitimacy array. By introducing a single employer who will never pay a legal wage, and a single employer who will never pay less than minimum wage, we can see the impact this has on the diffusion of slavery as measured by a count of employers paying less than minimum. Tables 3 and 4 show the results. A single good employer was able to significantly reduce the number of slavers by a small amount. A single bad employer made no difference.

4.3. Socialisation

Our results show little support for the notion that workers sharing information about employers can have a positive impact. In theory, if workers can share data and move about then they should be able to engineer better conditions for themselves. However again this logic relies on there being well paid jobs around and in fact what we find is that, as more workers get to socialise, all that happens is that bad experiences are shared. This points to the necessity of a workforce unionising in order to improve conditions, which is sadly not an option for the workers discussed here who are in the country illegally.

4.4. Number and size of employers

We vary the number and size of the employers and their required workforces to assess the impact this has on average wages. Table 5 shows the results on the number of employers. We held number of workers constant and varied the number of employers, adjusting the workforce in the industry so that there is a potential job for every worker, but dividing this by the number of employers so that each employer requires the same size for workforce. (Note that the variable 'workforce' does not appear in the table as it is related to the variable 'employers' and would therefore introduce to a multicollinearity problem.) There are two ways we might think about the relationship between number of employers in an

Table 2
Factors impacting on average pay in the industry.

	Estimate	Std. Error	t value	Pr(>|t|)
Chance of inspection	0.0885	0.1127	0.79	0.4328
Number of workers	0.0001	0.0001	1.61	0.1078
Workforce required by employers	0.0000	0.0002	0.19	0.8477
Vision of employers	−0.3043	0.0283	−10.77	0.0000
Links between employers	−0.0199	0.0026	−7.74	0.0000
Socialisation among workers	−0.0019	0.0014	−1.38	0.1691
Days before leaving	−0.0154	0.0047	−3.28	0.0012
Can workers move	−0.0020	0.0134	−0.15	0.8819

Table 3
What difference does a bad employer make to the normal results?.

	Estimate	Std. Error	t value	Pr(>|t|)
Chance of inspection	−1.2453	1.9567	−0.64	0.5247
Number of workers	−0.0001	0.0010	−0.10	0.9234
Workforce required by employers	0.0036	0.0042	0.87	0.3850
Vision of employers	7.6900	0.4906	15.68	0.0000
Links among employers	0.6822	0.0447	15.26	0.0000
Socialisation among workers	0.0090	0.0243	0.37	0.7102
Days before leavings	0.2471	0.0814	3.04	0.0025
Can workers move?	0.1121	0.2328	0.48	0.6305
Irresponsible employer control	0.0333	0.2305	0.14	0.8851

Table 4
What difference does a good employer make to the normal results?.

	Estimate	Std. Error	t value	Pr(>|t|)
Chance of inspection	−0.5822	1.9421	−0.30	0.7645
Number of workers	−0.0008	0.0010	−0.77	0.4430
Workforce required by employers	0.0010	0.0042	0.24	0.8085
Vision of employers	8.4466	0.4980	16.96	0.0000
Links among employers	0.6666	0.0450	14.82	0.0000
Socialisation among workers	0.0152	0.0244	0.62	0.5348
Days before leaving	0.1861	0.0824	2.26	0.0243
Can workers move?	−0.0025	0.2340	−0.01	0.9916
Responsible employer control	−0.4656	0.2355	−1.98	0.0485

Table 5
Varying number of employers.

	Estimate	Std. Error	t value	Pr(>|t|)
Chance of inspection	−0.0751	0.1531	−0.49	0.6243
Number of employers	−0.0019	0.0007	−2.91	0.0040
Number of workers	−0.0000	0.0001	−0.18	0.8600
Vision of workers	−0.2474	0.0399	−6.20	0.0000
Links among employers	−0.0174	0.0036	−4.82	0.0000
Socialisation among workers	−0.0008	0.0020	−0.41	0.6838
Days before leaving	−0.0024	0.0067	−0.36	0.7193
Can workers move?	0.0118	0.0186	0.64	0.5256

industry and average pay. The first is that a small number of employers will abuse their market power and pay below minimum wage. The second is a 'safety in numbers' rationale – if many employers are paying less than minimum wage it becomes easier for a new employer to pay less, as they likely feel there is less chance of getting caught. We see an inverse relationship between average pay and number of employers: more employers leads to less pay. Our analysis of the agent model supports the safety in numbers view: when there were more employers—all of equal size—wages fell.

4.5. Inspection

A random inspection resulting in a fine made no significant impact on condition. Replacing this with the threat of jail led to a very different outcome. In the jail version of the simulation, a random inspection of a employer paying less than minimum leads to them being removed from the simulation to be replaced by a new independent agent, which is to say, one with a fresh, initially randomized legitimacy matrix. Results are shown in Table 6 and we note that the impact of this outcome on pay is greater and more significant than any other variable in all of the previous analyses.

5. Discussion

Our analysis furthers the understanding of factors which drive exploitative practices in the Spanish agricultural sector, and hence preclude social responsibility (Maloni and Brown, 2006) and sustainability (Gold and Heikkurinen, 2018) within the agrifood sector as well as within societies in general (Missimer et al., 2017). Results may be generalized with some caution to other similar situations as for example the agricultural sector in the Southern United States. Our agent-based modelling approach shows that it can be helpful to investigate in an in-depth way the inner logic of conceptually derived research propositions by modelling techniques, next to proposition testing and refinement through empirical research techniques.

Table 6
Determinants of average final pay when inspections lead to jail.

	Estimate	Std. Error	t value	Pr(>|t|)
Chance of inspection	0.4232	0.0564	7.50	0.0000
Number of workers	−0.0000	0.0000	−1.00	0.3172
Workforce required	0.0000	0.0001	0.40	0.6883
Vision of employers	−0.0426	0.0141	−3.01	0.0028
Links among employers	0.0000	0.0013	0.03	0.9790
Socialisation among workers	−0.0002	0.0007	−0.29	0.7720
Days before leaving	−0.0034	0.0023	−1.44	0.1503
Can workers move?	0.0054	0.0067	0.80	0.4220

In terms of industry context, our analysis underlines that the number of links between employers enforces a cluster effect that helps spread bad practice. Contrary to the assumption that markets that are dominated by a few or only one employer are more prone to exploiting workers, we see an inverse relationship between average pay and number of employers. This could be explained by the fact that a larger number of employers not paying minimum wage allows single dishonest employers to hide in the crowd as the number of peers diminishes the perceived risk of being caught and punished by the legal system.

In terms of socio-economic conditions, our model confirms the commonly shared idea that the pool of labourers looking for work increases the likelihood that slavery occurs (e.g., (Barrientos et al., 2013). This is a simple result of labour supply exceeding labour demand and not too astonishing. It has been pointed out in literature that informed consent is not sufficient to make transactions on the labour market morally justified if prevailing background conditions do not grant much choice to workers (Munter and Lindblom, 2017). More intriguing, however, are the differentiated insights we get regarding the isolation and connectedness, respectively, of employers and employees (i.e., the geographic context).

In fact, the cluster-effect and intense inter-employer communication is found to be a particularly effective driver of underpayment, if the cluster is homogenous inside in terms of wage level and if it is isolated from law-abiding employers. This means that employers tend to confirm and reinforce each other in their illegal behaviour, thus creating enclaves of non-standard norms that regard worker exploitations as legitimate means; these enclaves are isolated from mainstream institutional settings that generally disapprove of practices of labour exploitation. On the other hand, breaking the isolation of employees among each other, i.e. reducing the psychological and social distance to their surroundings, only reduces the underpayment if there are constantly law-abiding employers, i.e. employers permanently paying at least minimum wage. This means that it is not enough to empower workers and provide them more employment options to choose from, if there is not even one good option among them. This finding may suggest the substantial benefit of models of social business and entrepreneurship (Rahdari et al., 2016), inclusive corporate social responsibility initiatives (Gold et al., 2018), state-owned companies, or public entrepreneurs (Klein et al., 2010) meticulously complying with or even exceeding labour standards, as they can considerably increase (and perhaps even transform) labour conditions of entire markets. Although it can be assumed that state-owned companies in many cases are abiding more stringently to labour laws, partly since they are not subject to the same profit expectations as most private companies, it needs to be questioned whether altogether they always do more good for society.

Be that as it may, it is clear that labour exploitation flourishes in biotopes of like-minded companies that do not care about mainstream norms. Indeed criminal attitudes of profit maximisation at the expense of labour rights have become mainstream itself to the detriment of overall social welfare. Therefore, in particular in labour-intense low-technology sectors that are conducive to slavery such as agriculture or small-scale mining, actors are

required that break up such complicity, and that serve as beacons of good practice, and thus provide real choice to employees who are willing to emancipate themselves from undue labour exploitation. At the same time those actors may raise awareness among other employers and communities in general in order to change the inert conditions of entrenched beliefs and norms in favour of exploitation of certain minority or marginalized groups.

The outstanding importance of the normative mindset of employers is underlined by the observation that inspection and law enforcement is only effectively changing payment habits by employers in a certain area if law and punishment can change the prevalent norms within the group of employers. According to our analysis, fines as penalties that merely reduce profit do not change the behaviour of employers. Prison sentences are more powerful as they take bad employers out of the game. In reality, however, in the case of a very high percentage of family business in the agricultural sector, business will likely be continued by family members that are prone to adhere to a similar normative mindset as the previously jailed employer. In this case, also prison sentences would not change employer behaviour substantially. Such a change could only be brought about if jailed employers are replaced by independent new employers (featuring some chance of abiding to the law), or even better, by certainly law abiding social entrepreneurs or state-owned business. This means that in particular in slavery sensitive industries, severe contraventions to labour rights should directly entail endeavours of introducing law-abiding or even social value maximizing actors into the group of employers, driven by governmental and private initiatives, or public-private partnerships. In terms of combination of informal and formal institutions, our findings support Dixit (2015) in the sense that formal institutions of law and prosecution need to be reinforced by informal institutions within the (business) community in order to exert optimal impact on the conduct of business.

In any case, successful prosecutions of instances of labour exploitation and slavery are still rare today, which makes jail sentences appear rather unlikely. For the case of the UK, for example, Lawrence (2016) reports that when a supermarket's supply chain was found to employ slaves, the supermarket said it was shocked by the unacceptable conditions, the Gangmaster Licensing Authority shut the worker supply agency down for abusing its staff, and the company's licence was revoked. However, no prosecution was ever brought, and none of the workers' lost pay was ever recovered or returned.

5.1. Limitations

The data for this paper were generated by an agent based model. There is a paradox in developing agent models: researchers are interested in behaviour that emerges from interaction rules; the software is not programmed to display this behaviour – it is written to implement interaction rules; behaviour of interest *emerges* from these. Often emergence happens in ways that can never be fully understood. This is unlike most software. The paradox is this: if it can never be known what will emerge from a correctly written agent program, how can we know that an agent program is correctly written? By definition, black box testing—the idea of feeding input to the model where the output is already known, and then checking that this is what is actually produced—will not work properly with an agent model. We may indeed have some test cases where we have a prediction or even knowledge of how the model should behave. These usually come from subsets of the interaction rules (something like testing: *when employers behave a certain way and workers do nothing differently, then a certain outcome should happen*). However we likely cannot know what will happen when all these rules are run together using the parameters we are interested in – if we did know this, there would be no reason to construct the model in the first place. Or perhaps we do know how the entire model should behave for certain input and parameter settings but we want to explore fresh settings. To be clear on this point: there is no reason to construct a model of a target unless we want to explore the model *beyond* what we already know about the target; we must at some point go somewhere that we have no knowledge of what the model should be doing.

All we can do is rely on theory. We recognise that the theory relied on here is underdeveloped and because of this, our study should be considered to be exploratory, building on Crane's propositions.

6. Conclusion

We have shown that agent-based modelling can be used to further advance conceptual research in areas where reliable empirical data is hard or impossible to access. Using an agent model we have explored the implications of Crane's theory of modern slavery. We find that, regarding isolation and connectedness of employers, cluster effects and intense inter-employer communication are particularly effective drivers of underpayment if the cluster is homogenous in terms of wage level and if it is isolated from law-abiding employers. Anti-slavery interventions often focus on enabling networks and communication between vulnerable workers. We show that the same is valid on the perpetrator side where the cluster-effect allows employers to commonly reassure each other of the legitimacy of underpaying or exploiting workers. These are most likely to be enclaves that operate in a geographically or socially separate setting, which in the past was amalgamated into the effect of single dominant employers. Our study shows that the single dominant employer effect and the separation effect must be considered not as one effect but two effects that work in parallel.

Industries with few or one large employer are not necessarily more prone to exploitation. Networks of smaller employers can be equally or worse in causing modern slavery allow perpetrators to hide in a crowd without the risk of being publicly exposed that a large corporation would face. This opens further routes for research on the diffusion of good and bad practices in the interplay between supply chains and market structures.

Our findings suggest that purely profit-reducing penalties in situations of complicity amongst employers have no substantial effect. This questions the strength of corporate intervention in countries where slavery is culturally supported with no functioning judicial enforcement systems. Only by taking perpetrators out of the system entirely (for example through imprisonment and barring from business conduct) and stopping a normatively equal replacement slavery can be effectively challenged in a network of employers. This indicates the importance of enforcement of criminal law including prison sentences for ensuring good labour practices and transforming societies towards sustainability.

The agent based model was developed in Matlab and is available from the authors.

Acknowledgements

We are grateful to the University of Nottingham Digital Research Strategy Fund for supporting this work.

References

Acemoglu, D., Wolitzky, A., 2011. The economics of labor coercion. Econometrica 79 (2), 555–600.
Adesina, O.S., 2014. Modern day slavery: poverty and child trafficking in Nigeria. Afr.

Ident. 12 (2), 165–179.
Alsamawi, A., Murray, J., Lenzen, M., Reyes, R.C., 2017. Trade in occupational safety and health: tracing the embodied human and economic harm in labour along the global supply chain. J. Clean. Prod. 147, 187–196.
Amini, M., Wakolbinger, T., Racer, M., Nejad, M.G., 2012. Alternative supply chain production–sales policies for new product diffusion: an agent-based modeling and simulation approach. Eur. J. Oper. Res. 216 (2), 301–311.
Bainbridge, W.S., 2006. God from the Machine. AltaMira Press.
Bales, K., 2016. Blood and Earth: Modern Slavery, Ecocide, and the Secret to Saving the World. Spiegel & Grau.
Bales, K., Trodd, Z., 2013. Addressing Contemporary Forms of Slavery in Eu External Policy: Briefing Paper for the European Parliament's Subcommittee on Human Rights.
Bales, K., Trodd, Z., Williamson, A.K., 2009. Modern Slavery: the Secret World of 27 Million People. Oneworld Publications Limited.
Bales, K., Trodd, Z., Williamson, A.K., 2010. Modern Slavery: the Secret World of 27 Million People. Oneworld, Oxford.
Barrientos, S., Kothari, U., Phillips, N., 2013. Dynamics of unfree labour in the contemporary global economy. J. Dev. Stud. 49 (8), 1037–1041.
Bitektine, A., 2011. Toward a theory of social judgments of organizations: the case of legitimacy, reputation, and status. Acad. Manag. Rev. 36 (1), 151–179.
Borrill, P.L., Tesfatsion, L., 2011. Agent–based Modeling: the Right Mathematics for the Social Sciences? the Elgar Companion to Recent Economic Methodology, p. 228.
Boyd, D.S., Jackson, B., Wardlaw, J., Foody, G.M., Marsh, S., Bales, K., 2018. Slavery from space: demonstrating the role for satellite remote sensing to inform evidence-based action related to un sdg number 8. ISPRS J. Photogrammetry Remote Sens. (in press).
CIPS, 2013. Modern Slavery in Supply Chains.
Crane, A., 2013. Modern slavery as a management practice: exploring the conditions and capabilities for human exploitation. Acad. Manag. Rev. 38 (1), 49–69.
Davey, M., McElwee, G., Smith, R., 2015. Conversations with a 'small-town'criminal entrepreneur: a case study. In: Exploring Criminal and Illegal Enterprise: New Perspectives on Research, Policy & Practice. Emerald Group Publishing Limited, pp. 227–251.
Dixit, A.K., 2015. How business community institutions can help fight corruption. World Bank Econ. Rev. 29 (Suppl. 1), S25–S47.
Dyllick, T., Hockerts, K., 2002. Beyond the business case for corporate sustainability. Bus. Strateg. Environ. 11 (2), 130–141.
Epstein, J.M., 2002. Modeling civil violence: an agent-based computational approach. Proc. Natl. Acad. Sci. Unit. States Am. 99 (Suppl. 3), 7243–7250.
Foundation, W.F., 2016. Global Slavery Index. Walk Free Foundation.
Frost, J., Tischer, S., 2014. Unmasking collective corruption: the dynamics of corrupt routines. Eur. Manag. Rev. 11 (3–4), 191–207.
Ghali, M.R., Frayret, J.M., Ahabchane, C., 2017. Agent-based model of self-organized industrial symbiosis. J. Clean. Prod. 161, 452–465.
Gilbert, N., Troitzsch, K., 2005. Simulation for the Social Scientist, second ed. Open University Press.
Gold, S., Heikkurinen, P., 2018. Transparency fallacy: unintended consequences of stakeholder claims on responsibility in supply chains. Account. Audit. Account. J. 31 (1), 318–337. ISSN 0951-3574.
Gold, S., Kunz, N., Reiner, G., 2017. Sustainable global agrifood supply chains: exploring the barriers. J. Ind. Ecol. 21 (2), 249–260.
Gold, S., Muthuri, J.N., Reiner, G., 2018. Collective action for tackling "wicked" social problems: a system dynamics model for corporate community involvement. J. Clean. Prod. 179, 662–673.
Gold, S., Trautrims, A., Trodd, Z., 2015. Modern slavery challenges to supply chain management. Supply Chain Manag.: Int. J. 20 (5), 485–494.
Hahn, T., Figge, F., Pinkse, J., Preuss, L., 2010. Trade-offs in corporate sustainability: you can't have your cake and eat it. Bus. Strateg. Environ. 19 (4), 217–229.
Hall, J., Matos, S., Severino, L., Beltrão, N., 2009. Brazilian biofuels and social exclusion: established and concentrated ethanol versus emerging and dispersed biodiesel. J. Clean. Prod. 17, S77–S85.
Hall, J., Matos, S., Sheehan, L., Silvestre, B., 2012. Entrepreneurship and innovation at the base of the pyramid: a recipe for inclusive growth or social exclusion? J. Manag. Stud. 49 (4), 785–812.
Ham, J., Gilmour, F., 2017. 'we all have one': exit plans as a professional strategy in sex work. Work. Employ. Soc. 31 (5), 748–763.
Hart, S.L., Sharma, S., 2004. Engaging fringe stakeholders for competitive imagination. Acad. Manag. Exec. 18 (1), 7–18.
Izcara Palacios, S.P., Yamamoto, Y., 2017. Trafficking in US Agriculture. Antipode.
Klein, P.G., Mahoney, J.T., McGahan, A.M., Pitelis, C.N., 2010. Toward a theory of public entrepreneurship. Eur. Manag. Rev. 7 (1), 1–15.
Kulik, B.W., O'Fallon, M.J., Salimath, M.S., 2008. Do competitive environments lead to the rise and spread of unethical behavior? parallels from enron. J. Bus. Ethics 83 (4), 703–723.
Ladley, D., Wilkinson, I., Young, L., 2015. The impact of individual versus group rewards on work group performance and cooperation: a computational social science approach. J. Bus. Res. 68 (11), 2412–2425.
Lagon, M.P., 2008. Trafficking and human dignity. Pol. Rev. 152, 51.
Lawrence, F., 2011. Spain's salad growers are modern-day slaves, say charities. Guardian 7 (2), 2011.
Lawrence, F., 2016. The Gangsters on England's Doorstep.
Liu, Y., Ye, H., 2012. The dynamic study on firm's environmental behavior and influencing factors: an adaptive agent-based modeling approach. J. Clean. Prod. 37, 278–287.
Luby, S.P., Biswas, D., Gurley, E.S., Hossain, I., 2015. Why highly polluting methods are used to manufacture bricks in Bangladesh. In: Energy for Sustainable Development, vol. 28, pp. 68–74.
Macy, M.W., Willer, R., 2002. From factors to actors: computational sociology and agent-based modeling. Annu. Rev. Sociol. 28, 143–166.
Maloni, M.J., Brown, M.E., 2006. Corporate social responsibility in the supply chain: an application in the food industry. J. Bus. Ethics 68 (1), 35–52.
Marras, I., 2003. Unep: the power of choice. J. Clean. Prod. 11 (8), 927–929.
McKay, B.M., 2017. Agrarian extractivism in Bolivia. World Dev. 97, 199–211.
Midgley, D., Marks, R., Kunchamwar, D., 2007. Building and assurance of agent-based models: an example and challenge to the field. J. Bus. Res. 60 (8), 884–893.
Missimer, M., Robèrt, K.H., Broman, G., 2017. A strategic approach to social sustainability–part 2: a principle-based definition. J. Clean. Prod. 140, 42–52.
Munter, D., Lindblom, L., 2017. Beyond coercion: moral assessment in the labour market. J. Bus. Ethics 142 (1), 59.
New, S.J., 2015. Modern slavery and the supply chain: the limits of corporate social responsibility? Supply Chain Manag.: Int. J. 20 (6), 697–707.
Plant, R., Geneva, I., 2007. Forced labour, slavery and poverty reduction: challenges for development agencies. In: Presentation to UK High-level Conference to Examine the Links between Poverty, Slavery and Social Exclusion, FCO and DfID, London, vol. 30.
Rahdari, A., Sepasi, S., Moradi, M., 2016. Achieving sustainability through schumpeterian social entrepreneurship: the role of social enterprises. J. Clean. Prod. 137, 347–360.
Scott, W.R., 2013. Institutions and Organizations: Ideas, Interests, and Identities. Sage Publications.
Silvestre, B.S., Monteiro, M.S., Viana, F.L.E., de Sousa-Filho, J.M., 2018. Challenges for sustainable supply chain management: when stakeholder collaboration becomes conducive to corruption. J. Clean. Prod. 194, 766–776.
Sousa, R., Veiga, M., Van Zyl, D., Telmer, K., Spiegel, S., Selder, J., 2011. Policies and regulations for Brazil's artisanal gold mining sector: analysis and recommendations. J. Clean. Prod. 19 (6–7), 742–750.
Sozinho, D.W.F., Gallardo, A.L.C.F., Duarte, C.G., Ramos, H.R., Ruiz, M.S., 2018. Towards strengthening sustainability instruments in the brazilian sugarcane ethanol sector. J. Clean. Prod. 182, 437–454.
Spector, B., Lane, H., 2007. Exploring the distinctions between a high performance culture and a cult. Strat. Leader. 35 (3), 18–24.
Staniškienė, E., Stankevičiūtė, Ž., 2018. Social sustainability measurement framework: the case of employee perspective in a csr-committed organisation. J. Clean. Prod. 188, 708–719.
Stevenson, M., Cole, R., 2018. Modern slavery in supply chains: a secondary data analysis of detection, remediation and disclosure. Supply Chain Manag.: Int. J. 12 (3), 81–99.
Sverdrup, H., Koca, D., Ragnarsdottir, K.V., 2017. Defining a free market: drivers of unsustainability as illustrated with an example of shrimp farming in the mangrove forest in south east asia. J. Clean. Prod. 140, 299–311.
Szajkowska, A., 2012. Regulating Food Law. In: European Institute for Food Law Series, vol. 7. Wageningen Academic Publishers.
Trienekens11 Trienekens, J.H., 2011. Agricultural value chains in developing countries a framework for analysis. Int. Food Agribus. Manag. Rev. 14 (2).
Union, E., 2010. Farm Structure Survey. European Union.
Van Hemel, S.B., MacMillan, J., Zacharias, G.L., et al., 2008. Behavioral Modeling and Simulation: from Individuals to Societies. National Academies Press.
Veritè, 2011. Research on Indicators of Forced Labor in the Supply Chain of Fish in indonesia: Platform (Jermal) Fishing, Small-boat Anchovy Fishing, and Blast Fishing.
Winsberg, E., 2010. Science in the Age of Computer Simulation. University of Chicago Press.