Better Rather Than More?
Exploring the Sustainability Implications of Paying a Living Wage in the Western European Clothing Supply Chain

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August 2016
Declaration of Originality

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Abstract

The Sustainable Development Goals are a high level development plan for a world free of poverty, with decent work for all and less environmentally damaging patterns of production and consumption. This thesis explores whether paying living wages to Brazilian, Russian, Indian and Chinese (BRIC) workers in the Western European clothing supply chain could contribute towards the realisation of the Sustainable Development Goals.

This thesis principally uses two modelling frameworks. A global multi-regional input-output framework, extended to enable assessment of fairness in global supply chains, and a system dynamics model of the Western European clothing supply chain. This allows us to explore both the different ways in which clothing retailers might be able to pay for a living wage in their supply chains and associated sustainability impacts.

Our analysis makes three key contributions. (1) Empirical evidence suggesting that in the Western European clothing supply chain, consumption drives environmental impact, and BRIC wages are ‘unfair’ and unable to support a ‘decent’ quality of life. (2) Extension of the limited evidence base on the employment effects of living wages in developing countries. We point to a potentially powerful employment multiplier effect (which may mean that living wages increase employment). However, we also suggest that productivity gains following wage increases could exacerbate job losses. (3) Mixed evidence on the environmental impacts of paying a supply chain living wage. While this is likely to marginally reduce the environmental impacts of affluent country consumption our findings also suggest that global environmental impacts could rise due to increased developing country consumption.

Based on these findings, we argue that paying a living wage to those developing country workers employed in affluent country supply chains could contribute to a more sustainable world by reducing poverty and improving working conditions. We further argue that the risk of increased total environmental damage could be minimised through investment in more sustainable infrastructure in developing countries themselves, and we also highlight the need for additional reductions in the environmental impacts of affluent country consumption, beyond supply chain living wage initiatives. Finally, we suggest that efforts to move to craft based production methods could be used to resist labour productivity growth, minimising the risk of job losses.
Acknowledgments

First and foremost, thanks are due to Professor Angela Druckman and Professor Tim Jackson. Angela, you were brave enough to agree to supervise me, and even braver to persevere after seeing my first proposal (four lines of text!). I hope you’ve found the five years since that first email half as rewarding as I have, your combination of intellect and friendship made this thesis happen. Tim, thanks for encouraging me to go down more interesting roads than I dared go down alone. Thanks to you I’m finishing this thesis in a very different place than I started it, and I’m even calling myself an economist. (Sorry Angela).

Everyone in CES: thank you for your generosity, with time, ideas, and cakes! Special mentions for Alaa Owaineh, Craig Shenton and Nittida Sudmai, without you this process would have been very lonely. Also to Dr James Suckling, Dr Ben Drake, Dr Peter Bradley, and Dr Liz York for giving up your valuable time to help me out. Thanks to Gemma Birkett for sneaking me into Tim’s diary and to Moira Foster, Barbara Millington, and Marilyn Ellis for helping me navigate the administrative maze of the university.

Thanks to Dr Andy Jarvis, you made academia look like something worth doing! A small apology and thanks to my A level teachers – Karen Woolven, Alison Quarterman, and Gill Stott – I got there in the end.

To my family and friends, thank you for all your support over the last 4 years. I won’t list friends by name for fear of missing someone out, but thank you all for so many good times. Anna and Louise, thanks for keeping me grounded while I’ve studied “Geography and Maths”. Thanks to my Grandparents for great chats. Mum and Dad, thankyou for all your love and support, both during my PhD and in getting me here in the first place.

Finally, thanks to Amanda. For everything.
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<th>Full Form</th>
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<tbody>
<tr>
<td>BRIC</td>
<td>Brazil, Russia, India and China</td>
</tr>
<tr>
<td>COICOP</td>
<td>Classification of Individual Consumption According to Purpose</td>
</tr>
<tr>
<td>CGE</td>
<td>Computable General Equilibrium</td>
</tr>
<tr>
<td>CPA</td>
<td>Classification of Products by Activity</td>
</tr>
<tr>
<td>CPI</td>
<td>Consumer Price Index</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agricultural Organisation</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GMRIO</td>
<td>Global Multi-Regional Input-Output</td>
</tr>
<tr>
<td>ICP</td>
<td>International Comparison Program</td>
</tr>
<tr>
<td>ILO</td>
<td>International Labour Organisation</td>
</tr>
<tr>
<td>LC</td>
<td>Labour Compensation</td>
</tr>
<tr>
<td>LCA</td>
<td>Life Cycle Assessment</td>
</tr>
<tr>
<td>MER</td>
<td>Market Exchange Rates</td>
</tr>
<tr>
<td>MFA</td>
<td>Multi-Fibre Agreement</td>
</tr>
<tr>
<td>NACE</td>
<td>Statistical classification of economic activities in the European Community</td>
</tr>
<tr>
<td>OAC</td>
<td>Other Affluent Countries</td>
</tr>
<tr>
<td>OE</td>
<td>Other European countries</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>OLAC</td>
<td>Other Less Affluent Countries</td>
</tr>
<tr>
<td>PPP</td>
<td>Purchasing Power Parity</td>
</tr>
<tr>
<td>RCOT</td>
<td>Rectangular Choice of Technology</td>
</tr>
<tr>
<td>RoW</td>
<td>Rest of the World</td>
</tr>
<tr>
<td>RtC</td>
<td>Returns to Capital</td>
</tr>
<tr>
<td>SDGs</td>
<td>Sustainable Development Goals</td>
</tr>
<tr>
<td>SLCA</td>
<td>Social Life Cycle Assessment</td>
</tr>
<tr>
<td>SSA</td>
<td>Social Security Association</td>
</tr>
<tr>
<td>USD</td>
<td>United States Dollars</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Name</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>WEU</td>
<td>Western Europe</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
<tr>
<td>WIOD</td>
<td>World Input-Output Database</td>
</tr>
<tr>
<td>WWF</td>
<td>World Wildlife Fund</td>
</tr>
<tr>
<td>Symbol</td>
<td>Definition</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
</tr>
<tr>
<td>$E$</td>
<td>Matrix of impact (either environmental, social or economic) by country and sector.</td>
</tr>
<tr>
<td>$L$</td>
<td>Leontief Inverse, describing the inter-relationships between different sectors of the economy.</td>
</tr>
<tr>
<td>$u$</td>
<td>Direct impact intensity vector</td>
</tr>
<tr>
<td>$\hat{v}$</td>
<td>Diagonalisation</td>
</tr>
<tr>
<td>$Y$</td>
<td>Matrix of final demand by country and sector in basic prices and in the Statistical classification of economic activities in the European Community, (NACE) classification.</td>
</tr>
<tr>
<td>$Q$</td>
<td>Impact multiplier matrix, defined as: $Q = \hat{u}L$</td>
</tr>
<tr>
<td>$w^n$</td>
<td>Net living wage, equivalent to the cost of a decent life.</td>
</tr>
<tr>
<td>$f$</td>
<td>Cost of food per day</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Engel coefficient, the share of food costs in household expenditure</td>
</tr>
<tr>
<td>$\beta$</td>
<td>Household scalar</td>
</tr>
<tr>
<td>$s$</td>
<td>Savings allowance</td>
</tr>
<tr>
<td>$h$</td>
<td>Personal tax allowance</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Effective income tax rates</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Employee social security contributions</td>
</tr>
<tr>
<td>$w^g$</td>
<td>Gross living wage, equal to the net living wage plus the personal tax allowance</td>
</tr>
<tr>
<td>$w^l$</td>
<td>Living labour compensation, equal to the gross living wage plus employer social security contributions</td>
</tr>
<tr>
<td>$\varepsilon$</td>
<td>employer social security contribution rates</td>
</tr>
<tr>
<td>Symbol</td>
<td>Definition</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
</tr>
<tr>
<td>$\Delta w$</td>
<td>Vector of change in the labour cost per unit of economic output by economic sector</td>
</tr>
<tr>
<td>$Y_{wc}$</td>
<td>Matrix of Western European household clothing final demand in basic prices and using the World-Input-Output Database (WIOD) classification system.</td>
</tr>
<tr>
<td>$\Delta p$</td>
<td>Vector of relative price changes</td>
</tr>
<tr>
<td>$L'$</td>
<td>Transpose of the Leontief inverse</td>
</tr>
<tr>
<td>$\Delta v$</td>
<td>Vector of the change in the unit cost of the primary factors of production</td>
</tr>
<tr>
<td>$\Delta f_{wc}$</td>
<td>Vector of change in Western European clothing final demand bill in each of incorporating proportional adjustments in taxes and retail margins (in the Classification of Products by Activity (CPA) classification system and at purchaser’s prices).</td>
</tr>
<tr>
<td>$D$</td>
<td>Bridge matrix converting between WIOD and CPA classifications</td>
</tr>
<tr>
<td>$M$</td>
<td>Matrix converting from basic to purchaser’s prices</td>
</tr>
<tr>
<td>$i$</td>
<td>Vector of ones used as a summation function</td>
</tr>
<tr>
<td>$\otimes$</td>
<td>Entrywise (element by element or ‘Hadamard’) multiplication equivalent to ‘.*’ in Matlab.</td>
</tr>
<tr>
<td>$f_{wc}$</td>
<td>Vector of original Western European clothing final demand bill in purchaser’s prices.</td>
</tr>
<tr>
<td>$f_{wc}^*$</td>
<td>Vector of Western European final demand bill for clothing in purchaser’s after change in labour costs, assuming full-price pass through.</td>
</tr>
<tr>
<td>$g_{wc}$</td>
<td>Vector of percentage price change in clothing consumption for each of the Western European countries (purchaser’s prices)</td>
</tr>
<tr>
<td>Symbol</td>
<td>Definition</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>$\Delta f_{wc}$</td>
<td>Scalar value of change in Western European clothing bill at purchaser’s prices</td>
</tr>
<tr>
<td>$e_a$</td>
<td>Vector of estimated total impact of paying BRIC workers in the Western European clothing supply chain a living wage</td>
</tr>
<tr>
<td>$e_{wc}$</td>
<td>Vector of the impact caused by changes in Western European clothing demand in response to the living wage price increase. Also referred to as the WEU clothing effect.</td>
</tr>
<tr>
<td>$e_{wo}$</td>
<td>Vector of the impact caused by changes in Western European non-clothing demand in response to the living wage price increase. Also referred to as the WEU non-clothing effect.</td>
</tr>
<tr>
<td>$e_g$</td>
<td>Vector of the impact of the change in demand in all non-Western European countries following changes in Non-Western European income that are caused by the WEU Clothes Effect and WEU Other Effect.</td>
</tr>
<tr>
<td>$\Delta j_{wc}$</td>
<td>Vector of change in Western European demand for the Classification of Individual Consumption by Purpose (COICOP) clothing category valued at purchaser’s prices.</td>
</tr>
<tr>
<td>$\varphi_{wc}$</td>
<td>Vector of Western European own-price elasticity of demand values for clothing.</td>
</tr>
<tr>
<td>$\Delta y_{wc}$</td>
<td>Vector of changes in Western European clothing demand in the World-Input-Output database classification at basic prices.</td>
</tr>
<tr>
<td>$Q'$</td>
<td>Matrix of impacts per unit of economic output, estimated using data that reflect the increased cost of goods assuming BRIC workers are paid a living wage and all cost are passed through to the final consumer.</td>
</tr>
<tr>
<td>$F_{wo}$</td>
<td>Matrix of final demand bill in Western European countries for non-clothing goods.</td>
</tr>
<tr>
<td>$\Delta J_{wo}$</td>
<td>Matrix of change in demand for non-clothing goods in Western Europe</td>
</tr>
<tr>
<td>Symbol</td>
<td>Definition</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>$\Psi_{wc}$</td>
<td>Matrix of cross-price elasticities of demand with respect to non-clothing goods in Western Europe.</td>
</tr>
<tr>
<td>$G_{wc}$</td>
<td>Matrix made by repeating $g_{wc}$ eight times.</td>
</tr>
<tr>
<td>$\Delta y_{wo}$</td>
<td>Vector of change in demand for non-clothing goods in Western Europe.</td>
</tr>
<tr>
<td>$\Delta J_{wo}$</td>
<td>Matrix of change in demand in Western Europe in purchasers prices</td>
</tr>
<tr>
<td>$H_g$</td>
<td>Matrix of Percentage change in Labour Compensation in non-Western European countries</td>
</tr>
<tr>
<td>$\Phi_g$</td>
<td>Matrix of income elasticities of demand in non-Western European countries</td>
</tr>
<tr>
<td>$F_g$</td>
<td>Matrix of Non-Western European demand bill</td>
</tr>
<tr>
<td>$\Delta y_g$</td>
<td>Vector of change in non-Western European demand in WIOD classification at basic prices</td>
</tr>
<tr>
<td>$t$</td>
<td>Simulation time</td>
</tr>
<tr>
<td>$dt$</td>
<td>Change in simulation time</td>
</tr>
<tr>
<td>$Av_Consumer_Price$</td>
<td>Average clothing price faced by Western European consumers, accounting for the application of price mark downs to leftover stock.</td>
</tr>
<tr>
<td>$Change_in_Av_Consumer_Price$</td>
<td>Change in the average clothing price faced by Western European consumers</td>
</tr>
<tr>
<td>$Initial_Price$</td>
<td>The selling price of clothing goods in the Western European market before they are marked down</td>
</tr>
<tr>
<td>$Resellable_stock_as_proportion_of_Inventory$</td>
<td>Stock not sold at its initial price that can still be sold (i.e. has not been disposed of) as a proportion of the total amount of stock held.</td>
</tr>
<tr>
<td>$Marked_Down_Price$</td>
<td>The price that previously unsold will be placed on sale for having been discounted.</td>
</tr>
<tr>
<td>Symbol</td>
<td>Definition</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Costs</td>
<td>Total production costs to the Western European clothing retailer. Includes intermediate goods, labour, and capital costs.</td>
</tr>
<tr>
<td>Target_Profit_Rate</td>
<td>Proportion of the production costs that firms aim to receive as profit.</td>
</tr>
<tr>
<td>Physical_Output</td>
<td>Index of the physical quantity of clothing goods produced by Western European clothing retailers (start of the simulation = 1).</td>
</tr>
<tr>
<td>DELAY</td>
<td>STELLA function used to lag a variable by the specified number of timesteps</td>
</tr>
<tr>
<td>Percentage_Markdown</td>
<td>The proportion of the initial selling price that previously unsold stock will be placed on sale at.</td>
</tr>
<tr>
<td>Employees_Required</td>
<td>Number of employees needed to produce a desired quantity of goods.</td>
</tr>
<tr>
<td>Employee_Intensity</td>
<td>Number of employees required to produce one unit of output.</td>
</tr>
<tr>
<td>Stock_of_Employees</td>
<td>Number of employees currently employed.</td>
</tr>
<tr>
<td>New_Hires</td>
<td>Employees hired in the last quarter.</td>
</tr>
<tr>
<td>Leavers</td>
<td>Employees that left in the last quarter.</td>
</tr>
<tr>
<td>Turnover_Rate</td>
<td>Proportion of employees that leave in a given time period.</td>
</tr>
<tr>
<td>Change_in_X</td>
<td>Change in the exemplar variable X</td>
</tr>
<tr>
<td>Upper Limit</td>
<td>Upper limit of a sigmoidal curve</td>
</tr>
<tr>
<td>b</td>
<td>A constant.</td>
</tr>
<tr>
<td>exp</td>
<td>Exponential function.</td>
</tr>
<tr>
<td>Sensitivity_to_Wage_Change</td>
<td>Sensitivity of exemplar variable X to the change in wage rate</td>
</tr>
<tr>
<td>SMTH1</td>
<td>STELLA function for first order exponential smoothing</td>
</tr>
<tr>
<td>Symbol</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Wage_Change</td>
<td>Change in the wage rate</td>
</tr>
<tr>
<td>Labour_Compensation</td>
<td>Total cost of labour, defined approximately as in the System of National Accounts (wages+social security)</td>
</tr>
<tr>
<td>Hours_Worked</td>
<td>Total hours worked in production.</td>
</tr>
<tr>
<td>Lab_Comp_Rate</td>
<td>Total cost of labour per hour.</td>
</tr>
<tr>
<td>Consumer_Phy Demand</td>
<td>Physical quantities of clothing goods that consumers would like to purchase</td>
</tr>
<tr>
<td>Initial_Physical_Sales</td>
<td>Quantity of clothing goods sold to Western European consumers in year -0 (start of the simulation).</td>
</tr>
<tr>
<td>Change_in_Phys_demand</td>
<td>Change in the physical quantity of clothing goods demanded by Western European consumers.</td>
</tr>
<tr>
<td>Price_Elasticity_of_Demand</td>
<td>Percentage change in demand for clothing goods in Western Europe following a 1% change in price.</td>
</tr>
<tr>
<td>Percentage_Price_Change</td>
<td>Percentage change in the price of Western European clothing goods.</td>
</tr>
<tr>
<td>Short_Run_Desired_Production</td>
<td>Amount of goods a firm would like to produce for sale in the next sales period.</td>
</tr>
<tr>
<td>Change_in_Short_Run_Desired_Production</td>
<td>Change in short run desired production.</td>
</tr>
<tr>
<td>Short_Run_Demand_Forecast</td>
<td>Expected demand in the next sales period.</td>
</tr>
<tr>
<td>Stock_held_for_Demand_Uncertainty</td>
<td>Additional stock held by firms to account for the fact that demand is inherently unstable and uncertain.</td>
</tr>
<tr>
<td>Resellable_Stock</td>
<td>Stock not sold at its initial price that can still be sold.</td>
</tr>
<tr>
<td>Labour_Productivity</td>
<td>The inverse of employee intensity, output per employee.</td>
</tr>
</tbody>
</table>
Chapter 1  Introduction

1.1 Strategies for a More Sustainable World

Sustainability means a good and equitable life for all people within the ecological limits of the planet (Jackson, 2009, Jackson, 2011). However, economic activity is currently diminishing the natural world (Butchart et al., 2011, Tukker et al., 2014, Kew, 2016) and destabilising the only set of planetary conditions known to support human flourishing (IPCC, 2013, Steffen et al., 2015). Moreover, it is not delivering ‘the good life’ for all. Large regional differences in human development persist (Ecosura, 2015) and the comfortable lifestyles enjoyed by most people in affluent countries are supported by poor labour conditions in developing countries (Simas et al., 2014a, Alsamawi et al., 2014a).

1.1.1 Holism and Transformation for Sustainability

There is widespread agreement that achieving sustainability requires a vision of societal progress that goes beyond simply increasing levels of consumption and economic activity. Emblematic of this view are the 17 Sustainable Development Goals (SDGs) that make up Agenda 2030, the post-2015 development agenda adopted by the United Nations General Assembly. The SDGs are holistic and far-reaching, emphasising the need to tackle both social inequities and ecological problems through “fundamental changes in the way that our societies produce and consume goods and services” (United Nations, 2015, p. 8).

However, governments still predominantly look to GDP growth and increases in consumption to solve a variety of social problems (Victor, 2007). This is problematic as both GDP and consumption growth risk pushing us towards environmental limits (Krausmann et al.,
2009, Galli et al., 2012, Antal, 2014), and the extent to which they can improve quality of life is debatable (Meadows et al., 2005, Van den Bergh, 2009). Relying on economic growth to raise standards of living in developing countries (without reducing income in affluent countries) implies a quadrupling of global economic activity, which is likely to drive further environmental damage (Tukker, 2013) and undermine standards of living.

Because of the dominance of the relatively narrow, economic view of societal progress (Victor, 2007) the more holistic view of SDGs is viewed by many as potentially transformative. The World Wildlife Fund (WWF), for example, writes that in recognising the interlinkages between environmental, social and economic issues the SDGs are:

“an unprecedented international commitment... These goals have the power to transform our world, and deliver a future in which people and nature thrive. Taken together with the historic agreement at the Paris climate change negotiations, the SDGs mean that 2015 really can be the year that rewrote the future.” (WWF, 2016b)

Likewise, Hajer et al. (2015, p. 1652) argue that the SDGs are a “universally relevant agenda that integrates social, economic and environmental goals”. Similar sentiments praising the holism and ‘transformative potential’ of the SDGs are found across the academic literature (e.g. Fukuda-Parr, 2016, Gupta and Vegelin, 2016).

However, many proponents of the SDGs have reservations and stress the need to develop diverse implementation strategies that reflect the holism of the SDG framework. WWF (2016a) express concern that not all member states have begun to plan for delivering the SDGs and argue that it is essential to have a high level strategy for the whole European Union. Others are more concerned with non-state actors, arguing that the SDGs need to engage with broad communities of change agents. Hajer et al. (2015), for example, argue that the SDGs should be
used to foster more sustainable business practices and guide the development of new norms in the finance and business communities.

1.1.2 The need for a global perspective

Development of holistic sustainability strategies is complicated by the fact that sustainability demands a global perspective. The preamble of Agenda 2030 acknowledges that inequality, health and climate change are global problems requiring international as well as regional and local actions (United Nations, 2015). This is most obvious for environmental problems, which rarely conform to political boundaries. As Meadows (2008, p. 98) writes,

"Rivers make handy borders between countries, but the worst possible borders for managing the quantity or quality of the water. Air is worse than water in its insistence on crossing political borders. National boundaries mean nothing when it comes to ozone depletion in the stratosphere, or greenhouse gases in the atmosphere, or ocean dumping”

Moreover, the global nature of environmental problems has been exacerbated by changes in global economic structure. Since 1990 the global economy has become increasingly fragmented as production has specialised and become distributed across global production networks (Feenstra and Hanson, 1996, Los et al., 2014). Consequently, consumption in one country drives environmental impact in many others (Tukker et al., 2014, Wiedmann, 2016).

The importance of this for sustainability is illustrated by the case of national carbon emissions. Standard carbon accounting methods (such as that used in the Kyoto Protocol) are ‘production based’: they measure the amount of carbon emitted at the point of production of a good. Developed economies have become highly service oriented and manufacturing has largely relocated to developing countries (Timmer et al., 2014). Therefore, from the production
perspective, many developed countries appear to be reducing their carbon footprints. However, consumers in developed countries still consume the goods whose supply chains emit carbon (even if more of those supply chains and associated emissions now occur outside the national borders of developed countries). As a result, if supply chain carbon emissions are measured at the point of consumption, reductions in developed country emissions often disappear completely (e.g. Druckman et al., 2008, Brizga et al., 2016).

We must also take a global perspective on social issues: the global economy carries socio-economic as well as environmental impacts of consumption around the world. As developed countries specialise in high wage, high education services, they have offshored low skill, low wage work to developing countries (Timmer et al., 2014). As a result, the jobs of many low wage and vulnerable workers in developing countries depend on affluent country consumption (Los et al., 2012, Simas et al., 2014a). Simultaneously, developed country consumption patterns create incentives for developing country workers to be placed in dangerous situations. For example, Taplin (2014) argues that Western consumer demand for cheap clothing contributed to the Rana Plaza factory collapse that killed 1,100 workers and injured 2,000 more.

Consequently, although the SDG goals of eradicating extreme poverty (Goal 1) and ensuring decent work for all (Goal 8) seem to apply most readily to those in developing countries, achieving them also requires action by developed countries and they are intimately linked to the changes required to achieve sustainable consumption and production patterns (Goal 12). Any sustainability strategy must account for the global nature of the economy. Moreover, such strategies must account for the differences between economies, facilitating developed economies in reducing their impacts while contributing to improvements in living and working conditions in developing countries (Tukker et al., 2008, Jackson, 2011).
1.1.3 Flourishing within limits: the challenge of a twin focus

Central to this thesis is the challenge of how we might work toward the SDG aims of eradicating poverty (Goal 1) and ensuring decent work for all (Goal 8) while remaining within environmental limits (Goals 13, 14 and 15). The complex links between developed country consumption, global environmental degradation, and developing country social welfare mean improvement in one of these areas risks worsening another. For example, an immediate cessation of economic growth would be environmentallly beneficial. But it is also clear that uncontrolled degrowth would have disastrous social effects (Jackson, 2011, Antal, 2014).

Likewise, while restrained or altered consumption patterns are likely to reduce environmental degradation (Druckman and Jackson, 2010, Berners-Lee et al., 2012), there is no guarantee that they will be socially beneficial. The CEO of clothing retailer H&M has argued that “reducing consumption will create a social catastrophe” (Confino, 2015). Similarly, Erickson et al. (2012) suggest that ‘green’ consumption patterns could reduce the income of developing nations. These warnings serve to remind us that strategies for sustainable consumption and production (SDG Goal 12) need to be evaluated for their environmental and social impacts.

1.1.4 ‘Better’ rather than ‘more’?

It might be possible to address both the need for decent work/poverty reduction and to reduce environmental impacts by improving working conditions in developing countries. Measures such as a wage increase would (for some workers, at least) provide more decent work and boost their income, reducing their risk of poverty. Moreover, such measures have economic costs and if these are passed to consumers in affluent countries, economic theory would suggest that consumption (and its attendant impacts) will fall.
The concept of improving labour conditions to reduce the environmental burden of consumption is drawn from work in Industrial Ecology by Clift et al., (2013) and Girod and de Haan (2009, 2010). Girod and de Haan find that some Swiss consumers choose to buy ‘better’ (higher quality) goods rather than more of them. Moreover, because these higher quality goods are characterised by higher unit prices, consumers with quality-oriented spending patterns spend less on high emitting consumption items. Consequently, they are (relatively) low carbon emitters. Building on this work, Clift et al. (2013) argue that ‘quality’ could be redefined to mean products with more socially equitable supply chains, such that ‘better’ is understood to have a social component. The key argument is that employing “more skilled seamstresses and fewer sweatshops” (Clift et al., 2013, p. 303) would lead to higher unit prices, reducing levels of consumption and making supply chains more equitable.

There is also a growing body of work that reflects similar ideas but is specifically targeted at fashion production-consumption systems. This literature emphasises new business models for fashion built around the purchasing and selling of fewer clothes of higher value and higher quality. Again, it is argued that value and quality can be increased (partially) by paying workers fair wages and generally improving working conditions (Schor, 2002, Fletcher, 2014, Jung and Jin, 2014).

1.2 Aim of this thesis

The sustainability of measures that aim to improve labour conditions in global supply chains is a largely unexplored area, and Clift et al. (2013) call for further research. Likewise, in the sustainable fashion literature the idea that improving supply chain equity might have both social and environmental benefits constitutes a relatively small body of work. Most of this work comes under the umbrella of ‘Slow Fashion’, a concept in a state of flux, with definitions varying across different practitioners and academics (Black, 2012, Fletcher, 2014, Leslie et al.,
Moreover, much of this work is qualitative and has only engaged with the (extensive) economic literatures on wages, labour conditions, and the social benefits of production in a very limited way. Consequently, there is still much to learn about the extent to which this kind of approach could contribute to more sustainable consumption and production.

Therefore, the central aim of this thesis is to investigate the potential for improvements in supply chain labour conditions to reduce global environmental damage and improve the social conditions of workers in developing countries.

1.3 Scope

To structure the research, we impose several limits. We narrow our focus to investigate Western European clothing supply chains and concentrate our social impact analysis on workers in Brazil, Russia, India and China (BRIC). Methodologically, the analysis is limited to formal (computer) models and uses only quantitative indicators. Subsections 1.3.1-1.3.3 discuss these limitations in more detail.

1.3.1 Clothing Supply Chains

Our investigation is limited to clothing supply chains for three reasons. First, clothing consumption and production is widely held to be unsustainable. Although not one of the environmental priority groups identified by Tukker and Jansen (2006), clothing production is a substantial contributor to greenhouse gas emissions (Carbon Trust, 2011), solid waste (Claudio, 2007), chemical toxicity (Chen and Burns, 2006), and water use (Muthu et al., 2012). Additionally, clothing production has a reputation for poor labour conditions. Schor (2002, p. 47) calls clothing “the vanguard industry in the emergence of a new global sweatshop” and investigations following the Rana Plaza disaster reported that “hazardous conditions ... are systemic to the industry” (BAPPG, 2013, p. 15). Moreover, the environmental and social
impacts are often attributed to the low prices and low quality of modern clothes (e.g. Schor, 2005), something that a strategy of improving labour conditions and passing subsequent cost increases through to consumers would explicitly look to reverse.

However, clothing production also has social benefits. Together with textiles and footwear sectors, clothing production directly employs some 60 million people worldwide (ILO, 2014) and is a major source of revenue for many developing and emerging economies, in some cases accounting for up to 15% of GDP and 80% of export revenue (Keane and Willem te Velde, 2008).

The Western European clothing supply chain provides a useful exploration ground for this thesis because the tension between environmental damage, social damage, and social benefits are especially keenly felt in the context of clothing. This is partly because garment manufacturing has played an important historic role in economic development (Rivoli, 2006). As a result, there is a rich literature debating the best way to improve the lives of workers in the clothing supply chain (Pollin et al., 2004, Tokatli et al., 2011, Vaughan-Whitehead, 2014). This literature, however, remains largely divorced from the broader sustainable fashion literature, despite the two engaging with similar ideas.

Within the sustainable fashion community, ‘slow fashion’ emerged as a reaction to ‘fast fashion’, the term for the business models of many prominent clothing retailers (including Zara, H&M, and Primark) which is characterised by the production of cheap, low quality clothing goods with short lifetimes (Crofton and Doppio, 2007, Sull and Turconi, 2008). The term slow fashion was coined by designer and academic Kate Fletcher, who writes,

“Fast fashion…is largely disconnected from reality, with little recognition of poverty wages, forced overtime and climate change. Slow fashion,…[is a] shift from quantity to quality … Of course, quality costs more. We will buy fewer
products, but higher in value. A fairer distribution of the ticket price through the supply chain is an intrinsic part of the agenda. Jobs are preserved as workers spend longer on each piece. Slow fashion is a glimpse of a different – and more sustainable – future for the textile and clothing sector and an opportunity for business to be done in a way that respects workers, environment and consumers in equal measure. (Fletcher, 2007)

Slow fashion has since inspired several fashion brands\(^1\), although its definition is somewhat varied among both practitioners and academics (Black, 2012). Being a new field in its formative stages (but already having a practitioner base) there is scope for this thesis to have a substantive impact.

This said, it is worth noting that although much work on slow fashion is concerned with the use phase and longevity of clothing, we limit our research to the production and sale of clothing goods for Western European Markets. Therefore, we include every stage of production from the extraction of raw materials to the point at which the final clothing garment leaves the factory gate. Where pertinent we also consider some aspects of retail (such as decisions made by retailers on pricing, ordering of stock, employment etc.). However, we do not consider the use phase of clothing, or issues such as the longevity of clothing. This limits the scope of our analysis because the environmental impacts of clothing use are often high (Choudhury, 2014), and both social and environmental impacts are likely impacted by longevity (Allwood et al., 2006; Fletcher 2007). However, such relationships are highly uncertain (Steinberger et al., 2007) and there is little empirical data with which to characterise them (see Chapter 2). Moreover, (as we will see in Chapters 2 and 3) many of the environmental and social issues of

interest to us can be at least partially considered without taking either the use phase or longevity into account.

### 1.3.2 Western European Consumers and BRIC Workers

This subsection discusses the geographical focus of this PhD. For the purposes of this thesis, the world is divided into 5 regions according to the classification system in Table 1-1. The countries are taken from the World Input-Output Database (WIOD)\(^2\), which we use as our primary data source throughout the thesis.

Table 1-1 Aggregation of countries into regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Europe (WEU)</td>
<td>Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom</td>
</tr>
<tr>
<td>Other Europe (OEU)</td>
<td>Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania Malta, Poland, Romania, Slovak Republic, Slovenia, Turkey</td>
</tr>
<tr>
<td>BRIC</td>
<td>Brazil, Russia, India, China</td>
</tr>
<tr>
<td>Other Affluent Countries (OAC)</td>
<td>Australia, Canada, Japan, Korea, Taiwan, United States of America</td>
</tr>
<tr>
<td>Other Less Affluent Countries (OLAC)</td>
<td>Indonesia, Mexico, Rest of the World</td>
</tr>
</tbody>
</table>

We restrict our analysis to the Western European clothing supply chain because Western European countries are typically very affluent, and in the class of countries Tukker et al. (2008) identify as needing to reduce their consumption levels. This is pertinent as at the heart of our proposal is a cost increase to consumers, making it best suited as a way for affluent consumers to reduce levels of consumption. Moreover, growth in fast fashion is thought to have been particularly prevalent in Western Europe (Sull and Turconi, 2008). However, there

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\(^2\) See Chapter 3 for a discussion of WIOD, including our reasons for choosing it over other similar databases.
is diversity in the clothing consumption and production systems of different Western European countries (Farrer, 2011). By aggregating them we lose this detail and are able only to discuss averages.

Our social impact analysis is focused on BRIC workers because Brazil, Russia, India and China are all classified as developing countries (IMF, 2013), and for the majority of the time series available to us (1995-2009, see Chapter 3) had a GDP per capita below or within the 10-15,000 USD PPP range (World Bank, 2015) that has been suggested as the minimum income for a decent quality of life (Jackson, 2009, Tukker, 2013). Additionally BRIC have been extensively analysed as a single economic unit since the term was coined (O’Neill, 2001) and all four countries are thought to be important in the clothing supply chain (Allwood et al., 2006, Pickles, 2012). However, we accept that these economies are undergoing rapid transition and face new and divergent sustainability challenges in the immediate future (Tukker et al., 2008, Akenji et al., 2016).

1.3.3 Formal Models

Of the many possible methodological approaches that could be used to achieve the aim of this thesis, we use formal (computer) models. One advantage of using formal models is that we bring a new perspective to the slow and sustainable fashion literatures. Being a relatively new field of study, a majority of the literature reflects the design-led roots of the slow fashion movement. As a result, much of the existing research is qualitative in nature (e.g. Clark, 2008, Fletcher, 2010, Antanavičiūtė and Dobilaitė, 2015) with very little economic or modelling work.\[3\]

\[3\] Girod and de Haan (2010) do make use of models, but do not focus on clothing, and do not engage with sustainable fashion or slow fashion literatures.
We subscribe to the view of models as tools that mediate between theory and reality (Morgan and Mary, 1999). In this view, models draw from both theories and the real world (through data) but retain a level of autonomy. Therefore, models facilitate learning by allowing users to test and refine the mental models (theories, value judgements and assumptions) that they inevitably bring to research (Sterman, 2000, Epstein, 2008, Meadows, 2008). By manipulating models we are able to see where model and theory diverge (or converge), and explore why this is the case. Moreover, where our models are sufficiently representative of some aspect of the real world they can be considered ‘surrogate’ worlds and we can make qualified inferences from our model world to the real world (Sugden, 2000, Mäki, 2009).

Because we view models in this way, we do not believe that any one modelling approach represents the ‘best’ way to understand a problem. Rather we see different models as frameworks that allow us to consider problems from different perspectives. This is most obvious when looking at models from different academic communities. Such as, system dynamics and input-output analysis. The former focuses on the role of feedbacks and delays, emphasising the importance of system structures (Sterman, 2000, Pasqualino et al., 2015), while the latter stresses economic interdependencies and places considerable importance on the empirical basis of the model (Duchin and Steenge, 2007). However, models that come from much more closely related fields (such as input-output and computable general equilibrium models) also provide alternative perspectives (the latter placing much more importance on substitutability and price effects than the former).

Indeed, we would argue that multiple models should be used for economic and sustainability analysis because such problems are characterised by ‘deep’ uncertainty. By this, we mean that uncertainty is found not only in model parameters but in the fundamental model structures. An example pertinent to this thesis is the relationship between worker productivity
and wages. This relationship is highly contested, some economists argue that worker productivity is unaffected by wage increases, while others argue that workers are more productive when their pay increases, but disagree as to why (Yellen, 1995, Charness and Kuhn, 2007, Gneezy and List, 2007, Bellemare and Shearer, 2009, Georgiadis, 2013). Consequently, exploration of multiple viewpoints on this and other similarly contested issues is useful.

Therefore, in this thesis we choose models that bring new perspectives to the issues being explored. A good illustration of this is the model applied in Chapter 5, looking at the effect of wage increases on the price of clothing goods. As we will see, several studies (Pollin et al., 2004, WRC, 2005, Miller and Williams, 2009) have examined this effect previously but have not taken into account the fact that many clothing supply chains are highly fragmented and include multiple countries and sectors which would require wage increases. Therefore we apply a global multi-regional input-output model to capture these issues.

Additionally, because we view models as mediating tools that facilitate the exploration of particular viewpoints, we often intentionally apply models that do not include all potentially important effects. The rationale for this is that when a model includes many competing mechanisms it can be difficult to understand which mechanisms are driving model results. Therefore, as a first exploration it does not necessarily make sense to use the most complex model available. It is partly for this reason that we do not apply any of the more complex extensions that are available for some of the models used in this thesis (such as Computable General Equilibrium (CGE) models (Robinson, 2006), or the Rectangular Choice of Technology (RCOT) model (Duchin and Levine, 2011), both of which build on the static input-output model that we use). Instead we choose to explore relatively few mechanisms in a relatively simple framework that might later be built on using CGE or other more complex, dynamic model. Moreover, we conduct our model analyses in an iterative fashion, starting with
a simple static model in Chapter 5, then extending the same basic model framework in Chapter 6, before shifting to a more complex and dynamic perspective in Chapter 7. By building the complexity of the modelling approach at each stage we aim to maximise clarity and understanding from the analysis.

Moreover, we recognise that our results are drawn from imperfect data and models with imperfect assumptions. Therefore, our results are all stylised (Abad and Khalifa, 2015) and inference from model learning to the real world is necessarily imperfect (Morgan, 2005). Our results can inform future analysis and applications but should not be treated as laws or universal truths. Due to their stylised nature, we mediate our results through what Mäki (2009) calls commentary. That is, we describe and discuss our results in a way that makes explicit reference to the isolations and and constructions\(^4\) used in the modelling process, emphasising their relation to one another and to the real world.

Finally, quantitative modelling limits us to using quantitative indicators. These will unavoidably miss some of the detail and nuance of the real world. This is likely to be particularly relevant in our social analysis, where issues are recognised to be complex and difficult to characterise using single issue quantitative indicators (Dreyer et al., 2010).

\subsection*{1.4 Objectives}

In order to investigate the potential for improvements in the labour conditions of BRIC workers in the Western European clothing supply chain to reduce global environmental damage and improve the social conditions of BRIC workers, this thesis has the following objectives:

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\(^4\) As with our use of the term ‘commentary’ we follow Mäki’s (2009) definitions of ‘isolations’ and ‘constructions’. Therefore, by ‘isolation’ we mean that we use simplifying assumptions to remove other (potentially complicating) mechanisms in order to leave only the mechanism of interest. Similarly, ‘constructions’ refer to processes that occur in models with no real world counterparts.
1. Assess the environmental and socio-economic sustainability of Western European clothing consumption (Chapters 2-5).

2. Make the concept of ‘improving supply chain labour conditions in the Western European clothing supply chain’, more analytically tractable, by identifying a specific (narrower) mechanism (Chapters 4-5).

3. Construct and apply a range of formal models to explore how the improvement in supply chain labour conditions (as operationalised in objective 2) might affect the environmental impacts and social benefits of Western European clothing consumption. (Chapters 5-7).

4. Synthesise the above analyses to assess the sustainability potential of improvements in supply chain labour conditions (Chapter 8).

These objectives are highly interdependent, each objective is informed by the previous objective and informs the precise nature of the next. For example, how we operationalise the idea of ‘improving supply chain labour conditions’ (objective 2) will depend on the sustainability issues identified in objective 1 and will affect the models developed in objective 3. Therefore, the objectives are, at this stage, deliberately ‘high level’ and will be further elaborated on in the relevant chapters.

1.5 Overview

The thesis is structured around the four objectives listed above. This section provides an overview of each chapter. It is worth noting that because the thesis is structured around the four objectives, and because it uses a range of different models, it does not have a methodology chapter. Instead, the methods applied are discussed in the relevant analytical chapter.
Chapter 2 reviews the literature on the structure and sustainability of clothing supply chains. This review situates the thesis in the literature, highlighting knowledge gaps and drawing out lessons to guide and structure our later analyses.

Chapter 3 adds to the literature review with a quantitative evaluation of the sustainability of the Western European Textiles and Clothing supply chain. We develop a sub-systems global multi-regional input-output model and apply it to the Western European Textiles and Clothing supply chain between 1995 and 2009. By applying the model to environmental (carbon emission) and socio-economic indicators (employment, labour compensation and returns to capital) over a 15 year period, we extend the current literature on clothing supply chain sustainability (which predominantly covers only a short time period or a single indicator). The analysis has been published as Mair et al. (2016).

Chapter 4 estimates living wages for each of the BRIC countries in 2005. It then extends existing living wage work by incorporating personal income tax allowance and social security costs. This gives an estimate of the cost of living wages from an employer perspective, consistent with measures of labour cost used in macroeconomic analyses and the system of national accounts. We call this novel concept ‘living labour compensation’. As well as an extended method and new indicator, the chapter contributes to current debates on how to estimate living wages.

Chapter 5 applies the living labour compensation estimates from Chapter 4 in the sub-systems input-output model detailed in Chapter 3. In doing so it estimates the first ever living wage satellite accounts (compatible with the World Input-Output Database). This allows us to estimate the additional costs (both from an employer and a consumer perspective) of paying BRIC workers a living wage in the Western European clothing supply chain. Using an input-
output model for this kind of calculation is novel, and provides a more comprehensive assessment of potential living wage costs than is available in the current literature.

Chapter 6 makes an initial quantitative investigation into how paying BRIC workers in the Western European clothing supply chain might affect global carbon emissions and BRIC employment, under a range of different assumptions of consumer behaviour. In doing so, Chapter 6 extends our input-output model by linking it to various elasticity of demand values. The model assumes all additional costs of living wages are passed to Western European consumers. Our analysis includes examination of ‘respending’ effects (how changes in income following the living wage intervention affect our indicators) and changes in Western European consumer demand (for clothing and non-clothing goods). Analysis of respending effects is a contribution to the economic debate on sweatshops and living wages.

Chapter 7 constructs and applies a system dynamics model of the Western European clothing supply chain. The model has a different focus to the model in Chapter 6, foregoing analysis of potential respending or substitution effects in favour of more sophisticated modelling of labour markets and retailer behaviour. The model is developed from a relatively new economic literature which sees firms as having many ‘channels of adjustment’ which they utilise to adjust to cost increases. This allows us to investigate how different choices made by firms might affect sustainability indicators (material throughput, developing country employment, and developed country profits). The model is the first to apply these ideas in a dynamic supply chain model.

Finally, Chapter 8 draws out the overall findings from our research and synthesises them into an evaluation of the sustainability potential of improving supply chain labour conditions and passing costs through to consumers – the ‘better’ rather than ‘more’ sustainable consumption and production strategy.
Chapter 2  Sustainability and the Clothing Supply Chain: A Literature Review

2.1 Introduction

This thesis explores improvements in supply chain labour conditions as a strategy for sustainable consumption and production, with a particular focus on the Western European clothing supply chain. Therefore, in this chapter we review the relevant literature. First we provide an overview of the structure of developed country clothing supply chains (Section 2.2) and their environmental and social impacts (Sections 2.3 and 2.4). In Section 2.5 we review how recent changes in consumption and production are likely to have affected the environmental and social impacts of developed country clothing supply chains. Finally, we summarise knowledge gaps and highlight lessons for our investigation into the Western European clothing supply chain (Section 2.6).

2.2 Globalisation, Fast Fashion and the Clothing Supply Chain

Developed country clothing supply chains have long been characterised by highly complex and dispersed production structures. To illustrate the disparate global nature of the clothing supply chain Birnbaum (2000) describes a typical production process for a woollen sweater,

“Raw wool is exported from Australia to Italy where it is spun into yarn and dyed. The dyed yarn is shipped to China to be knitted into sweater panels, then moved to Hong Kong where the panels are linked into finished sweaters which are then
exported to the United States. The average sweater importer runs anywhere between 50-200 styles a season” (Birnbaum, 2000, p. 13)

Complex as it is, Birnbaum’s description is a simplification of the actual supply chain. For example, it misses the production of the dye and the manufacture of farming equipment to produce the wool. Moreover, global trade structures are in constant flux, shaped by changes in consumer demand patterns and broader macroeconomic forces and (as we will see below) since Birnbaum wrote in 2000, the structure of the supply chain has substantially altered.

2.2.1 Fragmentation and the Clothing Supply Chain

Since 1990 the number of countries involved in any given supply chain has tended to increase, driven by the vertical specialisation of production (Hummels et al., 2001, OECD, 2011b). Vertical specialisation is a theory of international trade and production in which firms in different countries specialise in discrete stages of the production process (Hummels et al., 2001). This leads to an increase in the international trade of intermediate⁵ goods (Figure 2-1, Feenstra and Hanson, 1996, Hummels et al., 2001) and is also termed ‘fragmentation of production’. Recent empirical work suggests fragmentation of production is occurring in most manufacturing industries, and that the rate of fragmentation has been increasing over the last two decades (Timmer et al., 2013b, Los et al., 2014).

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⁵ Intermediate goods are those manufactured and sold as inputs to other production processes ending up as final product only after multiple stages of production, distribution and marketing.
A simple vertically specialised supply chain involving three countries. Country 1 produces an intermediate good and exports it to Country 2. Country 2 combines the imported intermediates with the factors of production and domestically produced intermediate inputs to produce a final good (gross output). Finally, Country 2 exports some of the final good to Country 3. This example is highly simplified and would usually include many more stages and countries. Adapted from Hummels (2001).

In the 1970s and 1990s, fragmentation of the clothing supply chain was exaggerated by trade policies (Pickles et al., 2015). Specifically, the Multi-Fibre Arrangement (MFA) which regulated the majority of global Textile and Clothing trade between 1972 and 2005 (OECD, 2004a). A key mechanism of the MFA was the use of trade quotas to restrict the import of particular goods. Reactions to the quota system drove further fragmentation of production as producers switched production to countries with no or unfulfilled quotas. In the case of some small developing countries this process created new clothing industries virtually overnight (Dicken, 2011). Additionally, the clothing supply chain is thought to be especially amenable to fragmentation as at nearly every stage of the production process products are easily exported (Morris and Barnes 2008). Also, the relatively low barriers to entry into the garment production stages of the supply chain make sourcing from multiple countries relatively easy (Birnbaum, 2000).

More recently, however, textile and garment production has begun to consolidate (Pickles et al., 2015). 1995 marked the beginning of the phasing out of the MFA, leaving some
smaller countries unsure of their ability to compete with Chinese operations (Spinanger, 1999, Adhikari and Yamamoto, 2007, Dicken, 2011). Certainly since the MFA was phased out the relative share of production of China and other major suppliers has grown at the expense of smaller regions (Moazzem and Sehrin, 2016). In 2010 85% of apparel exports came from just 10 countries, with one third of apparel exports being from China (Pickles, 2012).

Nevertheless, the clothing supply chain is still relatively global and fragmented. In part this is due to the broader trends toward continuing fragmentation of other industries in the supply chain (Los et al., 2014) and continued chasing of low production costs (Pickles, 2012). Similarly, regional specialisation has seen developed countries grow their high skill service sectors and move their low skill manufacturing requirements to developing and emerging economies (Timmer et al., 2014, OECD, 2015). These trends have driven a reduction in clothing production in affluent countries and a rise in clothing production in developing and emerging countries (Allwood et al., 2006, Morris and Barnes, 2008, Dicken, 2011).

2.2.2 The Rise of Fast Fashion

Linked to globalisation are changes in consumer preferences. Consumers now dispose of and replace clothing products much more rapidly (Doyle et al., 2006, Niinimaki and Hassi, 2011). Retailers have both responded to and encouraged this change by shifting from a biannual to a continuous mode of production and frequent refreshing of their in-store stock, a process known as ‘fast fashion’ (Crofton and Dopio, 2007, Tokatli, 2008, Caro and Martinez-de-Albeniz, 2015). It is important to note here that although ‘fast’ fashion is typically thought to be environmentally detrimental (see 2.5.1) because of the perceived reduction in product lifetimes, there is very little data available on how product lifetimes have changed. Therefore in this chapter we refer to ‘fast fashion’ as it is used and understood by fashion and business
researchers and practitioners, i.e. continuous rather than biannual production and frequent refreshing of in store stock.

Firms commonly identified as having fast fashion business models have grown at substantially above average market rates in recent years, particularly in Western Europe and North America (Sull and Turconi, 2008, Caro and Martinez-de-Albeniz, 2015). This is illustrated in Figure 2-2, which plots changes in sales at two established fast fashion retailers (H&M and Zara) and two traditional fashion retailers (GAP and Esprit). Equally telling for likely future trends in clothing consumption and production is that many traditional retailers are moving toward fast fashion business models. As a result fast fashion pioneers are often credited with “revolutionising” fashion production and consumption (Crofton and Dopio, 2007, Gabrielli et al., 2013). For example, GAP is currently trialling fast fashion in response to falling sales (Anderson, 2015), while Esprit has been remodelling itself as fast fashion brand since late 2012 (Cruz and Chan, 2012, Baldwin and Morris, 2013).

Figure 2-2 Index of change in sales at two fast fashion (H&M; Zara) and two more traditional retailers (GAP; Esprit) since 2000. Adapted from Caro and Martinez-de-Albeniz (2015) and updated using annual report data (Esprit, 2016, GAP, 2016, H&M, 2016, Inditex, 2016). Raw turnover figures deflated to 2010 prices using Consumer Price Indices from the World Bank (2015)
Fast fashion is sometimes thought to have driven a re-localisation of supply chains, as retailers sought to be able to respond more rapidly to changes in consumer demand (Choi et al., 2014). This narrative builds on early business models adopted by Zara, who reduced the time taken to get products from designers to the shelf principally through using local suppliers (Tokatli, 2008, Dicken, 2011). More recently, however, fast fashion is seen to be regionalising and consolidating the clothing supply chain but not making it less global. This has come as the emphasis on low prices and quick responses has driven buyers toward more efficient supply chain management (Bhardwaj and Fairhurst, 2010) and faster transportation methods which have facilitated the development of ‘fast fashion at a distance suppliers’ who retain a cost advantage over ‘local’ counterparts (Zhu and Pickles, 2015).

The continued use of global sourcing has been possible because in practice, supply chain efficiency for many large clothing brands has meant consolidation of their production networks, focusing on fewer larger suppliers who are able to meet the required levels of efficiency (Pickles, 2012, Pickles et al., 2015). In particular, the Asian countries have managed to capitalise on this, principally due to the rise of Asian trading and freight forwarding companies able to efficiently manage Asian networks of production. Similarly, fast fashion is credited with the recent rise in air freighting (Pickles, 2012)

However, the fast fashion business model does not rely exclusively on rapidly delivered goods, but instead sells a range of goods for which it may use a range of production processes (Kaplinsky, 2015): 70% of H&M and 40% of Zara’s goods are ‘basic fashion’ goods (Caro and Martinez-de-Albeniz, 2015). These goods are still fast fashion in as much as they have short lifetimes, and rapid turnover in store. But, they can be ordered several months in advance of sale and are amenable to highly vertically specialised production techniques. Even at the peak
of their local production business model, Zara only produced around half its goods ‘locally’ (Tokatli, 2008).

2.3 Environmental Impact of Clothing Consumption

Allwood et al. (2006) identify four major categories of environmental damage in clothing supply chains: energy use, emission of toxic chemicals, water consumption and solid waste generation. In this section we discuss each of these in turn and then review higher level studies that estimate the environmental importance of clothing in relation to other consumption categories.

2.3.1 Overview of Environmental Impacts

Energy use is the principal source of greenhouse gas emissions in the clothing supply chain (Allwood et al., 2006, Wang et al., 2015). In production, energy use is concentrated in the use of machinery in the agricultural and fibre production stages (Allwood et al., 2006, Choudhury, 2014). In particular the production of man-made fibres is highly energy intensive and demand for these fibres has doubled in recent years (Allwood et al., 2006, Claudio, 2007). It is worth noting that a major contributor to energy use and greenhouse gas emissions is in the use phase of clothing, particularly laundry (Choudhury, 2014). However, this is highly dependent on the assumptions made about consumer washing habits, including frequency and method (Steinberger et al., 2007).

Additionally, although several writers assume transport plays a large role in energy use and carbon emissions (Farrer, 2011, Choi, 2013, Choi et al., 2014), this is not clear cut. Wang et al. (2015) find that for a t-shirt manufactured in China, transportation between different processing stages contributes only ~3% of the lifecycle emissions. Likewise, for an international supply chain, Allwood et al. (2006) find that transport is not a major contributor
to emissions. Conversely, because Farrer (2011) assumes that all clothing is air freighted their estimates of transport based clothing emissions are substantial. It is unclear which position is correct, as trade publications have mixed views on the prevalence of air freighting in the clothing sector (for example: Clements, 2009, Putzger, 2014), though Pickles (2012) notes that frequency of air freighting is increasing.

The agricultural and dyeing stages of the clothing supply chain are the principal contributors of toxic chemical emissions (Allwood et al., 2006, Karthik and Gopalakrishnan, 2014). Toxic chemicals are widely used in the dyeing and finishing stages of clothing production: even natural dyes often use chemicals containing heavy metals (Karthik and Gopalakrishnan, 2014). Within the agricultural sector, cotton production accounts for a majority of chemical usage because cotton crops are very vulnerable to pests (Grose, 2009). For example, Clay (2004) estimates that cotton production accounts for around 11% of global annual pesticide use and 25% of global annual insecticide use, despite only accounting for 2.4% of global arable land.

Cotton is also implicated in the high levels of water consumption that occur within the clothing supply chain. Perhaps the most dramatic example (in any system) of the over-consumption of water is the desertification of the Aral Sea (Figure 2-3). In the 1940s, the Soviet Union redirected water from two major rivers in Central Asia for use irrigating cotton (Allwood et al., 2006). As a result, the Aral Sea has almost completely dried up and by 2004 had lost 20 of its 24 fish species (Clay, 2004).
Finally, solid waste generation is dominated by manufacturing of natural fibres and the disposal of goods at the end of life (Allwood et al., 2006). In the UK, DEFRA (2007) estimate that around 2 million tonnes of clothing waste is generated annually in the use phase. Around two-thirds of this goes directly to landfill, a tenth is recovered and the remainder unaccounted for.

### 2.3.2 Scale of the Impact of Clothing Consumption

Relative to other consumption categories, the scale of the environmental impact of clothing consumption is moderate. In their comprehensive review of studies, Tukker et al. (2006) and Tukker and Jansen (2006) report that the environmental impact of clothing consumption is typically 2-10% of total environmental impact. More recent work tends to confirm this finding. Druckman and Jackson (2009) attribute 11% of UK household carbon
emissions in 2004 to clothing and footwear. Kerkhof et al. (2009) estimate clothing to be 1-3% (depending on impact category and income decile) of the environmental impact of Dutch household consumption in the year 2000. Finally, using data for European households in 2007 Ivanova et al., (2015) report that clothing consumption contributes 3.5% of the carbon footprint; 4.3% of the land footprint; 4.7% of the material footprint; and 5% of the water footprint. This scale of environmental impact makes clothing a lower priority household consumption category than food and drink, passenger transport, and housing, but higher than healthcare, communication, education, restaurants and hotels, and recreation (assuming transport for recreation is allocated to passenger transport) (Tukker et al., 2006).

However, low (or moderate) priority in environmental terms does not necessarily imply that sustainability initiatives should not target clothing production and consumption. Social issues, are a large concern (see 2.4), but it is also important to note that we would expect changes in the price of clothing to have spillover effects in terms of consumer demand, possibly prompting reductions in higher priority consumption categories. This is because clothing demand is typically relatively inelastic (Meade et al., 2011). That is, we would expect demand for clothing to fall less than proportionally with a price increase, implying that changes in the price of clothing goods will reduce spending in other categories. Econometric studies of ‘cross price’ elasticity of demand suggests that this is the case. For example, Meade et al. (2011) find small but fairly consistent reductions in demand for other consumption categories following clothing price increases in a variety of countries.

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6 A price elasticity of demand is defined as the percentage change in demand in response to a 1 percent change in price. A cross-price elasticity of demand is the change in demand for good X in response to a to a 1 percent change in the price of good Y. Correspondingly, the own-price elasticity of demand is the change in demand for good Y in response to a to a 1 percent change in the price of good Y.
2.4 Social Impacts of Clothing Consumption

The social impacts of clothing production are widely considered double-edged (Pickles et al., 2015). Because of its low barriers to entry, the clothing industry has been at the forefront of economic development in many countries, bringing increases in both wages and employment (Rivoli, 2006, Keane and Willem te Velde, 2008). However, this process of development has been driven by retailers chasing the lowest production costs, leading to systemic issues including very low wages, unsafe working conditions and human rights abuses (Pickles, 2012, Theuws and Overeem, 2014, Pickles et al., 2015). As a result, some researchers stress the complexity and ambiguity of the benefits to workers and argue that it is a mistake to try to identify winners or losers (Tokatli et al., 2011).

Nevertheless, there is a debate in the academic literature around the best way to produce more winners in the global economy. A particularly vigorous part of this debate centres on ‘sweatshops’, which are workplaces characterised by ‘poverty’ wages, systematic health and safety risks, coercion and generally very poor working conditions (Arnold and Hartman, 2005). Much of this debate is highly relevant to the clothing supply chain. This is likely because clothing production was one of the earliest examples of sweated labour and the mental connection between the word ‘sweatshop’ and the clothing industry remains strong (Hapke, 2004). Therefore, in this section we review the recent debates on sweatshops.

2.4.1 Sweatshop Advocates Vs Sweatshop Critics

The debate around sweatshops can broadly be characterised as sweatshop advocates versus sweatshop critics. Sweatshop advocates typically make their case on the basis of two principles. First, sweatshops are the best offer available to many developing country workers, who freely take up this offer. This is uncontroversial. The empirical evidence suggests that
sweatshop workers earn more at sweatshops than they otherwise would (Powell and Skarbek, 2006, Keane and Willem te Velde, 2008, Clark and Powell, 2013) and it is widely accepted that sweatshop work provides opportunity and independence not otherwise afforded to many workers (especially women) and is therefore in considerable demand (Zwolinski, 2007, Dicken, 2011, Tokatli et al., 2011).

Sweatshop critics counter that while sweatshops may currently have the highest rates of pay and the best working conditions available to most sweatshop workers, this does not remove the obligation of multi-national companies to improve sweatshop conditions (Arnold and Hartman, 2005). Moreover, rates of pay that are relatively high in local terms, are not necessarily ‘fair’. In fact, they can be judged to be unfair in absolute terms if they are not sufficient for a sweatshop worker to have a ‘decent’ standard of living (Vaughan-Whitehead, 2014).

Moreover, sweatshop critics argue that in many developing countries freedom of choice is constrained. This is because workers do not have access to the basic protections (such as freedom of association) required to address power imbalances (Arnold and Bowie, 2003, Rasiah, 2012, International Trade Union Confederation, 2015) and because of the pervasive nature of poverty (Kates, 2015). From this perspective, those multinational companies employing workers at sweatshop wages and in sweatshop working conditions are exploiting historic and structural injustices (Miller, 2003, Preiss, 2014).

The second premise of sweatshop advocacy is that sweatshops are a natural ‘stage’ of economic development. In this view, countries use a surplus of low cost labour as a competitive advantage to generate jobs in the short run and upgrade these jobs in the long run (Hall and Leeson, 2007, Powell and Zwolinski, 2012). Moreover, it is argued that any measure that improves working conditions or increases wages will hamper the ability of sweatshops to play
this role and therefore reduce employment opportunities in developing countries (Stern and Terrell, 2003, Powell and Zwolinski, 2012, Sollars and Englander, In Press). This point is highly contested and is the area of the most substantial disagreement in the latest entries into the sweatshop debate. Sub-section 2.4.2. reviews these issues further.

**2.4.2 The Economic Debate on Sweatshops**

Coakley and Kates (2013) (sweatshop critics) summarise the current position of the economic debate on sweatshops in a response to prominent sweatshop advocates Powell and Zwolinski (2012),

“Now, the certain and primary consequence of increasing sweatshop worker wages is, of course, that sweatshop workers will have more income. There is a range of potential secondary consequences too. First, depending on both efficiency effects and its share of the total cost, the price of the goods that these workers produce might thereby increase. Second, profits for sweatshop owners might decrease. Third, given that sweatshop workers spend their additional income on local goods and services, the employment of developing world non-sweatshop workers might increase as a result. Fourth...if the price of the produced goods increases, and if consumers reduce consumption accordingly, then employment in developing world sweatshops might decrease as well.” (Coakley and Kates, 2013, p. 554)

They conclude that,

“Overall, then, increasing the minimum wage paid to workers has a number of consequences, both good and bad... A basic welfare analysis of [any proposal to improve sweatshop conditions] must, therefore, estimate the magnitude of each one
of these consequences and determine whether the gains...are expected to outweigh the losses” (Coakley and Kates, 2013, p. 555)

Among both sweatshop critics and advocates, however, there has been a striking lack of analysis of this type.

This can partly be attributed to the lack of a suitably comprehensive evidence base, a fact tacitly acknowledged by both sides of the debate. For example, there is relatively little evidence for or against the existence of an ‘employment multiplier’ associated with increased wages for sweatshop workers. This mechanism is raised by Coakley and Kates (2013) who argue that it has been ignored by sweatshop critics. Sollars and Englander (In Press) largely confirm that this is the case writing that,

“we are not aware of any economic literature which estimates actual aggregate changes in consumer spending in developing countries subsequent to an increase in the minimum wage”

Instead, Sollars and Englander (In Press) refer to an analysis examining the GDP multiplier associated with minimum wage increases in the USA (Aaronson and French, 2013). This analysis finds that minimum wage increases boost aggregate household spending in the short run. Similarly, Hall and Cooper (2012) estimate net job increases associated with minimum wage increases in the USA. More relevant to developing countries, Magruder (2013) provides both theoretical and econometric evidence to show that employment in Indonesia increased following implementation of minimum wage. It is, however, true that the evidence on employment multipliers is limited and merits further investigation.

Debate over the employment effects of increasing sweatshop wages also provides other examples of the restricted and partial nature of the economic evidence base. Sweatshop
advocates often base their critiques of increases in sweatshop wages on econometric studies that examine the effects of minimum wage increases. For example, Sollars and Englander (In Press) argue that active intervention in the conditions of sweatshop workers will result in ‘economic harm’ on the basis of a review of econometric studies that find minimum wage increases reduce employment. However, such arguments are problematic on two fronts. First, econometric evidence on the minimum wage disemployment effects is highly disputed and contradictory. Sollars and Englander (In Press) base their review on Neumark and Wascher (2007) who argue that the ‘best’ econometric evidence supports the hypothesis that increasing wages reduces employment. However, this finding is explicitly contradicted by Schmitt (2015) who concludes that the usual finding is that minimum wage increases have no (or no substantial) effect on employment.

Secondly, while reviews of minimum wage studies are an appropriate way to analyse the case of mandatory minimum wages, they are an inappropriate model for directly assessing the softer initiatives often advocated by sweatshop critics (what Arnold and Hartman (2005) refer to as ‘positive deviancy’ initiatives). For example, Miller and Williams (2009) outline five alternative ways a living wage might be implemented. Only one of these is based on statutory minimum wage increases. The others use softer forms of self-regulation based on the fact that clothing brands and retailers have substantial influence in the supply chain and as a result,

“those brands and retailers with living wage clauses in their codes of conduct could simply insist that a pre-defined wage rate consonant with a living wage be paid by the supplier and this would be audited accordingly” (Miller and Williams, 2009, p. 108).
In a similar vein, Miller and Williams suggest that a Fairtrade type model could be used, passing additional living wage costs through to consumers. Other academics and practitioners have called for similarly ‘voluntary’ approaches, aimed at utilising consumer power, codes of conduct and the influence of clothing retailers over their suppliers (Pollin et al., 2004, Prasad et al., 2004, ETI, 2015). An example of this kind of initiative from practice, is Nudie Jeans, who negotiated with their suppliers to set up a system of bonuses that would raise the wages of Indian workers producing goods for Nudie Jeans, to living wage standards (Egels-Zandén, 2015). Nudie Jeans are a small business, but similar commitments have been made by multi-national retailers (for example, New Look, 2011, M&S, 2015). Minimum wage programs are an inappropriate model for assessing these softer initiatives because where firms impose their own initiatives this implies a continuing commitment to producing in a given region even after the wage increase. This means that the risk of retailers simply sourcing from regions with lower wages is dramatically reduced.

Further illustration of the partial nature of the economic evidence base, can be seen in the work that examines the effect of wage increases on prices and subsequent effects on consumption. Several studies estimate that paying sweatshop workers in apparel supply chains a living wage would result in only a small price increase (typically 2-7%) for consumers (Birnbaum, 2000, Pollin et al., 2004, WRC, 2005, Miller and Williams, 2009, Fairwear Foundation, 2012). However, they all follow very similar methodologies and therefore share the same limitations. Specifically, they all consider the supply chains of one or two individual garments (mainly t-shirts), estimate wage increases for workers in only one country in each supply chain, and do not systematically examine potential responses to the wage increases.

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7 The extent to which such commitments have been implemented is disputed (Labour Behind the Label, 2015, McMullen, and Majumder, 2016).
They therefore have limited generalisability to a broader range of clothing supply chains and can only make limited comments on likely consumption or employment consequences.

Similar to the lack of systemic consideration of consumer responses to price increases, there is little systematic research into different potential firm responses to wage increases, or their knock-through effects on employment. Minimum wage work focused on the USA suggests that firms have multiple options (‘channels of adjustment’) available to them when faced with cost increases. This work suggests that firms might pass increased prices to consumers, reduce other costs, achieve efficiency/productivity gains or accept reduced profits (Schmitt, 2015, Hirsch et al., 2015). For example, drawing on efficiency wage theory (see, for example, Akerlof and Yellen, 1986) the channels of adjustment framework suggests that firms can partially offset the costs of increased wage bills through labour productivity gains. Efficiency wage theory says that for a variety of reasons (which vary according to different forms of the theory), employees may become more productive when paid higher wages. This then allows firms to produce and sell more goods with the same workforce, making them more competitive. This idea has substantial traction in the living wage literature, where it is often proposed as a way for firms to benefit from living wages (e.g. Arnold and Hartman, 2005).

However, it is worth finishing this section with an observation from a sustainability perspective. Both sweatshop critics and advocates operate within economic frameworks that pre-suppose future economic and consumption growth. Sweatshop advocates see sweatshops as mechanisms to further economic growth, principally by inspiring affluent consumers to consume more (Hall and Leeson, 2007, Powell and Zwolinski, 2012). On the other hand, many of the arguments of sweatshop critics also make problematic assumptions. For example, arguments drawn from efficiency wage theory rely on continuing growth in consumption. Increased labour productivity is a good thing for workers only if can increase their output of
goods, or if consumers will purchase the same amount if not more goods in response to supply chain living wage payments (Pollin et al., 2004, Arnold and Hartman, 2005). The sweatshop advocate approach is untenable from a strong sustainability point of view which rejects the notion of infinite economic growth. However, the sweatshop critic approach raises its own questions for sustainability practitioners, something that we will explore further in this thesis.

2.5 The Impact of Globalisation and Fast Fashion on the Environmental and Social Impacts of Clothing Consumption

In reshaping the geography and structure of the clothing supply chain, globalisation and the rise of fast fashion are likely to have affected both the environmental and social impacts of the production of clothing for Western European markets. However, the exact nature of these impacts is ill defined. Here we summarise the current state of knowledge on the relationship between globalisation, fast fashion and sustainability.

2.5.1 Globalisation, Fast Fashion and the Environment.

The geographical shifts in manufacturing are likely to have caused shifts in the location of pollution and resource use. High level studies of global trade typically find that international trade has shifted pollution into developing countries that have used manufacturing and heavy industry to fuel their growth (Peters et al., 2011b, Kanemoto et al., 2014, Tukker et al., 2014). Previous studies suggest that this could be the case for textiles and clothing consumption, reporting China to be the biggest source of carbon in the textiles and clothing value chains supplying consumers in a small sample of Western European countries (Andrew and Peters, 2013, Carbon Trust, 2011). However, these studies (and many of those considered in section 2.3) examine a single point in time and so it is unclear if this represents a displacement or an increase in global emissions.
It is also unclear how the environmental impact of clothing consumption has changed with the rise of fast fashion. Although it is widely accepted in the literature that fast fashion has caused “phenomenal environmental burden” (Pal, 2014, p. 228) there are very few empirical studies to confirm this. Allwood et al. (2006) are a rare example. Their Life Cycle Analysis (LCA) suggests that extending the life of a viscose blouse such that demand for viscose blouses in the UK is reduced by 20% will reduce the associated climate and waste impacts by around 15% each. However, they note that this will vary by product type. We suggest it will also vary with the region of focus and are unaware of studies looking at other countries or broader product groupings. Similarly, it is worth noting that Allwood et al. (2006) assume no changes in production technology while a small number of researchers claim the efficiency gains of fast fashion may offset the impact of demand increases (Choi, 2014).

2.5.2 Globalisation, Fast Fashion and Society

Because of the contested nature of social impacts in the clothing supply chain, it is hard to know how they have been affected by fast fashion and globalisation. The gradual phase out of quotas restricting world trade in textiles and clothing goods combined with the more general globalisation process allowed for substantial movement of low skill, labour intensive parts of the clothing supply chains into developing countries (Dunford, 2004, OECD, 2004b, Los et al., 2014). On the one hand this has been associated with job creation in developing countries, but, as discussed, many of these jobs have very low wage rates and are in countries with poor rights for workers and unsafe working conditions (Allwood et al., 2006, International Trade Union Confederation, 2014). The partial nature of the evidence in the sweatshop debate means that it is unclear whether this process has been associated with a net benefit or net loss.

The picture is further complicated by the fact that the phasing out of the MFA combined with the rise of fast fashion has likely led to concentrations of low skill labour processes in the
larger Asian countries (notably China and India) at the expense of smaller nations (Moazzem and Sehrin, 2016). For those countries that benefitted, the consolidation of the clothing supply chain has been associated with ‘upgrading’: the work is more skilled and commands higher wages, while the supply chain is less fragmented suggesting better working conditions (fragmented supply chains are associated with difficulties in regulating working conditions) (Pickles, 2012). Consequently, we would expect wages and working conditions in these countries to have improved, but only at the cost of jobs being lost and/or wages falling as production moved out of other countries (principally the Sub-Saharan African countries). Moreover, it is unclear the extent to which this will have occurred, particularly given that in general returns to capital have increased faster than returns to labour⁸ (Timmer et al., 2014).

Finally, fast fashion (due to its focus on low prices) has led affluent country retailers to look for ways to reduce their costs. As well as leading to consolidation and efficiency gains, this has incentivised retailers to pass additional risk and pressure to their developing country manufacturers (Taplin, 2006, Morris and Barnes, 2008, Taplin, 2014). This is likely to have contributed to a ‘race to the bottom’ in developing countries that resulted in a squeezing of both labour and capital. In Bangladesh, for example, politicians feared that enforcing building safety regulations and working conditions would drive manufacturing sectors to other parts of Asia. Inadequate enforcement of labour laws and factory standards eventually lead to the Rana Plaza disaster (Taplin, 2014).

2.6 Lessons for the Thesis

From the above discussion we can draw several points that will guide the rest of the thesis. First, there are several knowledge gaps related to the current state of sustainability in

⁸ Returns to capital is the share of income derived from production that accrues to capital, while returns to labour is the share of income derived from production that accrues to workers.
the Western European clothing supply chain. It is worth noting that we did not find a single study explicitly focused on Western European clothing supply chains. Similarly, most work on sustainability aspects of the clothing supply chain are focused on short periods of time. Combined with conflicting evidence and narratives of how fast fashion and globalisation have affected environmental and social impacts, there is a strong rationale for an empirical investigation of how the sustainability of the clothing supply chains has changed in recent years.

A subset of the recent work on global fragmentation reviewed above covers an appropriate timeframe (1995-2009) and provides a framework for analysing sustainability impacts of the Western European clothing supply chain. Specifically, several of the studies investigating fragmentation and changing structures of global value chains reviewed above were based on the World Input-Output Database (WIOD) (e.g. Timmer et al., 2013b, Los et al., 2014). WIOD provides empirical data on the global economy and the environmental and social impacts of trade between 1995 and 2009 (Erumban et al., 2012, Dietzenbacher et al., 2013), a period of substantial change in clothing supply chains. Therefore, in Chapter 3, we apply an input-output model based on WIOD to assess how the socio-economic and environmental impacts of Western European textiles and clothing consumption have changed.

Second, clothing is a promising target for using labour cost increases to raise consumer prices and rather than a more usual sufficiency strategy (buy less, spend the saved money on alternative goods). Clothing demand is relatively price inelastic, meaning that as well as reducing clothing consumption itself clothing price increases will likely reduce consumption in other, higher environmental impact, consumption categories. Consequently, Chapter 6 uses a modelling approach that emphasises both cross-price (or ‘spillover’) and own-price effects.
Third, there is intense debate around whether clothing supply chains (and global use of sweatshops more generally) make a positive or negative social impact. This is limited by the lack of an appropriate economic evidence base. The empirical analysis in Chapter 3 further investigates this, looking at the extent to which economic ‘upgrading’ has occurred in the Western European textiles and clothing supply chain. Chapters 4 and 5 develop and apply novel and more comprehensive approaches than are usual to estimate the additional cost of living wages. Similarly, Chapters 6 and 7 extend existing modelling techniques to explore alternative economic scenarios and mechanisms surrounding payment of a living wage. This allows us to extend the economic evidence base.

Finally, debates around social impacts and environmental sustainability rarely overlap, despite clear linkages. For example, employment multipliers discussed in the sweatshop literature have clear parallels with rebound effects in the environmental literature. Additionally, both sweatshop advocates and critics make assumptions about consumer behaviour and economic growth that we believe are fundamentally unsustainable. Therefore, Chapter 3, Chapter 6 and Chapter 7 integrate both environmental and social elements into their analysis and examine these issues from a more holistic sustainability perspective. In doing so we are able to highlight trade-offs, opportunities and challenges.
Chapter 3   How Sustainable is Western European Textiles and Clothing Consumption? Attributional Footprint Analysis

Parts of this chapter have previously been published as Mair, S., A. Druckman., and T. Jackson (2016), Global Inequities and Emissions in Western European Textiles and Clothing Consumption, Journal of Cleaner Production, 132, 57-69, doi:10.1016/j.jclepro.2015.08.082

3.1 Introduction

In this chapter we empirically assess socio-economic and environmental sustainability aspects of Western European textiles and clothing consumption between 1995 and 2009. As described in Chapter 2, this period has seen substantial changes in the structure of clothing supply chains driven both by globalisation and the rise of fast fashion. Therefore, in this analysis we address some of the knowledge gaps around how changes in the global production structures have changed the sustainability implications of Western European clothing consumption.

Additionally, in the existing literature, environmental and socio-economic impacts along textiles and clothing supply chains are largely considered separately (e.g. Chen and Burns, 2006, Claudio, 2007, Sørensen, 2008, Carbon Trust, 2011, Tokatli et al., 2011) or analysed over short periods of time (Allwood et al., 2006, Andrew and Peters, 2013). Therefore, in this chapter we extend the existing literature by adopting a multi-factor approach to examine changes over a 15 year period. Moreover, we investigate how changes in Western
European demand for textiles and clothing goods have affected each indicator at three different scales: the sum of impacts at every stage of production (production footprints) and the impacts that occur in both specific geographical regions and specific economic sectors. By investigating multiple sustainability factors at multiple scales we are able identify both winners and losers, to identify tensions between different sustainability goals, and to suggest a win-win scenario meriting further investigation. Furthermore, looking over a fifteen-year time period provides a richer understanding of mechanisms driving changes in the textiles and clothing value chain sustainability than is possible from single point in time studies.

The next section presents our model, sections 3.3-3.5 present the results from the different levels of our analysis, and section 3.6 discusses these results and interprets them in a sustainability context. Finally, section 3.7 summarises the results and arguments presented here.

### 3.2 Methods and Data

#### 3.2.1 Sub-Systems Input-Output Analysis

The core of our analysis is a global multi-regional input-output model (GMRIIO). GMRIIOs represent the world economy through explicit modelling of the international and domestic trade networks of multiple countries (Tukker and Dietzenbacher, 2013). A standard extended\(^9\) GMRIIO can be written,

\[ E = \tilde{u} L Y \]  

\(^9\) A purely economic GMRIIO defines a relationship between changes in final demand and economic output. An 'extended' GMRIIO is so called because it defines additional relationships between impact factors (pollution or jobs, for example) and economic output thereby allowing analysis of a greater range of problems (Miller and Blair 2009).
Defining the number of countries as \( c \) and the total number of sectors across all countries as \( s \), \( \mathbf{E} \) is the \( s \times c \) matrix\(^{10}\) of impact (either environmental, e.g. carbon emissions; social, e.g. hours worked; or economic, e.g. profit generated). \( \mathbf{L} \) is the \( s \times s \) leontief inverse describing the interactions between sectors both within and between countries and \( \mathbf{u} \) is an \( s \times s \) diagonalised vector of direct impact intensities for production activity in each sector. \( \mathbf{Y} \) is the \( s \times c \) matrix describing final demand in each country from each sector. We use the World Input-Output database (WIOD), which has 40 countries and one Rest of the World (RoW) ‘country’, each with 35 sectors, so \( c = 41 \) and \( s = 1435 \) (for more detail see section 3.2.3). For ease of exposition we write \( \mathbf{u} \mathbf{L} = \mathbf{Q} \), so,

\[
\mathbf{E} = \mathbf{QY}
\]

Because input-output analysis and GMRIOs are established methods for a wide range of both environmental and socio-economic footprint analyses (Bradley et al., 2013, Moran et al., 2013, Schaltegger et al., 2014, Simas et al., 2014b) the remainder of this section focuses on the adaptation of the input-output model to improve robust estimates of sectoral production footprints. Interested readers are directed to Appendix A for a derivation and description of the basic input-output model.

The stochastic nature of uncertainty in input-output data (Acquaye et al., 2011) means that GMRIO model results are most uncertain at the individual country-sector level (e.g. Turkish Agriculture) and aggregation of results reduces these uncertainties (Lenzen et al., 2010, Wilting, 2012). Therefore, we do not report estimates of individual sector level impacts for specific countries. Rather we report results at a more aggregate level (e.g. global Agriculture or all sectors in BRIC). But aggregating in this way before running an input-output model

\(^{10}\) Throughout this thesis matrices are written as bold uppercase characters, vectors are written as bold lower case characters and scalars are written as italicised lower case characters.
represents a loss of information which increases uncertainty in results relative to using the original data (Andrew et al., 2009, Lenzen, 2011). Therefore, we apply a sub-systems (see, for example, Piaggio, 2015, Zhang and Chen, 2008, Schnabl, 1995) framing and use partitioned matrices to achieve a regional breakdown of impacts without aggregating before running the model. After obtaining a set of results using the original data we then aggregate to the desired level. This approach of using all available information then aggregating the detailed results should provide the most robust analysis possible, given our research focus and dataset.

The first step is to separate WIOD’s 1435 sectors into our sector-category system. In our analysis we use five sector partitions but for simplicity the following exposition shows only two sector partitions – Textiles and Clothing ($t$), which contains the 41 “Textiles and Textile Products” sectors from the WIOD table (which in turn corresponds to NACE$^{11}$ 17, manufacture of textiles and textile products and 18, manufacture of wearing apparel), and All Other Sectors ($o$) which contains the remaining 1394 WIOD sectors. Partitioning equation (3-2) in this way gives,

\[
\begin{bmatrix}
E^t \\
E^o
\end{bmatrix} = \begin{bmatrix}
Q^{tt} & Q^{to} \\
Q^{ot} & Q^{oo}
\end{bmatrix}
\begin{bmatrix}
Y^t \\
Y^o
\end{bmatrix}
\]

(3-3)

In our empirical application the 1394 “other” sectors are further partitioned into Agriculture, Energy and Resources, Other Manufactures, and Services according to the classification system in Appendix B.

We now introduce regional partitions to equation (3-3) so that we have Textiles and Clothing and All Other Sectors by region. We use 5 regions, Western Europe (1), BRIC (2), Other Europe (3), Other Affluent Countries (4), and Other Less Affluent Countries (5), each

---

$^{11}$ Statistical classification of economic activities in the European Community
of which is a grouping of countries (defined in Table 1-1, Chapter 1). Accordingly, equation (3-3) becomes,

\[
\begin{bmatrix}
E_{1,1}^t & \cdots & E_{1,5}^t \\
E_{1,1}^o & \cdots & E_{1,5}^o \\
\vdots & \ddots & \vdots \\
E_{5,1}^t & \cdots & E_{5,5}^t \\
E_{5,1}^o & \cdots & E_{5,5}^o
\end{bmatrix}
= \begin{bmatrix}
Q_{1,1}^t & Q_{1,1}^o & \cdots & Q_{1,5}^t & Q_{1,5}^o \\
Q_{1,1}^o & Q_{1,1}^o & \cdots & Q_{1,5}^o & Q_{1,5}^o \\
\vdots & \ddots & \vdots & \vdots & \vdots \\
Q_{5,1}^t & Q_{5,1}^o & \cdots & Q_{5,5}^t & Q_{5,5}^o \\
Q_{5,1}^o & Q_{5,1}^o & \cdots & Q_{5,5}^o & Q_{5,5}^o
\end{bmatrix}
\begin{bmatrix}
Y_{1,1}^t & \cdots & Y_{1,5}^t \\
Y_{1,1}^o & \cdots & Y_{1,5}^o \\
\vdots & \ddots & \vdots \\
Y_{5,1}^t & \cdots & Y_{5,5}^t \\
Y_{5,1}^o & \cdots & Y_{5,5}^o
\end{bmatrix}
\tag{3-4}
\]

In equation (3-4) the first subscript is the region of production and the second is the region of consumption. So, \(Y_{5,1}^t\) is consumption in Western Europe (subscript \(1\)) of textile and clothing goods (superscript \(t\)) produced in Other Less Affluent Countries (subscript \(5\)). Similarly, \(E_{5,1}^o\) is the impact produced in the non-textile sectors (superscript \(o\)) located in Other Less Affluent Countries (subscript \(5\)) that was driven by consumption in Western Europe (subscript \(1\)).

To isolate the textile and clothing value chains serving Western Europe, we set the elements of all the consumption partitions other than those for Western European textiles and clothing consumption to zero. This leaves a modified \(Y\) matrix containing the WIOD final demand values for textiles and clothing in Western European countries and zeros everywhere else:

\[
Y = \begin{bmatrix}
Y_{1,1}^t & 0 & \cdots & 0 \\
0 & 0 & \cdots & 0 \\
Y_{2,1}^t & 0 & \cdots & 0 \\
0 & 0 & \cdots & 0 \\
Y_{3,1}^t & 0 & \cdots & 0 \\
0 & 0 & \cdots & 0 \\
Y_{4,1}^t & 0 & \cdots & 0 \\
0 & 0 & \cdots & 0 \\
Y_{5,1}^t & 0 & \cdots & 0 \\
0 & 0 & \cdots & 0
\end{bmatrix}
\tag{3-5}
\]
Equation (3-5) can be simplified by removing the columns that sum to zero,

\[ Y = \begin{bmatrix} Y_{1,1}^t \\ 0 \\ Y_{2,1}^t \\ 0 \\ Y_{3,1}^t \\ 0 \\ Y_{4,1}^t \\ 0 \\ Y_{5,1}^t \\ 0 \end{bmatrix} \]  

(3-6)

We can then rewrite equation (3-4) with our modified Y to estimate the impacts that occurred in meeting that particular subset of global final demand:

\[
\begin{bmatrix} E_{1,1}^t \\ E_{1,1}^o \\ \vdots \\ E_{5,1}^t \\ E_{5,1}^o \end{bmatrix} = \begin{bmatrix} Q_{1,1}^{tt} & Q_{1,1}^{to} & \cdots & Q_{1,5}^{tt} & Q_{1,5}^{to} \\ Q_{1,1}^{ot} & Q_{1,1}^{oo} & \cdots & Q_{1,5}^{ot} & Q_{1,5}^{oo} \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ Q_{5,1}^{tt} & Q_{5,1}^{to} & \cdots & Q_{5,5}^{tt} & Q_{5,5}^{to} \\ Q_{5,1}^{ot} & Q_{5,1}^{oo} & \cdots & Q_{5,5}^{ot} & Q_{5,5}^{oo} \end{bmatrix} \begin{bmatrix} Y_{1,1}^t \\ \vdots \\ Y_{5,1}^t \end{bmatrix} \]  

(3-7)

We apply equation (3-7) for each year, 1995-2009, and each indicator (see section 3.2.2). Finally, again for each year and indicator, we apply the following aggregations:

1. The **production footprint**: the sum of the impact vector,
2. **Regional contributions to the production footprint**: the sum of each regional partition of the impact vector,

\[
\begin{bmatrix}
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1
\end{bmatrix}
\]  

(3-8)

3. **Sectoral contributions to the production footprint**: the sum of each sector partition in the impact vector. Although in our application we use five sector partitions, the preceding equations only showed two sector partitions. In the case of two sector partitions the aggregation is,

\[
\begin{bmatrix}
0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0
\end{bmatrix}
\]  

(3-9)
4. **Sectoral contributions to the regional contributions to the production footprint**: the sum of one sector partition in each regional partition. This represents the least robust of our results (as it is the least aggregated), and as a result we do not present it for every indicator or every sector, but only where it provides additional substantive insights and where those insights can be readily explained by the existing literature. The aggregation for the Textiles and Clothing sector contributions to regional contributions to the production footprint given 2 sector partitions is,
3.2.2 Indicators

To estimate socio-economic performance we follow Timmer et al. (2013a) in splitting gross value added into two parts, labour compensation, and returns to capital (i.e. returns to capital is gross value added minus labour compensation). The returns to capital production footprint represents returns to capital generated at every stage of the production process in producing the final good. It is used here as a proxy for (pre-tax) profit\(^\text{12}\). Likewise, the labour compensation production footprint represents the compensation of labour in producing the final good and can be considered a proxy for wages\(^\text{13}\). Linked to the labour compensation production footprint is the labour hours production footprint – the sum of labour hours worked in production of the final good. The labour hours production footprint complements the labour compensation production footprint by providing a physical indication of labour use. By dividing the labour compensation production footprint by the labour hours production footprint we estimate labour compensation rates.

The carbon production footprint – the sum of the carbon dioxide emitted in production of the final good – is our environmental indicator. We do not assess non-carbon greenhouse gases because WIOD (see section 3.2.3) represents Agriculture as one sector and Agricultural subsectors are known to vary substantially in their non-carbon greenhouse gas intensities (Tukker and Dietzenbacher, 2013). It is also important to note that climate is only one environmental issue, however, carbon data is substantially more reliable than other environmental metrics and received special attention when constructing WIOD (Genty et al., 2012). Finally, we noted in Chapter 2.3.1 that the use phase (washing etc.) can be a substantial

\(^{12}\) We use the term returns to capital rather than profit for clarity: in Chapter 7 we shift focus and examine firms, where profits are defined somewhat differently.

\(^{13}\) We refer to labour compensation rather than wages for clarity in future chapters where we will distinguish between the two concepts.
contributor to total environmental impact (Choudhury, 2014), but this phase is not included in here.

3.2.3 Data

All data are taken from the World Input-Output Database (WIOD). For a full description readers are directed to the relevant documentation (Erumban et al., 2012, Genty et al., 2012, Timmer, 2012, Dietzenbacher et al., 2013). In brief, WIOD provides harmonised multi-regional input-output tables covering 41 regions (40 countries and one rest of the world region) and corresponding socio-economic and environmental satellite accounts. We use WIOD rather than an alternative database (Lenzen et al., 2013, Tukker et al., 2013, Peters et al., 2011a, Giljum et al., 2008) for several reasons. First, WIOD provides detailed socio-economic statistics (including sector specific price indices and labour hours by sector) for the full 1995-2009 period. Second, it is built from publically available, official data, meaning that tracing the construction process of WIOD is easier than for other datasets, allowing unusual results to be checked more readily. Additionally, WIOD improves upon a major source of uncertainty in multi-region input-output modelling; the import proportionality assumption. Applied to overcome a lack of detailed import data, the import proportionality assumption assumes that intermediate and final consumption share the same proportion of imports. WIOD improves upon this by differentiating between intermediate and final imports using detailed Comtrade data (Dietzenbacher et al., 2013). Finally, because WIOD is freely available our analysis is open to the broadest possible range of practitioners and researchers.

A drawback of WIOD is that it does not provide labour hours data or component breakdowns of gross value added for the Rest of the World (RoW) region. Therefore, the

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14 Eora (Lenzen et al 2013) is also freely available to academic (university or grant-funded) work at degree-granting institutions, though not for commercial work. Similarly, since work on this thesis began, EXIOBASE has been made freely available for the years 2000 and 2007 (Tukker et al., 2013).
returns to capital, labour compensation and labour hours production footprints do not include RoW. Appendix C compares the gross value added production footprint including RoW with the gross value added production footprint excluding RoW. Results of this ‘sense check’ suggest that although our labour compensation and returns to capital production footprints are underestimated, their main trends are relatively unaffected. That said, we would expect production in the RoW region (which includes, for example, Cambodia and Bangladesh) to be labour rather than capital intensive. Hence we would expect most of the value added in this region to be labour compensation. This implies that not including contributions from RoW had the biggest effect on the labour compensation production footprint. A similar assessment was not possible for the labour hours production footprint, but it is likely that excluding labour intensive low-wage economies of RoW also underestimates the labour hours production footprint.

Additionally, WIOD (like most input-output databases) uses an industrially based classification system at a relatively coarse level of aggregation. Therefore (as noted above) we do not strictly assess the sustainability of the clothing supply chain. Instead we assess the sustainability of the Western European Textiles and Clothing supply chain, which corresponds to NACE 17, manufacture of textiles and textile products and 18, manufacture of wearing apparel. It is possible to either disaggregate WIOD’s classification system to isolate just clothing supply chains, or to use a concordance matrix to convert between the WIOD (industrial) classification system and an alternative classification system that has a clothing category. In Chapters 5-7 we do the latter. However, this adds an additional level of complexity that is not necessary for the preliminary analysis being carried out in this chapter.

The gross value added and labour compensation data in WIOD’s socio-economic accounts are provided in nominal national currencies. To examine changes overtime we use
the sector level price indices for value added from WIOD to deflate labour compensation and returns to capital data to 1995 prices. In order to compare regions we convert national currencies to US dollars. Conversion of multiple national currencies to a common currency can be done with either Purchasing Power Parity (PPP) conversion factors or Market Exchange Rates (MER). MERs reflect price differences in internationally traded goods, while PPP conversion factors reflect differences in both internationally traded and domestic goods (such as haircuts). Consequently, PPPs attempt to control for differences in the purchasing power of different national currencies, while MERs do not. This means that MERs underestimate the local value of returns to capital and labour compensation in developing countries (but typically have little effect on developed countries) (Nordhaus, 2007, Ortiz and Cummins, 2011).

However, estimating detailed PPP time series is a complex process, with substantial conceptual difficulties, while MER time series are much easier to estimate and therefore more widely available (Callen, 2007, Deaton and Heston, 2010, Ortiz and Cummins, 2011). Therefore, we use MER to convert wages and profits in national currencies to US dollars, acknowledging that this increases the inequalities that we find relative to using PPP. Nevertheless, our results are useful for identifying potential hotspots, trends, and areas for further detailed investigation. As a further mitigating measure, we apply a MER to PPP adjustment factor in some of our detailed regional investigation to investigate the difference that PPP might make to our results. Specifically, MER is thought to underestimate the true value of income in developing countries by a factor of around 3 (Nordhaus, 2007, Callen, 2007) and we multiply our results (obtained using MER) for BRIC by a PPP adjustment factor of 3 to see if observed inequalities still hold.
3.3 Trends in Production Footprints

Figure 3-1 shows trends in Western European consumption deflated to 1995 USD alongside the Western European textiles and clothing production footprints for carbon, labour hours, labour compensation, and returns to capital. They are the sum of the impacts of every stage of production. Sections 3.4 and 3.5 show regional and sectoral contributions to the Western European textiles and clothing production footprints respectively.

![Figure 3-1](image)

**Figure 3-1** Trends in the Western European textile and clothing carbon, labour hours, labour compensation (LC) and returns to capital (RtC) production footprints, labour compensation rates (LC rates) and Western European textile and clothing consumption. LC is the sum of the compensation (gross wages plus social security payments, plus payment in kind) paid to all workers in the Western European clothing supply chain. LC Rate is LC divided by labour hours. Dashed black line is the line of no change against 1995, the dark grey block indicates recession.”

In line with levels of real Western European textiles and clothing consumption, all production footprints fell after 1995. However, while the labour hours production footprint and carbon production footprint rose again after 1997 the labour compensation and returns to capital production footprints continued to fall until 2001\(^\text{15}\). After 2002, there is a pronounced

\(^{15}\) Recall that labour compensation and returns to capital production footprints do not include the RoW region (as detailed in section 3.2). However, the aggregate gross value added production footprint (which does include RoW data) does not show substantial deviation from the wage and profit production footprint trends (see appendix C).
upward trend in all indicators driven by the corresponding increase in levels of consumption. The returns to capital and labour compensation production footprints continue to follow the consumption trend closely, rising with consumption expenditure but never quite recovering to 1995 levels.

All production footprints decrease again at the end of the time series. The 2008 recession caused consumption to fall again, explaining some of the fall in the production footprints. However, falls in the carbon and labour hours production footprints prior to 2008 cannot be explained by recession or falling consumption. Rather, pre-2008 reductions in the labour hours production footprint and carbon production footprint may indicate production processes that have become more carbon and labour efficient with respect to consumption. This is what we would expect – capitalist economies are good at efficiency. However, two things should be noted here. First, between 2002 and 2007 carbon emissions rose slightly as efficiency gains were outstripped by the rapid growth in consumption. Similarly, two of the biggest falls in the carbon production footprint occurred between 1995-1997 and 2008-2009, times when levels of consumption also fell. This is in line with other work showing that rising consumption is an important driver of emission profiles (Peters et al., 2007, Brizga et al., 2014). Second, whilst improved efficiency seems a possible explanation for the decoupling of the carbon production footprint and levels of consumption after 2007 this is less plausible for the sharp reduction in the labour hours production footprint. Rather, we hypothesise that at least some of this sharp fall is indicative of the rising importance of countries for which we do not have labour hours data.

Figure 3-1 also shows that the labour compensation rate (the cost of labour per hour) in producing textiles and clothing goods for Western European consumers fell between 1996 and 2006 and had not quite recovered by 2009. This is likely the result of increased use of labour
in lower wage nations and the reduced use of labour in more economically developed nations (Dunford, 2004), something considered further in section 3.4. We should, however, be aware that the use of MERs is likely to overstate the fall in wage rate considered from the perspective of workers. That is lower wages have increased purchasing power in developing countries, and so (from a workers perspective) the effects of any fall are lessened.

Finally, Figure 3-1 shows that the returns to capital production footprint recovered more rapidly and to a greater extent than the labour compensation production footprint, particularly at the end of the time series. This potentially indicates profit seeking behaviour with low wage labour subsidising profit margins. Although this is consistent with the idea that manufacturing sectors in developing countries use cheap labour to maintain higher profit margins while out-competing their developed country counterparts on cost, this has a relatively high level of uncertainty due to the exclusion of RoW data for these production footprints.

Figure 3-2 expands on the relationship between the labour compensation and returns to capital production footprints by showing their absolute values rather than their normalised trends. In Figure 3-2 we see that although the labour compensation production footprint fell at a greater rate than the returns to capital production footprint, it was consistently a bigger cost component of cost. This raises questions about the ability of firms to absorb labour cost
increases, and supports the argument that as labour costs increase in current manufacturing hubs manufacturing will move elsewhere.

Figure 3-2 Absolute trends in the Western European textile and clothing labour compensation and returns to capital production footprints.

3.4 Regional Contributions to Production Footprints

Figure 3-3 shows the regional breakdown of the Western European textiles and clothing consumption production footprints for labour hours; labour compensation; returns to capital; and carbon. That is, each panel in Figure 3-3 shows how much of each production footprint occurred in each region. Western Europe shows declining contributions to all these production footprints. This is in line with reported shifts away from developed countries in textiles and clothing and other manufacturing production (Dunford, 2004, Dicken, 2011, Los et al., 2014) and confirms that the production of textiles and clothing goods for Western Europe increasingly takes place outside of Western Europe.
Figure 3-3 Regional contributions to the labour hours (panel A), labour compensation (panel B), returns to capital (panel C), and carbon (panel D) production footprints. Labour compensation refers to the total compensation paid to all workers in the Western European clothing supply chain.
3.4.1 Labour Hours and Labour Compensation

The regional breakdown of the labour hours production footprint (Figure 3-3 Panel A) reveals that BRIC has supplied a majority of labour through the entire period, confirming expectations (Kaplinsky and Morris, 2006). Likewise, we see rapid growth in BRIC labour use after 2001 which is likely due to the 2nd stage phasing out of quotas on world trade in textiles and clothing (Spinanger, 1999, Adhikari and Yamamoto, 2007). This is potentially problematic as both China and India are known to have poor working conditions and restricted rights for workers (International Trade Union Confederation, 2014, Song, 2014).

In contrast to the labour hours production footprint, the regional breakdown of the labour compensation production footprint (Figure 3-3 Panel B) shows that Western Europe dominated the wages production footprint throughout the time series while, despite being the biggest contributor to the labour hours production footprint, BRIC is still marginal in terms of the wages production footprint. These discrepancies translate into the effective real wage rates shown in Figure 3-4. Figure 3-4 also shows that because the difference between the wage rates is so large, it is unlikely to be substantially effected by use of PPP rather than MER.
The substantial differences between labour compensation rates in Western Europe and BRIC supports the suggestion that Western European production is in the highly skilled, high value portions of the global value chains, such as, design, research and development (Nordås, 2004, Sørensen, 2008). Likewise, it suggests that the jobs created in BRIC by Western European textiles and clothing consumption are in the low skilled, low value portions of the supply chain.

On the other hand, real BRIC labour compensation rates doubled between 1995 (wage rate = 0.31 1995 USD per hour) and 2009 (wage rate = 0.62 1995 USD per hour). This suggests that the material quality of life for BRIC workers has been improved by globalisation in the textiles and clothing supply chains that serve Western Europe. Moreover, Gereffi and Memedovic 2003), argue that countries can ‘upgrade’ by capturing higher value activities. The rise in BRIC wage rates suggests more skilled, higher value work is being undertaken in BRIC. This supports the long standing contention that regions outside Europe, not only have “low
labour input costs to be exploited, but also an increasing availability of highly skilled labour” (Giuli, 1997 P.2) and that firms are beginning to capitalise on this (Tewari, 2006).

Qualifying these results is that WIOD does not have Labour data for the RoW region which is included in the Other Less Affluent Countries region (Table 1-1, Chapter 1). The likely effect of this is that our estimates are conservative indicators for low wage labour use (Appendix C) – others have shown that the supply chain supplying affluent nations tend to rely on high quantities of overseas cheap labour (Alsamawi et al., 2014a).

3.4.2 Returns to Capital

Figure 3-3 Panel C shows that after 2002 BRIC began to generate a much greater share of the returns to capital production footprint, in 2009 almost matching the Western European contribution (and likely surpassing it if a PPP rather than MER measure was used). As with the growing labour compensation rates this suggests BRIC is upgrading. An increase in BRIC contributions to the returns to capital production footprint may also indicate a move toward more capital intensive production stages in the Western European textiles and clothing supply chain. Provided this capital income remains in BRIC and does not subsequently flow abroad, this would be a positive development for BRIC. Nonetheless, it is worth noting that BRIC contributions to the returns to capital production footprint increased substantially faster than its contribution to the labour compensation production footprint. Consequently, the graph may provide further evidence of ‘profit seeking’ behaviour – especially as the contributions to the returns to capital production footprint are much more likely than the contributions to the labour compensation production footprint to leave BRIC through complex ownership and accounting structures.
3.4.3 Carbon

Figure 3-3 Panel D shows that contributions from BRIC and the Other Less Affluent Countries (OLAC) became increasingly important to the Western European textiles and clothing carbon production footprint. This is in line with other studies finding that offshore emissions constitute increasingly bigger portions of the carbon footprints of affluent nations (Wiedmann et al., 2010, Peters et al., 2011b). There also appears to be a link between the Western European textiles and clothing carbon and labour hours production footprints as both follow similar regional patterns, with BRIC contributions to both spiking after 2002. This is about the time of the third stage removal of MFA quotas (Spinanger, 1999) and in line with expectations around the consolidation or regionalisation of clothing supply chains in response to fast fashion (Pickles, 2012). The trend suggests that production is consolidating and that carbon and labour intensive production is relocating to similar geographical locations.

As the contributions to the carbon production footprint from Western Europe, Other Europe and the Other Affluent Countries all declined after 1997, the growth in the overall Western European textiles and clothing carbon production footprint between 1997 and 2000 (Figure 3-1) was the result of the growth in carbon emissions from BRIC and OLAC during this period. Moreover, in Figure 3-1 we see that Western European consumption of textiles and clothing goods fell between 1997 and 2000. Therefore, increases in contributions to the carbon production footprint from BRIC and OLAC between 1997 and 2000 were likely due to the more carbon intensive nature of BRIC and OLAC production systems.

After 2002 BRIC contributions to the carbon production footprint grew rapidly, but there was only moderate growth in the overall carbon production footprint (Figure 3-1). This is because Western European and OLAC contributions to the carbon production footprint begin to decline shortly after 2002, suggesting that a large portion of the growth in BRIC
contributions to the carbon production footprint after 2002 was a displacement of carbon emissions from Western Europe and OLAC. The overall growth in the carbon production footprint between 2002 and 2007 (which is relatively small) can be attributed to the increase in Western European textiles and clothing demand after 2002.

It is also worth noting that this demand grew much more rapidly than the carbon production footprint – implying a decrease in the carbon intensity of BRIC production relative to final demand. On the other hand, until 2007, levels of demand remained below 1995 levels and so the carbon intensity of production in the textiles and clothing value chains serving Western Europe remained higher than in 1995. From this we infer that despite its decreasing trend, the carbon intensity of BRIC production between 2002 and 2007 was still greater than the carbon intensity of Western European production in 1995.

3.5 Results 3: Sectoral Contributions to Production Footprints

Figure 3-5 shows the sectoral contributions to the Western European textiles and clothing production footprints for labour hours; labour compensation; returns to capital and carbon. The Textiles and Clothing sector is the biggest contributor to the labour hours, wages and profit production footprints and the second biggest contributor to the carbon production footprint after the Energy and Resources Sector. In all cases, by 2009, the contributions of the Textiles and Clothing sector had fallen relative to 1995, albeit only slightly in the labour hours production footprint.
Figure 3-5 Sectoral contributions to the Western European Textiles and Clothing labour hours, labour compensation, returns to capital, and carbon production footprints.
3.5.1 Labour Hours and Labour Compensation

The biggest contribution to the labour hours production footprint was the Textiles and Clothing sector (Figure 3-5 Panel A). This can be explained by the highly labour intensive nature of clothing production; because cloth is soft and flexible, mechanising the process has proved difficult in clothing production (though not in textiles production) (OECD, 2004b, Dicken, 2011). The labour compensation production footprint is also dominated by the Textiles and Clothing sector (Figure 3-5 Panel B). Figure 3-6 shows that this is the result of the high wages paid to Textiles and Clothing sector workers in Western Europe. Figure 3-6 should be interpreted with care as it represents the highest level of uncertainty of our analysis. However, it corresponds to expectations in the literature regarding the geographical distribution of work in the Textiles and Clothing sector (design and other skilled activities in affluent nations and low skilled manual labour in developing nations (Nordås, 2004)). Therefore we feel confident in interpreting Figure 3-6 as further evidence of the reliance of Western European Textiles and Clothing retailers and consumers on low wage labour in BRIC.
Figure 3.6 Regional contributions to the Textiles and Clothing sector contributions to the Western European textiles and clothing wages production footprint.

A similar picture emerges for the Agricultural industry. Unlike clothing production, mechanisation of, for example, cotton production is relatively easy and in the USA has greatly reduced labour requirements (Rivoli, 2006). However, the regional breakdown of the labour hours production footprint (Figure 3-4) reveals strong similarities between the overall BRIC labour contribution and the labour hours worked in the Textiles and Clothing and Agricultural sectors (Figure 3-5 Panel A). This suggests that most of the increase in the labour hours was within the Textiles and Clothing and Agricultural Sectors in BRIC countries. This is supported by the fact that China, Brazil, and India were consistently among the top 10 global cotton producers between 1995 and 2009 (FAOSTAT, 2014) and rely on substantial quantities of labour-intensive hand harvesting (Chaudry, 2004).

However, there is one important difference between the Textiles and Clothing and the Agricultural sectors: the latter contributes much less than the former to the labour compensation production footprint, despite similar contributions to the labour hours production footprint. This is probably the result of two factors. First there are very few high value activities in
Agricultural sector, whereas the Textiles and Clothing sector has design and branding focused jobs (EMCC, 2008). Second, in developing countries work in garment factories is seen as attractive partly because it usually pays better than work in agriculture, which is often informal (Rivoli, 2006, Dicken, 2011).

### 3.5.2 Returns to Capital

The sectoral breakdown of the Western European textiles and clothing returns to capital production footprint (Figure 3-5 Panel C) mirrors that of the labour compensation production footprint with the biggest profits being seen in the Textiles and Clothing sector itself and Agriculture contributing proportionally much less to the returns to capital production footprint than to the labour hours production footprint. The suggested explanation for this is the same as in section 3.5.1 – the Textiles and Clothing sector contains both high and low value-adding production tasks, while Agriculture does not. An additional insight from the sector breakdown of the returns to capital production footprint is that the contributions from the Services and Other Manufactures sectors saw a marked increase after 2002 whereas the labour compensation footprints in these sectors rose much more modestly. This, again, suggests growth in profits at the expense of wages.

### 3.5.3 Carbon

Section 3.4.3 argued that increases in the carbon production footprint between 1997 and 2001 were likely due to movement of manufacturing out of Western Europe and into BRIC and OLAC. Figure 3-5 Panel D shows that contributions to the carbon footprint from the Energy and Resources sector follows a similar trend as contributions from BRIC and OLAC. This suggests that the reason for the growth in the carbon production footprint at this time was due to a shift amongst manufacturers to regions with more carbon intensive Energy and Resources sectors.
Figure 3-7 breaks down the contributions of the Energy and Resources sector to the Western European Textiles and Clothing carbon production footprint, showing the BRIC Energy and Resources sector to be the biggest contributor. As with Figure 3-6 this represents a high level of uncertainty. Nonetheless, the pattern is in line with the wider literature. For example, Andrew and Peters (2013) report that the Chinese Electricity sector was the biggest contributor to the UK, French, and Norwegian Clothing greenhouse gas production footprints for 2007 while the Carbon Trust (2011) reported that the Chinese Electricity Sector was the biggest contributor to the UK’s clothing carbon production footprint for 2004. Therefore, we conclude that the biggest source of carbon in the Western European textiles and clothing carbon production footprint was the BRIC Energy and Resources sector. Further, we conclude that the carbon intensity of the background energy system has been of considerable importance in determining the Western European textiles and clothing carbon production footprint.

Figure 3-7 Regional contributions to the energy and resources sector contributions to the Western European textiles and clothing wages production footprint.
3.6 Towards Sustainability, Supply Chain Living Wages?

Several key findings emerge from our analysis. First, Western European consumption of textiles and clothing goods between 1995 and 2009 relied on large quantities of low paid labour principally in the Textiles and Clothing, and Agricultural sectors in BRIC, whilst more highly paid jobs were found in Western Europe. Alsamawi et al. (2014a) characterise this type of relationship as a “master” and “servant” relationship - the low paid servant nations supporting the affluent lifestyles of the wealthy master nations. This type of inequity does not sit easily with visions of a sustainable future where intra-generational equity is key (Brundtland, 1987, Haughton, 1999, Jackson, 2011).

Achieving intra-generational equity requires an increase in the income of the global poor sufficient to both meet their material needs and to partake in society. Our analysis does provide evidence that BRIC workers benefitted from removal of restrictions on international trade – wages rose as production moved into BRIC. However, the remaining large differences in wage rates suggest that this development path is likely to take a long time to reach a more equitable situation, especially if, as we suggest, production is now moving out of BRIC and into lower wage nations. It is also worth noting that those who view sweatshops as a natural stage of economic development estimate that it would take 300 years for the poorest countries to leave the sweatshop ‘stage’ of economic development (Hall and Leeson, 2007).

One way to speed up progress toward equity and to better enable BRIC workers to flourish, is for Western European brands to enforce payment of higher wages by their suppliers. This is a strategy that curries favour with third sector groups. For example, the Asia Floor Wage Alliance is a group of unions and labour activists from across Asia whom advocate payment of
a living wage to garment workers. The argument made by NGOs is that high profit margins and the relative power of retailers means they can both afford and enforce such actions. To an extent these arguments are supported in the academic literature. For example, it is well established the power in clothing value chains lies with Western European retailers (Gereffi and Fernandez-Stark, 2011, Gereffi and Memedovic, 2003) and some studies suggest substantial pay increases are possible at minimal cost to retailers (Miller and Williams, 2009). Moreover, McMullen et al (2014) report that New Look, the British high street chain, is already paying a living wage to some of its workers in China. Likewise, Nudie Jeans, a Swedish SME, pay workers in part of their supply chain a living wage (Egels-Zandén, 2015). However, financing for these initiatives is unclear. Also unclear is the extent to which payment of a living wage affects production cost (something we explore in Chapters 5 and 7). Beyond studies examining the consumer price effects of increases in the minimum wage in developed nations (O’Brien-Strain and MaCurdy, 2000, Aaronson, 2001) we find very limited consideration of this in the literature. Our analysis here showed that labour costs already dominate profits, but also that per unit labour costs fell substantially.

Additionally, the Asia Floor Wage Alliance and the McMullen report focus on improving prospects of workers in clothing factories. By highlighting the substantial contributions to the Western European Textiles and Clothing labour hours production footprint of Agriculture, our analysis shows that a focus on garment workers alone will not be sufficient to remove dependency on low wage labour. For that, wage increases must also be made in other sectors, in particular Agriculture.

Next, we found that the biggest contributor to the Western European textiles and clothing carbon production footprint was the Energy and Resources sector in BRIC, and that

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16 http://www.cleanclothes.org/livingwage/who-are-the-asia-floor-wage-alliance
movement of manufacturing to BRIC represented both displacement and growth in global emissions at different points in time. This indicates the importance of decarbonising economies, especially those of the nations where industry is expected to relocate. Therefore, sustainable textiles and clothing consumption relies on energy companies and governments to ensure a sustainable future for manufacturing by investing in low carbon energy infrastructures.

Third, for substantial portions of the time series, efficiency gains in the Western European textiles and clothing carbon production footprint, were outstripped by rising levels of consumption. Consequently, our results suggest large scale reductions in carbon emissions from Western European textiles and clothing would be facilitated by reductions in levels of consumption. Therefore, Western European retailers may need to rethink their business models, and consumers their consumption choices, in order to absolutely reduce per capita consumption levels. This recommendation is in line with arguments that achieving a sustainable society will require substantial lifestyle changes in affluent nations away from consumerist values (Duchin and Lange, 1994, Jackson, 2009).

However, as we argued in Chapter 1, the extent to which this is feasible is unclear: reductions in affluent country consumption are typically though to be socially damaging for developing countries (Erickson et al., 2012, Confino, 2015). And, as we noted above, there are few estimates of how much wage increases are likely to actually cost. Particularly as existing estimates tend not to include the cost of taxes, cover the full supply chain or consider alternative responses by retailers (issues we explore in more depth in Chapters 5 and 7). Because of this, discussions on sustainability through wage increases, or other supply chain equity initiatives are qualitative and remain largely unexplored.
3.7 Conclusions

In this chapter we presented estimates of trends in the socio-economic and carbon impacts of Western European consumption of textiles and clothing goods between 1995 and 2009 from our sub-system global multi-regional input-output framework. We showed that production moved out of Western Europe, predominantly into BRIC and found a substantial fall in the wage rate for producing textiles and clothing goods for Western European consumers. The reduced wage rate was the result of large increases in low wage labor in the BRIC Agricultural, and Textiles and Clothing sectors. BRIC workers in the value chains that serve Western European textiles and clothing consumers earn around 3% of the hourly rate of their Western European counterparts (at market exchange rates) – potentially a substantial inequity. However, wage rates in BRIC grew between 1995 and 2009, and profits are increasingly being generated within BRIC. We suggest that some of this is the result of BRIC moving towards producing higher value goods as production of some of very cheap low value added goods moves out of BRIC and into poorer countries – many of which we do not have data for.

Initially, movement of production from Western Europe to BRIC increased the carbon intensity of the production of textiles and clothing goods for Western Europe, cancelling out the effect of falling demand. From 2002 onwards, BRIC production became more carbon efficient but this was outpaced by increased demand and so the carbon production footprint in 2007 was approximately the same as it had been in 1995. However, after 2007 carbon emissions from the BRIC Energy and Resources sector fell and combined with reduced consumption (due to recession) in 2008 and 2009, this was enough to give a reduction in the 2009 Western European textiles and clothing carbon footprint relative to 1995. While this overall trend in the
carbon production footprint is not discouraging, to stop runaway climate change more ambitious and robust reductions will be needed (IPCC, 2014).

In summary, our study presents a mixed picture for sustainability. The empirical evidence appears to support previous arguments that Western European textiles and clothing retail models are reliant on cheap labour. However, we cannot advocate localisation of production on social grounds as we have shown that globalisation appears to have substantially increased wages for BRIC workers. Our results also support the idea that high volume business models hamper otherwise successful attempts to reduce carbon emissions.

In the light of these findings, we suggest that increasing wages in BRIC (and other low wage countries) to a living wage level may be a useful way to begin to operationalise the strategy discussed in Chapter 1. Increasing the wages of BRIC workers in the clothing supply chain might improve socio-economic sustainability. Additionally, by passing on the increased cost of conditions for BRIC workers to Western European consumers, improvements in environmental sustainability might also be achieved. The rest of the thesis explores these arguments in more depth.

An adapted form of this chapter is currently in submission with the *International Journal of Lifecycle Assessment*.

### 4.1 Introduction

The previous chapter documented large differences in the labour compensation paid to Brazil, Russia, India and China (BRIC) and that paid to Western European workers in the Western European textiles and clothing supply chain. We suggested that this was a potential inequity that would conflict with widely accepted understandings of sustainability (DEFRA, 2005, Daly, 2007, Costanza et al., 2013) and would be of interest to those concerned with the effects of global income inequalities (e.g. Firebaugh, 2015, Milanovic, 2006). Consequently, we suggested that payment of a living wage may be a good mechanism to improve socio-economic and environmental sustainability in the Western European clothing supply chain. Therefore, in this chapter we estimate living wages (and other associated costs) for BRIC.

By estimating living wages for BRIC this chapter aims to provide the means for the thesis to further investigate the equity of wages in the Western European clothing supply chain. As it stands we have only identified a *possible* inequity. It is not immediately clear whether the low wages in BRIC are so called ‘poverty wages’ associated with sweatshops, or whether they are low for more benign reasons (for example because the cost of living is much lower in BRIC than in Western Europe). In Life Cycle Management terminology we showed that BRIC wages
in the Western European textiles and clothing supply chains are a ‘hotspot’, worthy of further investigation (Barthel et al., 2015). The results from this chapter will also allow us to investigate the potential impacts of paying a supply chain living wage in later chapters. Having estimates of living wages is important because the impact of paying a living wage are likely to be influenced by the size of the living wage payment.

Finally, this chapter aims to contribute to the living wage literature by extending existing methods. Living wage estimates tend to only be available for select countries and have some methodological limitations (see 4.11). One of the most problematic of these from our perspective is that they rarely include additional costs to employers in the form of social security contributions or allowances for taxes (Vaughan-Whitehead, 2014). This is important because these additional costs are likely to represent a substantial cost to employers over and above wage costs. Therefore, we propose a new measure ‘living labour compensation’ which incorporates these factors and discuss the implications for existing living wage work.

4.1.1 Living wages and assessing fairness

Assessment of fairness requires a normative analysis. Here we use living wages as a normative standard of fairness. A living wage has four defining characteristics (Glickman, 1999, Labour Behind the Label, 2015):

1. It provides for a better than subsistence lifestyle.

2. It allows a worker to support their family.

3. It is earned within a standard working week and does not rely on overtime.

4. It allows for savings.
Wages that do not meet these criteria are deemed ‘unfair’ or inequitable. Introducing an explicit value judgement is problematic in as much as it introduces a subjective element to any results building on the analysis. In social life cycle assessment (SLCA), analysts seek to mitigate the effects of subjectivity by ensuring that the subjective elements have a broad base of support. Usually this means subjective elements have a grounding in international treaties or agreements (UNEP, 2009).

The living wage concept has a strong grounding in international law. Although there is no international labour convention explicitly for living wages it is referred to in the United Nations Universal Declaration of Human Rights and at least four other international conventions (Vaughan-Whitehead, 2010, Anker, 2011b). Additionally, the living wage has a long academic pedigree (see Stabile (2009) who charts the living wage in the history of economic thought) and is commonly used by a wide range of stakeholders (e.g. Miller and Williams, 2009, New Look, 2011, Labour Behind the Label, 2015). Hence using living wages as a metric of wage equity should provide a broad base of support.

However, at the time of the analysis there were no living wage estimates available for Brazil or Russia, and only three studies that estimated living wages for both India and China (Anker, 2006a, Merk, 2009, Worker Rights Consortium, 2013). The other estimates of living wages for India (Fairwear Foundation, 2012, Rani and Belser, 2012b) and China (Fairwear Foundation, 2009, Merk, 2009, Xu et al., 2015) are not directly comparable due to differences in methodology. Therefore, in this chapter we estimate living wages for each of Brazil, Russia, India and China (BRIC). Our estimates are the first cross-nationally comparable estimates for all of the BRIC countries.

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17 This purely normative basis distinguishes a living wage from a minimum wage. A minimum wage is the lowest legal minimum wage that an employer can pay an employee, often set below a living wage level in order to maintain economic competitiveness (e.g. UK Government Low Pay Commission, 2016).
In estimating living wages for BRIC, we also contribute an extension of the existing method set out by Anker (2005, 2006a) – there are several ways to estimate living wages and Anker’s is the most appropriate for our purpose. However, it does not account for personal taxes or employee social security contributions. We extend Anker’s method to include these potentially important factors.

4.1.2 Living Labour Compensation

As well as estimating living wages, we also introduce a new concept: “living labour compensation”. Living labour compensation builds on our living wage estimates by incorporating employer social security contributions. By including an estimate of social security payments, the living labour compensation measure more fully reflects the costs to employers of paying workers a living wage than the living wage itself. In this way, it is more in line with how the value of labour is assessed in standard macro-economic analyses (e.g. Timmer et al., 2013b, OECD, 2014) and how we assessed labour income in Chapter 3.

Furthermore, because living labour compensation is directly comparable with labour compensation it circumvents some issues associated with comparing wages. Our living wage estimates (like many others, see 4.2.1) are based on a cost of living assessment which makes no allowance for non-financial compensation – what the System of National Accounts calls remuneration in kind (European Comission et al., 2008). That is, our cost of living assessment assumes workers have to pay for all elements of their living costs by themselves. In reality, however, remuneration in kind, in the form of housing or food, is often an important component of worker compensation packages. In such cases our living wage estimates will be inflated.

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18 Xu et al., (2015) adjust the Fairwear Foundation (2009) living wage estimates for China to account for employer social security contributions by arbitrarily assuming a 30% premium. However, they do not formally define living labour compensation, and their method is overly simplistic. Moreover, they do not use these estimates in their analysis, but mention them in passing.
because they reflect the total costs of living a ‘decent life’ not the specific costs borne by the worker. Therefore, comparing living wage estimates like ours and actual wages can lead to artificially high differences between observed and living wages. However, labour compensation includes estimates of the financial value of remuneration in kind and so comparing labour compensation and living labour compensation limits the effects of these problems.

Finally, living labour compensation better reflects broader definitions of ‘fair wages’ than the living wage alone as it assumes employers have to meet other legal obligations in the form of social security contributions. For example,

“Fair wages…provide a living wage floor for workers while complying with national wage regulations (such as… social security contributions).” (Vaughan-Whitehead, 2014 P. 69).

Therefore, this chapter makes three principal contributions to knowledge. First we extend an existing methodology to account for differences in tax regimes (both income tax and national insurance) between countries. Second we introduce and formally define the novel living labour compensation concept. Third we provide the first cross-nationally comparable estimates of living wages and annual living labour compensation in BRIC.

The rest of this chapter is structured as follows. In Section 4.2 we review approaches to estimating living wages, formally define the living labour compensation concept and present our method. Section 4.3 presents our empirical estimates of living wages and living labour compensation in the BRIC countries, 2005, and section 4.4 discusses their implications. Section 4.5 concludes.
4.2 Methods

4.2.1 Approaches to Estimating Living Wages

The first two steps in estimating a living wage are: 1) defining an acceptable standard of living and 2) estimating the cost of this standard of living. The most involved methods for estimating a living wage use interviews and focus groups to establish the basket of goods required for a basic but decent standard of living (e.g. Bradshaw et al., 2008). This approach distances the researcher from the subjective elements of the living wage, instead relying on the use of multiple stakeholder groups to arrive at a commonly accepted standard of living. Moreover, because local stakeholders are used the basket of goods is region specific – this is important because an acceptable standard of living is inherently subjective and subject to local experiences. For example, different countries (and within those countries, regions) have different food preferences, different lifestyles and generally different expectations for a decent standard of living. However, this type of approach requires large amounts of data and time and as a result applications have been confined to single country studies, typically in developed nations (Anker, 2011).

An alternative approach is to use fewer, smaller scale, interviews. This approach keeps a strong region specific focus and distance between the researcher and the subjective nature of the calculation. Additionally, it substantially reduces the cost compared to the more involved methods. The Fairwear Foundation (2009) used this approach to estimate a living wage for China in 2009. Factory workers in four locations were interviewed and asked to estimate living wage levels for their region. The difficulty with this approach is in generalisability: use of four factories in the Fairwear Foundation study makes generalising to the whole of China problematic (Anker 2011). Additionally, because (in this instance) the interviews asked for estimated earnings (rather than budgets) the results are quite opaque – what do the workers
expect to be able to purchase with their living wage? This can make communication and interpretation difficult.

Furthermore, conducting even small scale interviews in each of the four BRIC countries is beyond our resources (both financially and in terms of time). However, there is an alternative branch of approaches that do not directly use interviews to estimate standards of living. The fastest (but least robust) of these is either to define an arbitrary wage based on an extension of a poverty line or income decile (Rani and Belser, 2012b, Xu et al., 2015) or to convert an already estimated living wage for a single country into local currency using a Purchasing Power Parity (PPP) type measure (e.g. SweatFree Communities, 2010, Worker Rights Consortium, 2013). The former is, in our judgement, too arbitrary while the latter fails to account for the location specific norms surrounding living wages (Anker, 2011b). Therefore, we take an approach that bridges the gap between the interview-based methodologies and the conversion methodologies, estimating the cost of living based on secondary analysis of national datasets (normally drawn from interviews or surveys).

The most common approach to estimating living wages based on national datasets is to use the relationship between income and demand for food, known as Engel’s law. Engel’s law is the observation that as incomes increase the proportion of income spent on food decreases (Murcott et al., 2013). Since Engel’s work in 1857 (cited in Murcott et al., 2013) Engel’s law has proven to be extremely robust, having being verified by numerous studies at the household, national and international scales at various points in time (e.g. Zimmerman, 1932, Holcomb et al., 1995, Anker, 2011a).

A common approach to estimating a living wage using Engel’s law is for researchers to estimate food costs using a model diet (which meets nutritional guidelines and accounts for local preferences) then estimate non-food costs by multiplying food costs by an Engel
Coefficient determined by the development level of the area of interest (e.g. Anker, 2006a, Merk, 2009). The living wage is then the sum of the food and non-food costs, plus any additional allowances (such as an "emergency" or "contingency" allowance, see Anker, 2006a for example). While it is known that a variety of factors, (such as housing expenditure) make the mechanistic application of Engel’s law in living wage estimation problematic (Anker, 2011a), this approach has gained traction because of its relative simplicity and transparency. Furthermore, because robust Engel coefficients and food consumption/price data are available for a large sample of countries (whereas, for example, housing cost data is not) this method allows internationally comparable estimates to be produced while explicitly accounting for variations in development and local purchasing power.

### 4.2.2 Applying Anker’s Method to BRIC, 2005

Our estimates of BRIC living wage rates are based on the method developed by Anker (2005, 2006a, 2006b), and are methodologically similar to other estimates based on Engel’s law, such as the Asia floor wage (Merk, 2009), which has become a benchmark for living wage discussions both in the academic literature and by activists (e.g. Vaughan-Whitehead, 2010, Action Aid, 2011, Bhattacharjee and Roy, 2012). As these methods are well described elsewhere (Anker, 2006a, Anker, 2006b, Anker, 2005), we only provide an overview in this section. Our calculations, including the full specifications of the model diets and Engel coefficients used, are given in Appendix D.

For each BRIC country we specify and cost a nutritionally sound diet incorporating country level preferences for food types ($d$). To construct the model diets we use country specific data on food preferences (from FAOSTAT, 2015), and consumer food prices (from ILO, 2015). Brazil, Russia India and China, are all present in these databases. The ILO database provides the price paid by consumers for 93 food commodities, allowing a relatively detailed
pricing approach. The most up-to-date food price data in the ILO database were for 2000. These were converted to 2005 prices using food group consumer price indices (CPI; also from ILO 2015).

Our model diet assumes 2100 Kcal is sufficient for a good but basic standard of living. 2100 Kcal represents the lower estimate of various scholars and agencies (Bassett and Winter-Nelson, 2010, Economic Research Service and USDA, 2012, World Food Programme, 2015) and is considerably lower than the actual available food supply per capita for the BRIC countries in 2005 (3078 Kcal for Brazil; 3200 Kcal for Russia; 2267 Kcal for India; 2800 Kcal for China - see FAOSTAT, 2015). To ensure our model diet meets nutritional needs beyond daily calorie intake we follow guidelines from the World Health Organisation and the Food and Agricultural Organisation (WHO and FAO, 2003). For example, our model diets specify five 80 gram portions of fruit and vegetables per day.

We then use Engel coefficients to estimate total costs. Anker (2005) collects Engel coefficients used by a variety of countries to estimate their poverty lines and derives values for a variety of development levels at the international scale. We use these values, rather than more recent values that have been estimated from, for instance, the World Bank’s International Comparison Program (ICP) (Murcott et al., 2013) as Anker’s (2005) estimates are based on data for low income households specifically.

Multiplying food costs by the Engel coefficient gives us an estimate of the cost of a decent lifestyle for an average person in the country of interest. We multiply this value by a scale-factor to convert from an individual to a household value. To maintain comparability with existing estimates and to simplify interpretation of our living wage estimates we follow Merk (2009) and Xu et al., (2015) in choosing one standard family size and structure – 2 adults and 2 children with one full time worker. The choice of a 4 person family is not entirely
arbitrary, apart from Russia (average family size in 2005: 2.8, see OECD, 2011a), the average household size in the BRIC countries in 2005 was around 4. China has a range of 2.9 and 4.8 depending on the region (NBSC, 2005); India has an average of 4.8 (Bhat et al., 2007); and Brazil has an average of 3.7 (OECD, 2011a)). The number of earners in a household is highly variable even within countries. We assume one earner per family for simplicity and to maintain comparability with other living wage estimates for developing countries, most notably the Asia Floor Wage (Merk, 2009).

In moving from per person to household costs, there are economies of scale. Therefore, most estimates of national poverty lines use an adult equivalence scale to convert between the two. We use Anker’s (2005) equivalency scale which assumes all household members have the same calorific needs, but that there are economies of scale associated with non-food costs (which vary by development level). This means that we use a food scale factor of four and a non-food scale factor of less than four (for example, 1.54 in India). Empirical values used in the individual to household conversion are given in Appendix D.

Finally following Anker, we apply a savings allowance of 10%. This allows for planning for the future and ensures the living wage allows a decent standard of living during times of financial crisis. Therefore, writing the daily cost of food as $f$, the Engel coefficient as $\alpha$, the household scalar as $\beta$ and the savings allowance as $s$, the annual cost of a decent life can be written as,

$$w^n = 365f\alpha^{-1}\beta s$$

(4-1)

4.2.3 Extending Anker’s Method to Include a Tax Allowance

Although we called the output of equation (4-1) the annual cost of a decent life, Anker (2006a) and Merk (2009) use similar procedures to estimate their living wages. We would
argue that our interpretation of equation (4-1) is more appropriate because workers are required to pay income taxes and make social security contributions out of their wages, neither of which is captured in equation (4-1). Additionally, as Anker (2005) notes, income taxes can constitute a substantial payment on the part of an employee, as could social security contributions. Going forward we refer to estimates such as those from equation (4-1) as net living wages.

The next step is to estimate the effective income tax rate for each country of interest. We did this for the four BRIC countries for 2005 using information on income tax regimes from Ernst and Young (2006). The effective income tax rate is country specific as it is dependent on the tax bands within each country, which tax band the living wage falls into and any deductible allowances – all of which vary by country. Table 4-1 shows the value of the effective income tax rate applied in each country. In Brazil, India and China, the living wage falls below the minimum threshold for income tax, so the effective income tax rate is zero. However, in 2005 Russia was operating a flat tax rate and the living wage would be taxed at 10% after allowances.

<table>
<thead>
<tr>
<th>Country</th>
<th>Effective Income Tax Rate</th>
<th>Employee Social Security Contribution Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>-</td>
<td>0.0765</td>
</tr>
<tr>
<td>Russia</td>
<td>0.10</td>
<td>-</td>
</tr>
<tr>
<td>India</td>
<td>-</td>
<td>0.1365</td>
</tr>
<tr>
<td>China</td>
<td>-</td>
<td>0.11</td>
</tr>
</tbody>
</table>

19 We use Ernst and Young 2006 as this is the data going furthest back in time that we could find on income tax regimes. At the time of writing, information on personal tax regimes around the world between 2006 and 2014 can be found at http://www.ey.com/GL/en/Services/Tax/Global-tax-guide-archive.
Employee social security contributions were taken from the Social Security Association (SSA) international research program (SSA, 2015). These also vary by country: Russia is the only BRIC country not to require employees make a contribution to social security (the Russian system was entirely funded by employer contributions in 2005). For all of the BRIC countries the SSA report employee social security contributions on a gross wage basis. However, for some countries social security contributions are reported on a net basis, so analysts looking to extend our analysis should take care to check this. Table 4-1 reports the employee social security contribution rates used in this study.

Using the effective income tax rates, \( \gamma \), and employee social security contributions, \( \delta \), we can estimate a personal tax allowance, \( h \), that ensures a post-tax wage, \( w^n \), as estimated in equation (4-1),

\[
h = \frac{w^n(\gamma+\delta)}{(1-(\gamma+\delta))}
\]

And the annual living wage paid to an employee before any deductions for employee social security contributions or personal income taxes are made, i.e the gross living wage, is,

\[
w^g = w^n + h
\]

4.2.4 Estimating Living Labour Labour Compensation

Labour compensation is defined as the total compensation of employed labour: it is equal to the sum of gross wages and salaries of all employed persons and associated employer social security contributions. It is distinct from compensation of employees in that it includes an estimate of the compensation of self-employed persons (OECD, 2014). Labour compensation is an important metric commonly used in macroeconomic analyses – for example, by the OECD (2014) in their assessment of productivity and competitiveness between
nations. The analytical advantage of labour compensation is that by incorporating employer social security contributions it provides a more comprehensive view of labour costs than gross wages alone.

This is particularly relevant for our purposes: in the upcoming chapters we will use our living wage estimates to assess how producers and consumers might be able to finance living wages. The feasibility of different financing channels is likely to be dependent (amongst other factors) on the size of the cost increases associated with the living wage. Therefore, we need to estimate not just increases in workers’ wages, but also associated costs to producers.

To do this, we take the employer social security contribution rates, $\varepsilon$, associated with our gross living wage estimates for each of the BRIC countries from the SSA (2015). These are then used to estimate ‘living labour compensation’, $w^l$,

$$w^l = \varepsilon(w^g + h) \quad (4-4)$$

The employer social security rates used in our empirical calculations for BRIC countries in 2005 are given in Table 4-2. All estimates in the table are country level, but there is likely to be substantial sub-national variation. Possible sources of this variation are differences in rates for smaller employers and varying levels of compliance. China also represents a special case within BRIC as some of the components of social security are set by provinces rather than nationally. This leads to substantial variation across the country. In 2014, for example, employer contribution rates were 8% in Guangzhou and 22% in Shanghai (PWC, 2014). The SSA (2015) and Ernst and Young (2006) provide guideline estimates for countries as a whole and we use these while recognising that regionally there will substantial variation around them.
Table 4-2 Employer social security contribution rates. Taken from SSA (2015) for the year 2005

<table>
<thead>
<tr>
<th>Country</th>
<th>Employer Social Security Contribution Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>0.2000</td>
</tr>
<tr>
<td>Russia</td>
<td>0.2820</td>
</tr>
<tr>
<td>India</td>
<td>0.2236</td>
</tr>
<tr>
<td>China</td>
<td>0.1200</td>
</tr>
</tbody>
</table>

### 4.2.5 Living Wage Consistency Checks

We base our living labour compensation estimates on new living wage estimates rather than pre-existing living wage estimates because 1) living wage estimates did not exist for all the BRIC countries at the time of the analysis and 2) consistent (i.e. same methodology, assumptions, and year) living wage estimates for multiple countries are very uncommon. For Brazil and Russia, we struggled to find any estimates of a living wage at all, while estimates for China and India used conflicting methods for different years. Consistent methodologies are required because even small, and justifiable, differences in methodology can result in large discrepancies between estimates. Xu et al., (2015) demonstrate this by swapping Anker’s (2006) estimated Engel coefficient (0.6) for an Engel coefficient taken from official Chinese data (0.4). This changes Anker’s living wage estimate for China from 6864 Yuan to 10275 Yuan for the year 2000.

The lack of a consistent methodology makes judging the reasonableness of our living wage (and hence our living labour compensation) estimates by comparing them to those already in the literature difficult. Nonetheless, such a comparison can serve to highlight major problems, e.g. if our estimate is an order of magnitude larger than any others. Therefore, we
compare our results with the living wage estimates available in the peer-reviewed and grey literatures. Given the sparsity of living wage estimates we do not restrict the estimates used for comparison on the basis of methodology. However, we do restrict estimates to the country of focus, i.e. we only compare our Chinese living wage estimate with other estimates of living wages for China. Similarly, we restrict estimates to those between the years 2000-2009. These restrictions mean that we were unable to perform comparisons on our estimates for Brazil or Russia as we were unable to find living wage estimates in the literature. For comparative purposes, we also convert all estimates to US Dollars (USD) valued at Market Exchange Rates (MER) and deflated to 2010 prices using a Consumer Price Index (CPI) from the World Bank (2015). However, it is important to note that if countries are developing rapidly we would still expect living wages to rise over time even after controlling for inflation (because as countries develop the understanding of what it means to live a good life changes).

As the comparison of living wages is difficult, we also judge how reasonable our living wage figures are by seeing how closely our living wage estimates meet theoretical expectations based on the relationship between the living wage concept and measures of economic development and poverty. Because living wages represent a minimum decent standard of living we would expect living wages to be less than the average wage in countries with comparatively high economic development. For example, in the UK the 2011 living wage (outside London) was approximately 21,500 USD valued at Purchasing Power Parity (PPP), while average earnings were 34,000 USD PPP. As the level of economic development, and the portion of the population living at or below the poverty line increases, we would expect the gap between the average and living wages to narrow. The living wage would be expected to be above average earnings where a large portion of the population is below the poverty line. Therefore by
comparing our living wage estimates with estimates of average earnings\textsuperscript{20} in the BRIC countries in 2005 (ILO, 2015), and two measures of economic development (GDP per capita and percentage of population living on less than $2 PPP per day) (World Bank, 2015) we can see if our estimates conform to our expectations of a living wage.

Additionally, we can use estimates of our living wages in PPP as a rough guide for how reasonable they are. In theory PPP captures the real difference in costs of living between countries (Callen, 2007) (in practice this is questionable, see Anker, 2005, Deaton and Heston, 2010). Therefore, countries with similar development levels should have living wages that are approximately equal in terms of PPP.

4.3 Results

4.3.1 Living Wage and Living Labour Compensation Estimates for BRIC

Table 4-3 shows the living labour compensation estimates on a per worker basis for Brazil, Russia, India and China in 2005 valued in US dollars at Market Exchange Rates\textsuperscript{21}. From Table 4-3 we can see that there are substantial differences in the cost of a living wage worker to a foreign firm depending on where that worker lives. Employing a living wage worker in Brazil costs a foreign firm around twice as much as a living wage worker in India, for example.

\textsuperscript{20} The mean nominal earnings figures from the ILO (2015) that we use are conceptually the same as our gross living wage estimates: they include salaries, personal income taxes and employee social security contributions but exclude employer social security contributions.

\textsuperscript{21} We use USD MER here as firms pay wages and count costs at market valuations, and we are interested in the change in costs to firms.
Table 4-3 Components of Living Labour Compensation Estimates for a single worker in each BRIC country in 2005, valued at current price USD MER. Numbers may not sum due to rounding.

<table>
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<tbody>
<tr>
<td>Brazil</td>
<td>2763</td>
<td>-</td>
<td>229</td>
<td>2992</td>
<td>598</td>
<td>3590</td>
</tr>
<tr>
<td>Russia</td>
<td>1936</td>
<td>216</td>
<td>-</td>
<td>2152</td>
<td>607</td>
<td>2760</td>
</tr>
<tr>
<td>India</td>
<td>1289</td>
<td>-</td>
<td>204</td>
<td>1493</td>
<td>334</td>
<td>1826</td>
</tr>
<tr>
<td>China</td>
<td>1902</td>
<td>-</td>
<td>235</td>
<td>2137</td>
<td>256</td>
<td>2394</td>
</tr>
</tbody>
</table>

On the other hand, it is worth noting that the relative cost of BRIC workers seems unaffected by the inclusion or exclusion of taxes and employee/employer social security contributions. Although in all cases taxes and social security contributions make up a substantial portion of the estimated living labour compensation (being 23% in Brazil, 30% in Russia, 29% in India and 21% in China) they do not affect relative cost to employers.

Likewise, personal taxes and employee social security contributions are fairly constant between the four countries: 8% in Brazil, 10% in Russia, 14% in India and 11% in China. Although only Russian workers pay income tax at the living wage rate (Russia has a flat tax regime, while the other countries have progressive tax regimes where our living wage estimate falls below the lowest tax band) the Russian social security system is funded entirely by employers, which balances the total employee tax burden. We see a similar picture for employer social security contributions which are 17%, 22%, 18% and 11% of the total living labour cost in Brazil, Russia, India and China respectively.
4.3.2 Comparative Assessment

Figures 4-1 and 4-2 plot published living wage estimates for China (Figure 4-1) and India (Figure 4-2) between 2000 and 2009 alongside our net living wage, gross living wage and living labour compensation estimates. All values are converted to 2010 USD, MER. Overall, our estimates appear to be quite reasonable, being within the range of published estimates. For China, our net and gross living wage estimates fall toward the lower end of the spread of estimates, though considerably above the lowest estimates and lying close to the estimates for 2005 and 2006 by Xu et al., (2015) (Figure 4-1). Similarly, for India our estimate is reasonably central, though closer to the top half of the range of estimates (Figure 4-2).
Figure 4-1 Estimates of living wages in China 2000-2009. Markers of the same colour are from the same study; markers of the same colour but different shapes indicate same study but different method; markers of the same colour and shape indicate same study and same method but a different geographical focus.
Figure 4-2 Estimates of living wages in India 2000-2009. Markers of the same colour are from the same study; markers of the same colour but different shapes indicate same study but different method (see key); markers of the same colour and shape indicate same study and same method but a different geographical focus.
In Figures 4-1 and 4-2 the estimates methodologically closest to ours are Anker (2006) and Merk (2009), as both estimate food costs and apply an Engel coefficient. Neither Anker nor Merk account for taxes or social security, so the relevant comparison is with our net living wage. For both China and India, our net living wage estimate is substantially greater than Anker’s estimate. As we use the same Engel coefficient as Anker (0.6) and similar calorie requirements, the differences between our net living wage and Anker’s estimate must be due to differences in the specification and pricing of our model diets. We used the same food price database as Anker. However, we updated the prices using a food specific CPI. While we attempt to control for inflation in the living wage estimates in figures 4-1 and 4-2 using a general CPI, it is possible that this does not completely counteract our adjustment for inflation of food prices between 2000 and 2005. Additionally, Anker adjusts the price of rice downwards (by half in India and a third in China) on the grounds that cheaper forms of rice are available than those used in the ILO food prices database. This reduces the cost of his diets relative to ours. We do not do this in order to maintain the transparency and simplicity of our estimates. Regardless, as our living wage estimate is toward the lower end of the published estimates we do not think the differences between ours and Anker’s model diets are problematic.

We would expect Merk’s (2009) estimates for both China and India to be greater than our net living wage estimate as Merk uses a smaller Engel coefficient (Merk uses 0.5 for both China and India, while we use 0.6 and 0.7 respectively) and specifies a model diet with more calories (3000, to our 2100, see 4.2.2). In India this is the case, with Merk’s estimate being higher even than our gross living wage estimate. However, in China our net living wage estimate is greater than Merk’s. This could suggest that our Chinese model diet overstates the price of a good diet. However, it seems equally likely to us that the differences between our estimates, Anker’s and Merk’s highlight the limitations of mechanistic application of the Engel
coefficient and not explicitly modelling the cost of other essential goods such as housing (Anker, 2011a, Anker, 2011b).

The only other living wage estimates that explicitly attempt to account for social security costs are the Xu et al., (2015) adjustments of the Fairwear Foundation (2009) estimates. Our living labour compensation estimate is considerably less than the social security adjusted Fairwear Foundation estimates. This is most likely because the Fairwear Foundation (2009) living wage estimates are greater than our gross living wage estimate. It is difficult to say why the Fairwear estimates are higher than our estimates as they are based on interviews which asked for desired earnings rather than budgets. This fact does, however, suggest that our estimates are conservative.

4.3.3 Living Wages vs Average Wages in BRIC.

Figure 4-3 shows our living wage estimates for BRIC in 2005 valued at USD PPP. Brazil and China have very similar PPP annual living wage values, both around 5000 USD PPP, and Russia is only ~500 USD PPP less. On the other hand, our estimate of India’s annual living wage is much higher than all of our other estimates (around 1200 USD PPP higher than Brazil and China and 1700 USD PPP more than our Russian living wage estimate).

Figure 4-3 Mean nominal annual earnings, living wage, GDP per capita and percentage of population living below the poverty line in BRIC countries in 2005.
That the Indian living wage is the highest in terms of USD PPP is a counter-intuitive result as it suggests that the cost of living is higher in India than in Brazil, Russia or China. In fact if PPP were a perfect measure of cross-national purchasing power discrepancy and our living wage estimates provided for the exact same standard of living in each country we would expect all the values to be the same in terms of USD PPP. Therefore (discounting the numerous problems with PPP estimation), the fact that Indian living wage estimate has a much higher value in USD PPP than those for Brazil, Russia and China suggests that our living wage estimates for India are too high, or the other estimates too small (which would also suggest problems with the ILO data or the Engel coefficients). In our judgment, the discrepancy is most likely the result of the Engel coefficient being too low and what look like surprisingly high food prices (the food prices listed for India in the ILO database are comparable to Russian food prices at USD PPP – Appendix D). ILO food prices could be too high because a large number of food goods are being sold on the informal market, for example. This would be consistent with Figure 4-2, which shows our estimate being on the high side of the published estimate for India.

That said, Figure 4-3 also shows the ILO average earnings estimates, as well GDP per capita and the percentage of the population living on less than 2 USD PPP per day. We can see that Brazil and Russia have relatively high economic development and low poverty rates and, as we would expect, their average wages are above the living wage. Conversely, the gap between the living wage and the average wage is much smaller for China which has higher poverty rates and lower levels of economic development. In terms of income, India is the poorest country we look at, and has very low levels of economic development and extremely high levels of poverty. It makes sense, then, that our living estimate for India is higher than the average wage. Therefore, our estimates are broadly consistent with the theoretical expectations set out above.
4.4 Discussion

4.4.1 Implications for Existing Living Wage Initiatives and Research

Our results show that valued at market exchange rates, there is considerable variation in living wages and living labour compensation across countries. The total cost of employing a worker at a living wage rate (accounting for taxes and social security) is 1826 USD MER in India and 3590 USD MER in Brazil. Differences in living wage rates are well established and can be observed in other studies estimating living wages (Anker, 2006a, Merk, 2009). They are a reflection of the fact that living wages are inherently subjective and influenced by general living standards and levels of economic development. Consequently, those countries that are lower on the development ladder will have a lower living wage than more economically developed countries.

However, these differences have been implicitly ignored in studies looking at the effects of paying living wages in apparel supply chains. These studies typically use an exemplary, somewhat simplified supply chain. For example, Miller and Williams (2009, building on an earlier study by Merk, 2003) estimate how doubling the wages of garment factory workers in the Philippines producing a men’s knit shirt would affect prices. Similarly, Pollin et al. (2004) estimate how the price of a men’s shirt might be changed if Mexican garment factory workers were paid a living wage. Others make the same simplifying assumption of only examining workers in one country (Birnbaum, 2000, WRC, 2005). Given the fragmented nature of global value chains, the variation in living wage rates suggests that such studies may not be generalisable outside of their specific contexts.

Moreover, the cross-national variation in living wage rates implies that brands and retailers in Western Europe can become living wage employers and continue to chase the
lowest global labour costs. The only difference from the current system would be that the lowest possible wage would still be a living wage. Therefore, if all retailers selling clothing goods in Western Europe agreed to a living wage floor, competition based on wages would not necessarily stop. This could allow globalisation in the textile and clothing industry supply chain to continue to function in the same development role as it has historically, providing employment to workers in developing countries (e.g. Rivoli, 2006, Tokatli et al., 2011).

There is also another perspective on this issue: that any ‘race to the bottom’, even a substantially higher bottom, is inherently undesirable. This is the position of campaigns like the Asia Floor Wage Alliance (Merk, 2009), a group of unions and labour activists from across Asia whom advocate,

“a regional collective bargaining strategy ... [intended to] ... to counter the threat of capital mobility ...[and to]... prevent competition based on wage levels between Asian garment exporters and to make sure that gains are shared along the supply chain.”(Merk, 2009 P.39)

This regional collective bargaining strategy is based on a single living wage estimate for Bangladesh, China, India, Indonesia, Sri Lanka and Thailand, for 2009 set at 475 USD PPP.

Although we have a slightly different geographical focus, our results do provide insights into the Asia Floor Wage Alliance approach. Firstly, the Asia Floor Wage Alliance figure does not account for taxes in any form. Our results suggest that including personal income taxes in the Asia Floor Wage is probably unnecessary as in most countries with progressive tax regimes living wages would fall within tax free allowances (though this is not certain, and could change). Conversely, we saw that employee and employer social security contributions can substantially increase living labour costs. This is important because the Asia Floor Wage Alliance proposal must focus on costs from the employer’s perspective if it is to
effectively combat capital mobility. Our estimates show that if the wage rate was equal across countries the cost of labour would still change when employer social security estimations were included. For example, if our post-tax living wage estimates for India and China were equal, there would be an 8% difference in the cost of labour to employers after employer social security contributions were accounted for.

In addition, the approach of the Asia Floor Wage Alliance is to first estimate living wages in local currencies, before deriving a single figure in USD PPP. However, companies in Western Europe (and elsewhere) do not make payments at PPP prices – they make payments at MER. We have seen that even where our living wage estimates are similar at USD PPP, there can be substantial differences at USD MER. Therefore, there could still be scope for wage based competition under a living wage regime based on PPP values. On this basis, our results lead us to believe that the Asia Floor Wage Alliance proposals would benefit from thorough investigation of these issues in their specific geographical context and incorporation of labour tax and social security estimates into their calculations.

4.4.2 Implications for Western European Clothing Retailers and Supply Chain Living Wages

Cross-national variation in living wages also poses challenges to several Western European clothing retailers who have committed (at least notionally) to paying a living wage “to all workers in our supply chain” (New Look, 2011 P. 1). The analysis in this chapter showed that variation persists in living labour compensation (Table 4-2). Cross-national variation means that Western European companies have to estimate country-specific living wages – something that could be a costly process. Moreover, such variation is likely to persist even within countries. In the United Kingdom, for example, differences in the cost of living
prompted the Living Wage Foundation\textsuperscript{22} to estimate two separate living wage rates, one for London and one for the rest of the UK. Substantial sub-national variation in living wage rates should be expected in developing countries, perhaps even to a greater extent than in more affluent countries. In China and India, for example, much of the rural population engages in subsistence farming, selling some of their crop but also retaining a portion for themselves. This may substantially reduce their cost of living, and exacerbate differences between the urban and rural living wage requirements.

The lack of consensus on a methodology for estimating living wages is often identified as a barrier to actually implementing a living wage (Anker, 2011b). In response to the difficulties of estimating multiple living wages, brands and other organisations have argued that negotiated rather than formulaic approaches are more suitable. For example, Nike (2009 P.56) has argued that “\textit{local wage setting is best done by negotiations between workers, labor representatives, the employer and the government}” while the Ethical Trading Initiative (ETI, 2015 P.7) argues that emphasis should be “\textit{on implementation, not calculation}” and that “\textit{collective bargaining mechanisms...ensure wages reflect and keep up with increases in the cost of living}.”

The results of our comparative analysis do lend support to such a position: there is considerable variation within countries dependent on the details of the method used to estimate the living wage. However, it is worth noting that progress has recently been made towards agreement a living wage methodology supported by multiple stakeholders:

\begin{quote}
\textit{\textbf{Fairtrade International, Forest Stewardship Council, GoodWeave, Sustainable Agriculture Network, Rainforest Alliance, Social Accountability International and UTZ Certified are working together on the methodology, promotion and}}
\end{quote}

\footnote{\textsuperscript{22} http://www.livingwage.org.uk/}

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implementation of a living wage for the workers that are protected by their respective labour standards. The organisations have agreed to a common definition of living wage and will use the same methodology for estimating living wage” (Anker and Anker, 2013 P.1)

Notable by their absence, however, are the large clothing retailers that dominate the Western European markets.

Although the position that the living wage should be determined through between unions-employer negotiations has considerable heritage in the history of economic thought (Stabile, 2009), it is worth pointing out that Western European clothing retailers should not see encouraging collective bargaining as an easy option. Ciscel (2004) argues that the large gap between living wages and actual wages found in many studies reflects the imbalance of power and knowledge between employers and workers, which in turn reflects the relatively weak position of unions in many countries. For example, the International Trade Union Confederation (2015) report that in China, “Workers participating in strikes and pickets faced threats and harassment by both employers and government officials throughout the country” (P. 72). Likewise a report on the India garment sector noted that many manufacturers had a hostile attitude towards unions and that unions were “non-existent at the five investigated mills...In fact, none of the interviewed workers know what a trade union is, nor are they aware that they have the right to join one” (Theuws and Overeem, 2014 P.53).

4.5 Conclusions

The principal contributions of this chapter are: 1) the methodological advances leading to estimates of living wages incorporating personal tax and employee social security contributions. 2) Our estimates of living labour compensation for the BRIC countries which
are living wages plus social security contributions. We found that including tax and social security contributions substantially increases the cost to employers of paying the living wage. Nonetheless, we suggested that existing living wage initiatives would benefit from incorporating taxes and employee social security contributions into their estimates as this more accurately reflects the gross wages required to live a decent life. We also confirm that there is substantial cross-national variation in living wages and living labour compensation when valued at USD MER. We suggested that this could allow the basic dynamics of textile and clothing supply chains (wage based competition between countries) to survive the introduction of living wages through the supply chain.

Finally, we find that our living wage and living labour compensation estimates are reasonably robust. Despite the limitations of our methodology, estimates for China and India fall within the range of previously published estimates and all estimates meet theoretical expectations. This is important as the living labour compensation estimates reported in this chapter will be used in subsequent parts of this thesis. In the next chapter they will be used to estimate the how the price of Western European clothing goods might increase if BRIC supply chain workers were paid a living wage.
Chapter 5  Additional Costs of Living Wages in the Western European Clothing Supply Chain.

5.1 Introduction

This chapter furthers our investigation into the fairness of the Western European clothing supply chain and begins our exploration of how it might be made fairer. Drawing on the discussion of ‘soft’ wage interventions in Chapter 2.4.2, we estimate the cost to producers and associated price increases for consumers if Western European clothing brands and retailers voluntarily chose to pay a living wage in their supply chain. We do not consider the implications of other mechanisms that we might expect to be more prominent in more general cases, such as where all supply chains pay living wages or the living wage initiative is not voluntary. In the context of Western European clothing, ‘soft’ living strategies have been advocated not only by anti-sweatshop activists and scholars (Merk, 2014) but also by Western European clothing retailers (e.g. M&S, 2015). Such a ‘soft’ strategy implies that substitution and relocation effects associated with minimum wages will be of limited impact. Therefore we integrate the living labour compensation estimates from the previous chapter into our global multi-regional input-output model and use this to estimate the additional costs (all else being equal) of paying Brazilian, Russian, Indian and Chinese (BRIC) workers in the Western European clothing supply chain a living wage.

Estimating price increases, all else being equal, is relevant to this thesis because how Western European firms choose to finance supply chain living wages will affect both their social and environmental impacts. For example, passing all costs through to consumers is likely to reduce levels of clothing consumption to a greater extent than passing half of these costs
through to consumers and accepting lower profit margins to cover the rest. Moreover, it is not necessarily the case that prices should or could rise to cover all the additional costs associated with wage increases. This is especially true in light of recent research which suggests firms have multiple channels that they use to manage cost increases (Hirsch et al., 2015, Schmitt, 2015). In this way, this chapter contributes to the development of the two models used in Chapters 6 and 7 of this thesis.

This chapter makes several contributions to knowledge. First, the application of an input-output model is novel in the living wage literature and allows us to estimate the cost of paying a living wage in multiple sectors and countries. Previous work in this area has focused on product level supply chains and modelled wage increases in only one country per supply chain (e.g. Pollin et al., 2004). Therefore, using a global multi-regional input-output model provides a different perspective to previous work. To apply our method, we also develop a new dataset in the form of a living labour compensation satellite account compatible with the World Input-Output Database (WIOD). Finally, by incorporating the living wage into an input-output model we also advance recent social accounting/industrial ecology research into social sustainability (Alsamawi et al., 2014b, McBain, 2014, Simas et al., 2014a) by including an explicit measure of fairness in our quantitative analysis.

The rest of this chapter is structured as follows. Section 5.2 describes the development of a living labour satellite account for the BRIC countries in 2005 and its application in an input-output model. Section 5.3 presents the results of our analysis. Section 5.4 discusses these results in light of the first aim of this chapter: contributing to our understanding of the fairness of BRIC wages in the Western European clothing supply chain. Section 5.5 discusses our results with respect to the second aim of this chapter, reflecting on their implications for how
firms might finance living wages. We summarise our arguments and their implications for our research going forward in Section 5.6.

5.2 Methods

In this section we present our methods. Section 5.2.1 outlines the process of producing a living labour compensation satellite account based on the living labour compensation estimates from Chapter 4. Section 5.2.2. describes important differences between our analysis in this chapter and the analysis presented in Chapter 3. Finally, we outline the methods for estimating how labour costs change by economic sector (5.2.3.1) and how these costs changes translate into consumer price increases (2.3.2).

5.2.1 Developing a Living Labour Satellite Account for BRIC, 2005

In order to assess the supply chain costs of a living wage we incorporate our living labour compensation estimates (see Chapter 4) into our sub-systems GMRIO framework. This means converting our estimates of annual living labour compensation for an average worker in each of the BRIC countries into estimates of the total living labour compensation for each economic sector. The first step in this process is to estimate the living labour compensation rate: the per hour cost of labour, where the living wage is paid.

The living wage should be able to be earned by workers in a normal working week – workers should not have to rely on overtime (Anker, 2011b). Therefore we divide the annual living labour compensation estimates by full time working hours. We assume that full time means 48 hours a week, 50 weeks a year. This is approximately in line with working time statutes in the BRIC countries (ILO, 2011) and reflects a general international consensus that more than 48 hours constitutes excessive working time (Lee et al., 2007).
We then multiply this living labour compensation rate by the actual number of hours worked in each economic sector to get an estimate of the total living labour compensation by sector. Estimates of hours worked for each of the WIOD sectors are available in the WIOD socio-economic satellite accounts. By multiplying estimates of the hours worked in each sector by the living labour compensation rate, we obtain estimates of the cost of labour by sector if the average wage had been equal to the living wage.

Finally, to estimate our living labour satellite account we compare our living labour compensation estimates by sector with the WIOD labour compensation estimates by sector. For those sectors where our living labour compensation estimate is less than WIOD’s labour compensation value we use the latter in our living labour satellite account. The rationale is that for this is that in this thesis (as with most previous work on living wages) we are interested in raising wages in developing countries\(^{23}\). This leaves us with estimates of the total cost of labour for each economic sector in each of the BRIC countries, after raising the average wage in all those sectors with an average wage less than the living wage in 2005 to a living wage. The full living labour satellite account is available in Appendix E and we plan to make it freely available online in the near future.

### 5.2.2 Focusing on Western European Household Clothing Supply Chains

Key to the idea that raising supply chain wages may have environmental benefits is the hypothesis that this will change consumer behaviour. Therefore, in this analysis we examine the Western European *household clothing* supply chain rather than the Western European *textiles and clothing* supply chain (Chapter 3 presents analysis of the latter). There are three differences between the two supply chains. First, ‘clothing’ refers to the Clothing and Footwear

\(^{23}\) However, it is worth noting that there may be some compression of the wage distribution in developing countries if a living wage were introduced, see Lemos (2009).
category in the Classification of Individual Consumption According to Purpose (COICOP). The outputs of several industries feed into this consumption category. The Textiles and Clothing sector is the principle contributor to the Clothing and Footwear category. However, not all of the output from the Textile and Clothing Sector ends up in the Clothing and Footwear category (because Textiles and Clothing industries also produce non-clothing goods such as household furnishings). As is standard practice, we use bridge matrices to convert between different classifications systems (for example, Tukker et al., 2009, Mongelli et al., 2010, for more detail on our bridge matrices see Appendix F).

Second, the prices faced by consumers (purchaser’s prices) include retail margins, transport margins and net taxes. The standard WIOD input-output table values consumption at basic prices, which does not include these factors. Therefore, the final demand figures for textiles and clothing reported in Chapter 3 are valued at basic prices. On the other hand, in this chapter we convert from basic to purchaser’s prices using a conversion matrix derived from the World Supply-Use Tables supplied by WIOD (Appendix F) and so final consumption expenditures reported in this chapter are valued at purchaser’s prices.

Finally, the Western European household clothing supply chain (hereon the Western European clothing supply chain) only includes household consumption, whereas the Western European textiles and clothing supply chain included government expenditure and other final consumer categories. These three factors mean that the results in this chapter are not directly comparable with those in Chapter 3. This change in emphasis was made to ensure that this chapter provided the most suitable data to aid model development in Chapters 6 and 7, both of which are focused on household consumption of clothing goods.
5.2.3 Changes in Labour Costs: The Quantity Input-Output Model

We use an input-output model to estimate the cost impact of living wage in the Western European clothing supply chain (an approach taken by several studies looking at minimum wage increases (Lemos, 2008, MaCurdy, 2015, Saari et al., 2016)). There are two ways to use input-output models for this purpose: the quantity model and the price model (5.2.4). The quantity model shows where in the supply chain the cost increases occur (e.g. how much of the cost increase occurs in Chinese manufacturing) and the price model shows how these cost increases are reflected in consumer prices (e.g. how the price of clothing in the UK increases). In this analysis we use both forms of the model.

The quantity model is the same as the model used in Chapter 3 but extended using change in the labour cost per unit of economic output following the introduction of the living wage:

\[
\Delta \mathbf{E} = \mathbf{\Delta wLY}_{wc}
\]  

(5-1)

where, \( \Delta \mathbf{E} \) is the impact matrix, \( \mathbf{\Delta w} \) is the diagonalised vector of changes in labour cost in each sector in the Western European clothing supply chain, \( \mathbf{L} \) is the Leontief inverse describing the interactions between different economic sectors, and \( \mathbf{Y}_{wc} \) is Western European household demand for clothing goods in 2005 at basic prices (where the subscript wc indicates Western European clothing consumption).

5.2.4 Changes in Consumer Prices: The Input-Output Price Model

In the general case, the price model defines a relationship between changes in the price of output of a sector and changes in the primary factors of production (Miller and Blair, 2009),

\[
\Delta \mathbf{p} = \mathbf{L'}\Delta \mathbf{v}
\]  

(5-2)
where \( \Delta p \) is the relative price increase by sector, \( \Delta v \) is the change in the unit cost of the primary factors of production and \( L' \) is the transpose of the Leontief inverse. The logic of equation (5-2) is that changes in the cost of the primary factors of production are completely passed along in the form of price increases at every stage of the supply chain.

For our purposes, the change in value added comes only from changes in labour cost. Therefore, \( \Delta v \) is equal to \( \Delta w \).

\[
\Delta p = L' \Delta w
\]

(5-3)

Multiplying the original Western European consumer demand bill by the relative price change \( (\Delta p) \) we can estimate change to \( \Delta Y_{wc} \): the change in Western European clothing prices, before retail margins, transport margins and net taxes (i.e. the change in basic prices),

\[
\Delta Y_{wc} = \tilde{\Delta p} Y_{wc}
\]

(5-4)

where \( \tilde{\Delta p} \) is the diagonalised vector of relative price changes as estimated in equation (5-3). At this stage the aggregate values of \( \Delta Y_{wc} \) and \( \Delta E \) (from the quantity model, equation (5-1)) are equal,

\[
\text{sum}(\Delta Y_{wc}) = \text{sum}(\Delta E)
\]

(5-5)

The difference between \( \Delta Y_{wc} \) and \( \Delta E \) is in how the change is distributed. \( \Delta Y_{wc} \) shows how the living wage is transmitted to consumers in different Western European countries as price increases whereas \( \Delta E \) shows how the living wage affects production costs at different points in the supply chain. At this stage, \( \text{sum}(\Delta Y_{wc}) \) or \( \text{sum}(\Delta E) \) can be added to the 2005 purchaser’s price Western European final demand bill for clothing to provide an estimate of the price increase faced by consumers assuming that the absolute values of retail margins, transport margins, and net taxes are unchanged.
However, we also estimate the final change in consumer prices accounting for any additional changes in retail margins, transport margins and net taxes (i.e. we convert from basic to purchaser’s prices). This is important because, as Miller and Williams (2009) note, changes in labour costs are likely to affect the net taxes and profit margins of retailers and will mean that the change in the final consumer price is greater than the change in labour costs alone.

Therefore, we estimate $\Delta f_{wc}$, a vector showing the Western European clothing final demand bill in each of our Western European countries incorporating proportional adjustments in taxes and retail margins,

$$\Delta f_{wc} = ((D \Delta Y_{wc}) \otimes M)i$$

where $D$ is a matrix converting $\Delta Y_{wc}$ from the WIOD classification to the Classification of Products by Activity (CPA)\(^{24}\), $M$ is a matrix converting from basic to purchaser’s prices (Appendix D), $\otimes$ denotes entrywise (element by element or ‘Hadamard’) multiplication, and $i$ is a vector of ones and zeros used as a summation function. The new Western European final demand bill for clothing is then,

$$f_{wc}^* = \Delta f_{wc} + f_{wc}$$

Where $f_{wc}$ is the original Western European clothing final demand bill in purchaser’s prices in the CPA classification system. The percentage price change in clothing consumption for each of the Western European countries ($g_{wc}$) is found by dividing each entry in $\Delta f_{wc}$ by the original consumer expenditure on clothing in the respective country,

$$g_{wc} = \Delta f_{wc} \odot f_{wc}$$

\(^{24}\) We convert to CPA because WIOD provides final demand data at both purchasers and basic prices in the CPA classification allowing us to easily convert between the two price concepts using the CPA classification. See Appendix D for more detail.
Finally, we can sum the elements of $\Delta f_{wc}$ to get the total change in the Western European clothing final demand bill,

$$\Delta f_{wc} = i' \Delta f_{wc}$$ (5-9)

5.2.5 Limitations of the method.

This chapter estimates the cost and price increases that might occur if clothing retailers and brands in Western Europe voluntarily choose to pay all the workers in their supply chains a living wage. Implicit in this aim is the assumption of fixed technology. That is, we assume that firms do not substitute capital or other inputs for labour as the price of labour increases. Likewise, we assume that firms do not move their production to other countries as the price of labour in one country increases, and that consumers do not reduce (or substitute) the amount of clothing goods they buy as the price of BRIC labour in the Western European clothing supply chain increases. These assumptions are isolations that allow us to focus solely on the price-pass through mechanisms that we are interested in. However, such mechanisms could be explored with a more complex model. Indeed, some alternative consumer, worker and firm responses will be explored further in upcoming chapters. Assumptions about the fixed nature of production technology could be relaxed using alternatives such as the RCOT model, or a CGE model (Folawewo, 2007, Lemos, 2008, Duchin and Levine, 2011).

5.3 Results

This section presents the results of our analysis. In sub-section 5.3.1 we compare the cost of BRIC labour under 2005 estimates to our counterfactual living labour scenario (where those sectors in BRIC with a 2005 labour compensation rate below the living labour compensation rate have their compensation rates raised up to the living labour compensation
rate) and present the living labour premium (the difference between labour cost in 2005 and labour cost in the counterfactual). In sub section 5.3.2 we look at how the living labour premium is distributed across 5 economic sectors. We then compare the living labour premium to several other supply chain costs, each related to various proposed financing mechanisms. For example, it is often argued that retailers can finance living wages by passing cost increases to consumers (e.g. Pollin et al., 2004). Therefore, we compare the living labour premium to the Western European household final demand bill and estimate the average price increase needed to finance our living wage estimates (section 5.3.3). Similarly, it has been suggested that wage related cost increases for lower paid employees have been financed by firms through reduced profit margins (e.g Metcalf, 2007, Hirsch et al., 2015) or by reducing the wages of those higher up the wage scale (Schmitt, 2015). Thus we compare the living labour premium to supply chain labour costs (section 5.3.4), and supply chain profit and Western European retail margins (section 5.3.5).

### 5.3.1 The additional cost of BRIC workers in the Western European clothing supply chain in the living wage counterfactual

Labour compensation for BRIC workers in the Western European clothing supply chain almost doubles in our living labour compensation counterfactual. The right hand bar in Figure 5-1 shows that in 2005 the cost of BRIC labour in the Western European clothing supply chain was ~10 billion USD MER. The left hand bar in Figure 5-1 shows the counterfactual scenario. In this counterfactual the cost of BRIC labour in the Western European clothing supply chain is approximately 20 billion USD MER.
Figure 5-1 Change in the cost of labour in the BRIC parts of the Western European clothing supply chain associated with paying BRIC workers a living labour compensation rate.
5.3.2 Sector Level Living Labour Premiums

Figures 5-2 and 5-3 show how the additional costs of living labour compensation were distributed across sectors within the BRIC parts of the Western European clothing supply chain. In other words, Figures 5-2 and 5-3 show how the cost of labour increased in the BRIC countries by sector under the living labour compensation counterfactual. As expected, in most sectors paying the living wage represents an additional cost.

Figure 5-2 Absolute labour cost increase associated with the living wage in the BRIC countries by sector

Figure 5-3 Relative labour cost increase associated with the living wage in the BRIC countries by sector
In both absolute (Figure 5-2) and relative (Figure 5-3) terms the biggest cost increase was in the Agricultural sector where costs increased by 4 billion USD MER (168%), followed by the Textiles and Clothing sector (3 billion USD MER, 98%). These findings are intuitive given the low wages for workers in these sectors that we reported in Chapter 3 and the general literature on skill level and working conditions in the Agricultural and Textile and Clothing parts of apparel supply chains (e.g. Rivoli, 2006). We would expect workers with relatively low skill levels to be paid considerably below living wage levels and therefore for sectors with lots of such workers (like Agriculture and Textiles and Clothing) to see large labour cost increases following the introduction of living wages.

The Other Manufactures and Service sectors have smaller labour cost increases than the Textiles and Clothing and Agriculture sectors because wages in the Other Manufactures and Service sectors were closer to the living wage in 2005 (and hence, labour compensation was closer to living labour compensation). Similarly, there was no increase in labour costs in the Energy and Resources sector because wages in this sector were above our living wage estimates. Although these sectors contain very heterogeneous activities in our classification, these results are consistent with general expectations around the wage rates in different industries. For example, the Energy and Other Resources sector in our classification system (Appendix B) includes the Mining and Quarrying, and the Electricity, Gas and Water supply sectors. Both of these sectors were above the industry average for the 2000-2005 ILO sectoral wage estimates for Brazil, Russia, and China (data for India was unavailable) (ILO, 2015).

5.3.3 Living Wage Impacts on Consumer Prices

Figure 5-4 shows that paying BRIC workers in the Western European clothing supply chain a living labour compensation rate would have added 22.5 Billion USD Western European clothing final demand bill, assuming full pass-through of cost increases at every stage of the
Western European clothing supply chain and proportional increases in retail margins, transport margins and net taxes. This is equivalent to an average price increase of ~6%. Making the alternative assumption of no increases in retail margins, transport margins or net taxes, the 10 Billion USD labour cost increase alone is only equal to an additional 3% on prices. However, these figures should be interpreted with care as they are likely to hide substantial variation in the price increase in different Western European countries and across different products. Nonetheless it seems reasonable given that BRIC labour represents only a small proportion of the total cost of production in the Western European textiles and clothing supply chain (see Chapter 3).

![Figure 5-4 Difference between the Western European clothing final demand bill in the living wage counterfactuals and in 2005. The solid black bar (far left) shows the price increase in accounting for increases in retail margins, transport margins and net taxes. The grey central bar shows the price increase assuming the absolute value of retail margins, transport margins and net taxes remain constant. The bar filled with diagonal lines (far right) shows the Western European clothing final demand bill in 2005.](image)
5.3.4 How do the Additional Costs of the Living Wage Compare to Returns to Capital and Western European Retailer Margins?

Table 5-1 presents the living labour premium as a percentage of the returns to capital generated in different parts of Western European clothing supply chain and the retail margins, transport margins and net taxes, both proxies for profit. The additional costs of paying living labour compensation in the BRIC parts of the Western European clothing supply chain are equal to around 6% of the retail margins, transport margins and net taxes paid by Western European retailers. Across the supply chain as a whole, the additional labour costs associated with BRIC living wages in the Western European clothing supply chain are equal to ~15% of the returns to capital. Looking at the returns to capital by region, the living labor premium is equal to approximately 23% of returns to capital generated in Western Europe and 92% of returns to capital generated in BRIC. However, it is important to recall that these figures show where return to capital is generated not where it finally ends up and also that we might expect intermediary partners to increase their profit margins in response to living wage increases (Miller and Williams, 2009), something we do not model here.

Table 5-1 Size of the additional costs of paying BRIC workers in the Western European clothing supply chain a living wage relative to returns to capital and retail margins, transport margins and net taxes.

<table>
<thead>
<tr>
<th>Profit Measure</th>
<th>Location Profit Generated</th>
<th>Additional Labour Costs of Living Wage as a Percentage of the Profit Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns to Capital</td>
<td>Complete Supply Chain</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Western Europe</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>BRIC</td>
<td>92%</td>
</tr>
<tr>
<td>Retail Margins, Transport</td>
<td>Western Europe</td>
<td>7%</td>
</tr>
<tr>
<td>Margins and Net Taxes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.3.1 How do the Additional Costs of the Living Wage Compare to other Labour Compensation costs?

Table 5-2 shows the additional costs of paying BRIC workers in the Western European clothing supply chain a living wage as a percentage of the total labour costs in the Western European clothing supply chain (8%). It also shows that the additional costs of the living wage counterfactual are equal to 10% of the Western European labour costs in the Western European clothing supply chain. These results are as expected. The work presented in Chapter 3 showed that wage rates in Western Europe are much higher than in BRIC. As a result, it makes sense that a doubling of BRIC labour costs would be equal to a relatively small share of Western European labour costs.

Table 5-2 Additional costs associated with paying BRIC workers in the Western European clothing supply chain a living wage as a percentage of total and Western European labour costs in the Western European clothing supply chain.

| Additional Labour Costs of Living Wage as a Percentage of Labour Compensation |
| Complete Supply Chain | 8% |
| Western Europe | 10% |

5.4 Fair wages?

We found that the difference between living labour compensation and labour compensation in the Western European household clothing supply chain was positive and substantial, around 10 Billion USD MER or 15% of the total labour cost in the Western European clothing supply chain in 2005. This figure was equal to almost doubling the cost of labour in BRIC. In this way, the analysis in this chapter suggests that substantial numbers of workers in the Western European clothing supply chain do not earn enough to live a decent
life. Therefore, our analysis supports the suggestion in Chapter 3 that BRIC wages in the Western Europeans clothing supply chain are unfair and supports previous work arguing that many workers in global supply chains are treated unfairly (Alsamawi et al., 2014a).

Additionally, we found that the Agricultural sector would see the largest labour cost increase if a living wage were implemented. This supports our previous findings showing that the Agricultural sector had a very low wage bill for the large number of hours worked. These results reinforce the need for the full value chain, and in particular the agricultural sector, to be considered by Western European retailers and brands. Despite commitments to full value chain assessment in some quarters (e.g. Scherman, 2015, New Look, 2011, ETI, 2015), there remains a major focus on garment factory workers in most discussions of social sustainability in the textile and clothing sector (e.g. Miller and Williams, 2009, Asia Living Floor Wage, 2014, Clean Clothes Campaign, 2015, Labour Behind the Label, 2015). There may be good reasons for excluding agricultural workers from living wage commitments – at least in the short term. For example, it may be infeasible for Western European brands to dictate labour costs in the agricultural stages. Moreover, there is a risk that increasing wages for garment factory workers could squeeze wages further down the value chain if garment manufacturers attempted to reduce their non-labour costs by pressuring their suppliers to provide them with cheaper materials.

Finally, we should note here that there is more to the fair wage debate than living wages alone. Vaughan-Whitehead (2010), for example lists 12 dimensions he considers essential to “fair wages”. Only one of these is the living wage (though others such as social insurance requirements are also captured by our living labour compensation metric). However, such definitions invariably include the living wage, the result being that living wages are seen as a necessary but not sufficient condition for a fair wage system. Consequently, while we cannot
say that our living labour compensation scenario represents all the costs of a fair wage system, we can say that the presence of labour cost increases in the scenario is evidence of unfair wages.

5.5 Financing a Living Wage

In this section we discuss the implications of our results for various ways firms might finance living labour compensation. In particular, we focus on three proposed channels of adjustment: price increases (5.5.1), wage compression (5.5.2) and profit reduction (5.5.3). The aim of this section is to begin to evaluate the feasibility of each of these mechanisms. This discussion lays the groundwork for more detailed investigation of the mechanisms and their likely impacts for environmental and social sustainability in Chapters 6 and 7.

5.5.1 Price Increases

We estimated that paying living labour compensation to BRIC workers in the Western European clothing supply chain would lead to an average price increase of 6% in Western European clothes, assuming full price pass through of cost increases to the final consumer. This is at the higher end of the 1-7% range found in the existing literature (Miller and Williams, 2009, Pollin et al., 2004, WRC, 2005, Fairwear Foundation, 2012). There are several important differences between our estimates and those already found in the literature which mean they should not be directly compared. First, the existing studies only cover garment factory workers while we include workers in multiple sectors. This has the effect of increasing our estimates relative to those already in the literature. Second (as discussed in Chapter 4) the existing estimates are all for specific supply chains covering a single good being delivered to a single country while our estimates are for a much broader supply chain delivering multiple types of clothing goods to multiple countries. All the existing estimates are for very labour intensive forms of clothing (T-shirts, sportswear, sweatshirts, etc.). On the other hand, our very broad
supply chain is likely to include some clothing goods that are less labour intensive than the examples available in the current literature. This will have the effect of reducing our estimates relative to those already available.

Additionally, we account for increases in social security costs to employers and increases in wholesale/retail margins and taxes paid by the final consumer (such as VAT and import duty). This has the effect of increasing our estimate relative to those that do not account for these increases (e.g. WRC, 2005). However, our model assumes that intermediate producers do not face additional tax increases or increase their desired profit margins. This has the effect of reducing the size of our estimates compared to Miller and Williams (2009) whose estimate does include the impact of intermediary tax increases (and who estimate a 7% price increase).

Despite these differences our estimates are of comparable size to existing estimates and it is interesting to note that several of the studies cited above consider price increases greater than our estimate to be relatively inconsequential from the consumer perspective (Pollin et al., 2004, WRC, 2005, Miller and Williams, 2009). Though counter-intuitive, this view does find support elsewhere in the literature. For example, in a comprehensive meta-analysis Tully and Winer (2014) found that on average 60% of respondents state that they are willing to spend 17% more for a socially responsible product. Moreover, this premium rises if the social responsibility measure directly benefits humans (e.g. improved labour practices) rather than being in improved environmental performance or animal welfare. Similarly, Hertel et al (2009) report that 62% of Americans would be willing to pay a premium of 25% for a “sweatshop free” sweater, Elliot and Freeman (2000, cited in Pollin et al., 2004) find that on average consumers are willing to pay a 15-28% premium for non-sweatshop labelled goods, and Hiscox and Smyth (2006) find only a -1.5% price elasticity of demand for a 20% increase in the price of towels if the towels were labelled as produced under good labour standards.
However, not all results are so encouraging. For example, Prasad et al., 2004) find that only around 30% of consumers would pay any level of premium for socks labelled as made in ‘Good Working Conditions, no child labour, no sweatshops and safe workplaces’ while Shaw et al., 2006) reports that even highly motivated ethical consumers find price a barrier to purchasing fairtrade/sweatshop free clothing. Nonetheless the balance of evidence appears to suggest that a large portion of consumers would have paid a big enough premium to raise wages to a living wage level in the BRIC countries in 2005.

The BRIC countries were chosen because in 2005 they provided a large, possibly a majority, of low wage labour in textile and clothing production at this time. The previous chapter suggested that this pattern is shifting. However, there is no reason to believe that the living labour compensation premium is significantly higher with the new patterns of labour use since 2005. Moreover, the willingness to pay studies we have cited suggest that even if the premium stands at double or triple our estimate consumers would pay the difference.

Of course, there are limitations to these studies. Most of the studies cited are based on small samples of US consumers – so their applicability to Western European markets is not a given. Moreover some of the studies use poll data (e.g. Hertel et al., 2009) and may not give an accurate picture of how consumers actually behave. The attitude-behaviour gap is an established social-psychological phenomenon where our actions do not reflect our stated attitudes (Jackson, 2005). That said, some encouraging studies are based on experimental data (for instance, Hiscox and Smyth (2006)) and as such should reflect revealed, rather than stated, preferences. Perhaps more importantly though, just because consumers are willing to pay the increase in prices, does not mean there would be no negative side effects of them doing so. Consumers have constrained budgets, and so to accommodate price rises they either have to purchase fewer clothing goods, or reduce spending in other sectors of the economy. Depending
on how consumers accommodated the price increase, and how suppliers responded, we might expect the situation for workers in BRIC to be better or worse after the wage increase. The next chapters explore this in more depth.

5.5.2 Wage Compression

Recent research provides evidence that that some firms compress their wage distributions in response to minimum wage increases (Dube et al., 2007, Lemos, 2009, Hirsch et al., 2015). This ‘wage compression’ leads to firms reduce pay increases and performance related bonuses for their employees who earn more than the new minimum wage. By reducing labour costs (in real terms) for employees above the minimum wage, employers can ensure that their overall labour compensation bill does not rise (Hirsch et al., 2015). Because we are looking at global supply chains – networks of interconnected but distinct firms – it is unclear what compression mechanisms could look like here. However, we estimated that paying the living wage in the BRIC countries in 2005 would have only increased the total supply chain labour costs by around 8% (see Table 5-2). Similarly, the additional cost of paying BRIC workers a living wage is equal to only around 10% of the labour costs in the Western European parts of the supply chain. Therefore, we suggest that there is some scope for wage compression as a way of financing living wages. We further investigate this in Chapter 7.

5.5.3 Profit Reduction

Our estimate of the additional cost of living labour compensation was equal to 15% of supply chain profits, 92% of BRIC profits and 23% of Western European profits (Table 5-1). These figures seem to support the concerns of developing country suppliers that they would not make a profit if forced to pay a living wage out of their own costs (Egels-Zandén, 2015). Moreover, it seems unlikely that Western European firms will accept a 23% reduction in profits to pay for a living wage. Indeed it is worth noting that even where developed country clothing
brands have initially reduced profits in order to finance developing country living wages this has been seen as a temporary measure (Egels-Zandén, 2015).

On the face of it, therefore, there appears to be more scope to finance living wages from retail margins. As with all our data, our retail margins should not be taken as anything other than a rough estimate – particularly as data on retailer margins are notoriously hard to find. However, our estimate of retail and transport margins plus net taxes as ~55% of the final consumer price are in line with other estimates (e.g. Miller and Williams, 2009) and we note that H&M, ASOS and Inditex, for example, reported gross margins of 59.6%, 49% and 56.2% respectively in 2004/5 (ASOS PLC, 2004, H&M, 2005, Inditex, 2005). However, this profit is used by clothing retailers to pay for their own direct costs including labour. Therefore, the extent to which this ‘profit’ can be reduced and used to finance supply chain living wages depends on how much of it is ‘pure’ profit. In 2004/5, H&M and Zara reported net operating profit (after their direct costs), of around 21% and 25% respectively (H&M, 2005; Inditex, 2005). If such margins are typical of the sector, it may be possible to redistribute profits to pay for living wage increase. However (even with such margins), it is likely to be challenging to persuade firms to accept the required profit losses. Moreover, operating profit margins are highly variable among clothing retailers and H&M and Zara are market leaders. Other clothing retailers are likely to have substantially smaller profit margins. For instance, ASOS reported a much more modest 6% operating profit margin in 2004/5 (ASOS, 2004).

5.6 Conclusions

In this chapter we presented estimates of the increased labour costs associated with paying BRIC workers living labour compensation in 2005, all else being equal. We estimated that in BRIC countries the labour compensation bill would have almost doubled had living labour compensation been paid. As in the previous chapter, we found that taking a full supply
chain approach highlighted the low pay of agricultural workers – a group often neglected in discussion of social sustainability in a clothing context.

Considering how payment of living labour compensation might be financed we estimated that the total cost increase would be a relatively small proportion of the average price of a clothing good in Western Europe, well within the premiums that willingness to pay studies have indicated consumers would pay for ‘sweatshop free’ clothing. Likewise, we estimated the increased cost represented by a living wage to be only small proportion of retail, wholesale and transport margins.

The results presented here support the arguments advanced in the previous chapter in as much as they suggest that passing cost increases to consumers is feasible. However, the effect this would have on BRIC workers and supply chain carbon emissions is still unclear. In the next chapter we investigate this issue in more detail, in particular focusing on the carbon and employment impacts of the changes in both BRIC and Western European countries under three different scenarios of consumer behaviour. In Chapter 7 we revisit the other channels of adjustment discussed here by developing a dynamic model.
Chapter 6  Raising Prices to Pay for the Living Wage: a Demand Side Sustainability Analysis.

An early version of this chapter was presented as Mair, S. Druckman, A. Jackson, T, How much for your shirt? Implications of Paying BRIC Workers a Living Wage, Taking Stock of Industrial Ecology, International Society for Industrial Ecology, University of Surrey, UK, July 2015

6.1 Introduction

In this chapter, we investigate the sustainability implications of passing the increased costs of paying a living wage to BRIC workers in the Western European clothing supply chain through to consumers. The analysis presented here is an extension of the analysis in Chapter 5: we link demand elasticities to our input-output model, and use this framework to explore how the price increases estimated in Chapter 5 might affect BRIC employment and global carbon emissions.

As in Chapter 5, the model emphasises the mechanisms that we would expect to be prominent in soft living wage initiatives, where payment of the living wage is a voluntary exercise undertaken by Western European clothing retailers (Miller and Williams, 2009, New Look, 2011, M&S, 2015). Therefore, we again assume constant production technology, and only simulate price increases for those BRIC workers working in the Western European clothing supply chain. However, using various demand elasticities, we extend the previous analysis to consider three different scenarios of Western European consumer behaviour and to account for potential effects caused by subsequent changes in global expenditure.
The primary purpose of using a relatively simple modeling framework is to isolate specific causal mechanisms rather than attempt to accurately predict effects in a given scenario. Therefore, although the model most closely resembles voluntary payment of a living wage by Western European clothing retailers in their supply chains, it is not our intention to evaluate this scenario per se. In fact, this scenario is itself quite stylised. The fragmented and long nature of clothing supply chains makes wage compliance difficult (Pickles 2012) and incentives to firms to move to more cost efficient production technology would still exist. Instead, in this analysis we are interested in exploring two mechanisms that we believe to be important, but which have been understudied: 1) Changes in Western European consumption in response to clothing price increases and 2) subsequent changes in global demand or ‘respending’ effects. Therefore we use a simplified modelling system that allows us to look at how these mechanisms might work in the absence of other, confounding, and mechanisms (such as shifting production or trade patterns). Through these simplifying assumptions, we aim to enhance our understanding of how these specific mechanisms might work. With this understanding as a baseline, later work can add in additional mechanisms and explore their interactions.

We choose to highlight mechanism 1) because there is considerable debate around whether price increases associated with living wages would lead to reduced levels of clothing consumption (Birnbaum, 2000, Miller and Williams, 2009, Dirnbach, 2008, Powell and Zwolinski, 2012). Regardless, because consumers have constrained budgets it is likely that even if consumers do not reduce their clothing consumption they will reduce consumption in other areas. Indeed, Girod and de Haan (2009) report that when consumers choose to purchase more expensive goods, they reduce their environmental impacts partly because they spend more money on low impact consumption items, leaving less money available for spending on high impact consumption items. However, reduced consumption is widely believed to have negative implications for social welfare (Powell and Zwolinski, 2012, Confino, 2015).
Therefore, our model explores the impacts of three alternative responses Western European consumers might have to the clothing price increases.

Likewise, we choose to highlight mechanism 2) because changes in Western European demand arising from the change in clothing price will affect the income of workers around the world which in turn this will influence global consumer demand. But, the sustainability implications of this are unclear. For example, there is debate around whether the additional income of recipients of the living wage could have an employment multiplier effect, cancelling out any disemployment effects (Coakley and Kates, 2013, Sollars and Englander, In Press). There are parallels here with the environmental rebound literature, where changes in income due to environmental abatement actions affect the overall environmental impact of that abatement action (Druckman et al., 2011).

Therefore, the primary contribution of this chapter is that it makes the first systematic examination of the potential social and environmental effects of passing supply chain living wage costs through to consumers. As discussed previously, most studies examining the effect of living wages on prices have not systematically considered how consumers might respond to such price increases (Birnbaum, 2000, Pollin et al., 2004, Miller and Williams, 2009). More broadly it is one of the first analyses to look at environmental aspects of living wages or to consider responding effects. In this way it builds on work by Druckman and Jackson (2010) who examine carbon emissions associated with living wages in the UK. However, the context of this chapter is very different from Druckman and Jackson’s (2010) work as we simulate the living wage being implemented in a developing rather than a developed country. This chapter also builds on earlier work that has suggested that multiplier effects may be associated with wage increases (Coakley and Kates, 2013).
6.2 Methods

In this section we set out our modelling framework. The framework is built around the sub-systems global multi-regional input-output model described in Chapter 3. All input-output data comes from the World Input-Output Database (WIOD, see Chapter 3 for a description). The additional costs and price increases following the BRIC living labour compensation payment are taken from Chapter 5. All other data sources are described in the text below. In keeping with the previous two chapters, all data are for 2005. Section 6.2.1 provides a descriptive overview of the modelling framework. Section 6.2.2-6.2.4 provides the detail on the model structure and equations.

6.2.1 Modelling Framework Overview

Figure 6-1 provides an overview of our modelling framework. The modelling process can be separated into three stages:

1. **WEU Clothing Demand Effect** ($e_{we}$). First, we estimate how changes in Western European (WEU) clothing demand (in response to the living wage price increase) affect our indicators. To do this we multiply the change in the Western European clothing price by own-price elasticities of demand for clothing in Western European countries. This generates a new Western European clothing demand vector that is used as an input to a price-adjusted input-output model (which reflects the changed prices due to increased labour costs). This process is represented by black arrows on Figure 6-1.

2. **WEU Non-Clothing Demand Effect** ($e_{wo}$): The second stage is to estimate how changes in Western European (WEU) non-clothing demand affect our indicators. To do this we multiply the change in the Western European clothing
price by cross-price elasticities of demand with respect to clothing in Western European countries. This generates a new Western European non-clothing demand vector that is used as an input to the standard input-output model (we assume labour costs and prices remain static in non-clothing production). This process is represented by red arrows on Figure 6-1.

3. **Global Respending Effect** ($e_g$): Finally we estimate the impact of the change in demand in all non-Western European countries following changes in non-Western European income *that are caused by* the WEU clothing demand effect and WEU non-clothing demand effect. To do this we multiply the estimated relative change in income in Non-Western European countries by income elasticities of demand and combine the resulting vector of final demand changes with the standard input-output model. The global respending effect is represented by the grey dashed arrows on Figure 6-1.

The estimated total impact ($e_a$) of paying BRIC workers in the Western European clothing supply chain a living wage is given by,

$$e_a = e_{wc} + e_{wo} + e_g$$  \hspace{1cm} (6-1)
The indicators of primary interest in this analysis are global carbon emissions and BRIC employment. In order to estimate the global respending effects we also model changes in labour compensation (see 6.2.4).

Figure 6-1 Overview of the modelling framework used in this chapter.
6.2.2 WEU Clothing Demand Effect

The WEU clothing demand effect describes how the price increase from paying BRIC workers in the Western European clothing supply chain a living wage changes Western European demand for clothing goods, and the subsequent impacts on our indicators. In Chapter 5 (equations (5-7) and (5-8)) we estimated the change in the Western European clothing final demand bill and the percentage clothing price increase in each of the Western European countries ($g_{wc}$). Combining these with own-price elasticities of demand for each Western European country we can estimate the change in demand for clothing in Western Europe ($\Delta j_{wc}$).

$$\Delta j_{wc} = g_{wc} \otimes \varphi_{wc} \otimes f_{wc}^*$$

(6-2)

Where $\varphi_{wc}$ is a vector of the own price elasticities for Western European clothing by country, and $f_{wc}^*$ is the vector of the ‘new’ cost of Western European clothing by country (estimated in equation 5-7). The own price elasticity values vary by scenario (as discussed in Section 6.3, below).

$\Delta j_{wc}$ is the change in demand for the COICOP clothing category valued at purchaser’s prices in Western Europe. To use this for impact analysis we convert $\Delta j_{wc}$ into the WIOD classification at basic prices using bridge matrices (Appendix F). This gives us $\Delta y_{wc}$, a vector of the Western European demand for clothing goods valued at basic prices in the WIOD classification following the BRIC living wage price increase.

$\Delta y_{wc}$ is used as an input to a price adjusted form of the sub-systems GMRIIO presented in Chapter 3

$$e_{wc} = Q' \Delta y_{wc}$$

(6-3)
where: \( \mathbf{e}_{wc} \) is a vector of impacts (changes in labour compensation, employment or carbon emissions) caused by the change in Western European demand for clothing goods following the BRIC living wage price increase; \( \mathbf{Q}^* \) is the matrix of impacts per unit of final demand as in Chapter 3 (equation (3-2)) but derived using Leontief inverse and economic output parameters that reflect the new price of commodities following the living wage increase in BRIC. The derivation of \( \mathbf{Q}^* \) follows Choi et al., (2010) in using the price index estimated in Chapter 5 equation (5-3) to make the relevant adjustments. Derivation of \( \mathbf{Q}^* \) is given in Appendix G.

### 6.2.3 WEU Non-Clothing Demand Effect

The WEU non-clothing demand effect describes how the price increase from paying BRIC workers in the Western European clothing supply chain a living wage changes Western European demand for non-clothing goods, and the subsequent impacts on our indicators. To estimate the percentage change in demand for non-clothing goods in Western Europe (\( \Delta \mathbf{J}_{wo} \)), we multiply the cross-price elasticities of demand with respect to clothing (\( \Psi_{wc} \)) for 8 consumption categories\(^{25}\) by the clothing price increase,

\[
\Delta \mathbf{J}_{wo} = \mathbf{G}_{wc} \otimes \Psi_{wc} \otimes \mathbf{F}_{wo}
\]

where \( \mathbf{G}_{wc} \) is a matrix made by repeating \( \mathbf{g}_{wc} \) 8 times and \( \mathbf{F}_{wo} \) is the final demand bill for all Western European non-clothing goods in purchaser’s prices. As with the own price elasticities of demand (Section 6.2.2) the cross-price elasticities of demand with respect to clothing (\( \Psi_{wc} \)) vary by scenario (see section 6.3).

As in 6.2.2, we then convert \( \Delta \mathbf{J}_{wo} \) to the WIOD classification and to basic prices. This gives us \( \Delta \mathbf{y}_{wo} \), a vector of Western European demand for non-clothing goods following the

\(^{25}\) As defined by Meade et al., (2011): Food Beverages and Tobacco; Gross Rent, Fuel and Power; House Furnishings; Medical Care; Transport and Communication; Recreation; Education; Other.
BRIC living wage price increase in the Western European clothing supply chain. $\Delta y_{wo}$ can be used as an input to our standard GMRIO\textsuperscript{26} for impact assessment,

$$e_{wo} = Q \Delta y_{wo}$$

where: $e_{wo}$ is a vector of impacts (changes in labour compensation, employment or carbon emissions) resulting from the change in Western European demand for non-clothing goods following the BRIC living wage price increase and $Q$ is the matrix of impacts per unit of final demand as in Chapter 3 (equation (3-2)).

### 6.2.4 Global Respending Effect

The global respending effect describes how the changes in Western European demand (estimated in 6.2.2 and 6.2.3) drive changes in global demand, which have their own impacts. Most obviously, we would expect a change in the demand in the BRIC countries where total income is likely to change substantially as a result of both the changes in wage rates and the change in Western European demand. However, we would also expect some (smaller) changes in demand in other countries due to the interconnected nature of the global economy.

To estimate these effects, we make two simplifying assumptions. First we assume that percentage changes in labour compensation are equivalent to the resulting percentage change in income. Second we assume that there is no change in income in Western Europe. These assumptions allow us to multiply the percentage change in labour compensation in the Non-Western European countries ($H_g$, derived from equations (6-3) and (6-5)) by the relevant income elasticities of demand ($\Phi_g$),

$$\Delta J_g = H_g \otimes \Phi_g \otimes F_g$$

\textsuperscript{26}We do not use the price adjusted GMRIO as the price of goods in all supply chains other than Western European clothing are assumed to remain constant.
where $F_g$ is the Non-Western European final demand bill. Note that, unlike for Western European price elasticities of demand, the elements of $\Phi_g$ are constant between scenarios (taken from Muhammad et al., 2011).

Finally as for the previous two effects we convert $\Delta J_g$ to WIOD classification and basic prices. This gives us $\Delta y_g$, a vector of the change in all non-Western European final demand following the BRIC living wage price increase in the Western European clothing supply chain. This can be used as an input to the standard GMRIO model from Chapter 3,

$$e_g = Q\Delta y_g$$

where $e_{wo}$ is a vector of impacts (changes in employment or carbon emissions) resulting from the change in Non-Western European demand following the BRIC living wage price increase in the Western European clothing supply chain.

### 6.3 Scenarios

For this analysis we simulate 3 scenarios of Western European consumer responses to the price increase associated with paying BRIC workers in Western European Clothing supply chain a living wage, each drawing on a different narrative found in the literature. All scenarios deal with alternative consumer responses to price increases driven by payment of the living wage (note that we do not explicitly model changes in the longevity of clothing).

Sub-sections 6.3.1-6.3.3 describe the unique characteristics of each scenario. The following characteristics are shared between scenarios:

- All cost increases are passed to the final consumer in their entirety (full price pass-through),
- Constant production technology (i.e. no returns to scale or substitution between inputs to production),

- Unconstrained factors of production (i.e. no limits on employment, capital or natural resources),

- All scenarios use the same ~6% price increase estimated in Chapter 5, resulting from the paying BRIC workers in the Western European clothing supply chain a living labour compensation,

- The same income elasticities of demand for the non-Western European countries.

As discussed above, these assumptions are consistent with a voluntary living wage initiative in the Western European clothing supply chain, but primarily serve to help us isolate the effects of the causal factors we are most interested in. Therefore, they should not be considered a limitation of our modelling framework, as such. For example, although the assumptions of full price pass through and no technological change are strong assumptions and it is arguable how well they hold (see 6.5.3) they are key to the arguments put forward as the basis for our scenarios. However, they do limit the generalisability of our results, and future work could relax some of the assumptions (for example, constant production technology) through the application of an alternative model (see Lemos, 2008 for a discussion of several alternative modelling approaches applied in a minimum wage context).

### 6.3.1 Slow Fashion

The key characteristic of our Slow Fashion scenario is that shifts in consumer preferences lead to consumers spending approximately the same amount of money, but purchasing fewer physical goods. The following quote from the designer Kate Fletcher (2008P. 173) captures the spirit of this scenario:
“Garments are still mass produced, but they are done so in supplier factories that pay living wages...[therefore] slow fashion pieces will cost substantially more than they do today... This will result in us buying fewer...products and bring key resource savings”

To operationalise this in our model, we set Western European own-price elasticity of demand with respect to textiles and clothing goods values as -1. This means that Western European nominal spend on textile and clothing goods remains constant, while the physical quantity of textile and clothing goods drops proportionally with the price increases. As Western European consumers accept the complete price increase and fund this by purchasing fewer clothing goods, there is no WEU non-clothing effect in this scenario (cross-price elasticity values are set to zero).

6.3.2 Willing to Pay

The key assumption of Willing to Pay is that consumers will accept the price increases and will not reduce the quantity of textiles and clothing goods that they demand. This scenario draws from the willingness to pay and living wage studies discussed in chapter 5 (e.g. WRC, 2005, Tully and Winer, 2014). This is modelled by setting Western European own-price elasticity of demand with respect to clothing goods values to 0: in this scenario demand for clothing goods in Western Europe is perfectly inelastic.

However, we assume Western European consumers have fixed budgets and so will have to transfer expenditures from other categories to textile and clothing goods. We treat the increased expenditure on clothing goods as analogous to a decrease in real disposable income (following Chitnis et al., 2013, Chitnis et al., 2014). This allows us to use income elasticity of demand values in the relevant matrix of elasticities in the model framework. As with the other
income elasticities of demand used in the model, the Western European income elasticities of demand are taken from Muhammad et al., (2011).

### 6.3.3 Business as Usual

**Business as Usual** assumes no substantial deviation from estimated consumer responses to historic price changes. Therefore, where the previous scenarios assumed a shift in consumer preferences (**Slow Fashion**) or that consumers respond differently to socially responsible price increases than to other price increases (**Willingness to Pay**), **Business as Usual** assumes that historic consumer responses to price changes are a good approximation of how consumers would react to the proposed living wage price change.

To model this we take the Cournot-uncompensated own-price and cross-price elasticity values for 9 consumption categories\(^\text{27}\) from Meade et al. (2011) and Muhammad et al. (2011) respectively. These values were estimated from the World Bank International Comparison Programme dataset (covering all the countries in our model apart from Greece), using the Florida model (discussed extensively by Seale and Regmi, 2006). On average, the Western European own-price elasticity of demand for textiles and clothing goods is approximately -0.7, while the cross-price elasticity values vary between -0.006 and -0.02.

### 6.4 Results

#### 6.4.1 Overview of Changes in BRIC employment and Global Carbon Emissions

For each scenario, Figure 6-2 shows how BRIC employment changes relative to BRIC employment supported by the 2005 Western European clothing supply chain. Likewise, Figure

\(^\text{27}\) Food Beverages and Tobacco; Clothing and Footwear; Gross Rent, Fuel and Power; House Furnishings; Medical Care; Transport and Communication; Recreation; Education; Other.
6-3 shows how global carbon emissions change relative to global carbon emissions embodied in the 2005 Western European clothing supply chain. Both BRIC employment and global carbon emissions increase in all three scenarios, though BRIC employment increases by substantially more than global carbon emissions. Conversely, there is relatively little variation between scenarios within the respective indicators: BRIC employment varies between 45% and 57%, while global carbon emissions vary between 4% and 5%. However, it is clear that **Willing to Pay** has both the biggest increase in employment (57%) and the biggest increase in carbon emissions (5%).

![Bar chart showing percentage change in BRIC employment](chart.png)

**Figure 6-2** Total change in BRIC employment (relative to the BRIC employment supported by the 2005 Western European clothing supply chain) caused by paying BRIC workers in the Western European clothing supply chain a living wage and passing all costs through to Western European consumers in three scenarios. Figures account for the impact of changes in Western European consumption (WEU clothing demand and non-clothing demand effects) and the impact of changes in global consumption (global respending effect).
6.4.2 Explaining the Change in BRIC Employment

In all scenarios the large increase in BRIC employment is caused by the global respending effect. Figure 6-4 shows how each of the three effects (WEU clothing demand, WEU non-clothing demand and global respending) contributes to the net increase in BRIC Employment in each scenario. The changes in Western European clothing consumption (WEU Clothing effect) reduce employment in BRIC by between ~7% in Slow Fashion and ~5% in Business as Usual (there is no WEU clothing effect in Willing to Pay as physical consumption remains constant). Similarly, changes in Western European non-clothing consumption (WEU non-clothing effect) reduces employment in BRIC by less than 1% in all scenarios. Conversely, changes in global expenditure (global respending effects) increase BRIC employment (compared to BRIC employment previously supported by Western European clothing consumption).
consumption) by approximately 50% in all scenarios. Both own and cross-price effects lead to only very small reductions in carbon emissions. As with BRIC employment, this is because the price increase is only small. Additionally, the effects are further reduced by the relative inelasticity of demand in Willing to Pay and Business as Usual. This is particularly the case for the cross-price elasticities in Business as Usual, which show that historically non-clothing consumption has only been very marginally affected by changes in clothing prices (Meade et al., 2011, Muhammad et al., 2011).

The global respending effect has such a large effect on employment in BRIC because payment of the living wage substantially increases BRIC labour compensation which leads to large respending in BRIC. In all scenarios, the net effect of paying BRIC workers in the Western European clothing supply chain a living wage and then passing all costs through to consumers is to more than double BRIC labour compensation (relative to the BRIC labour compensation provided by the 2005 Western European clothing supply chain) (Figure 6-5). That the BRIC employment impacts of the global responding effects are larger than the BRIC employment

![Figure 6-4 How the three effects (WEU clothing, WEU non clothing, global responding) influence BRIC employment relative to the BRIC employment supported by the 2005 Western European clothing supply chain in our three scenarios.](image-url)
impacts of WEU clothing demand and WEU non-clothing demand effects shows that our estimate of the BRIC employment intensity of the marginal BRIC consumption patterns is higher than our estimate of the BRIC employment intensity of the change in Western European consumption following the clothing price increase.

Figure 6-5 Total change in BRIC Labour Compensation (relative to the BRIC labour compensation provided by the 2005 Western European clothing supply chain) caused by paying BRIC workers in the Western European clothing supply chain a living wage and passing all costs through to Western European consumers in three scenarios. Figures account for the impact of changes in Western European consumption (WEU clothing demand and WEU non-clothing demand effects) and the impact of changes global consumption (global respending effect).

The WEU Clothing and Non-Clothing effects have only limited impacts on BRIC employment because the percentage change in Western European demand is only small. In all scenarios, the reduction Western European final demand (clothing plus non-clothing) are between 5.8% and 6.3%. This is a result of the small price increase which averaged 6% across the Western European countries (see Chapter 5) and the limited effect of the elasticities of demand.
6.4.3 Explaining the Change in Carbon Emissions

As with BRIC employment, the increases in global carbon emissions are the result of the global respending effect. Figure 6-6 shows how each of the three effects contribute to the total change in carbon emissions. The global respending effect has the largest influence increasing carbon emissions by approximately 11% in all scenarios. In all scenarios the combined WEU Clothing and WEU Non-Clothing effect reduces carbon emissions by around 6%.

Figure 6-6 How the three effects (WEU clothing, WEU non clothing, global responding) influence global carbon emissions relative to the carbon emissions embodied in the 2005 Western European clothing supply chain in our three scenarios.

Several factors lead to global responding increasing global carbon emissions despite the mitigating effects of reductions in Western European demand. First, the impact of the global responding effect is caused by the increase in BRIC labour compensation, as labour compensation in other world regions falls following the living wage price increase (Table 6-1). Additionally, the largest carbon savings came from reductions in Western European clothing consumption (Figure 6-6), a category known to be less carbon intensive than other consumption categories (Tukker and Jansen, 2006, UNEP, 2010). As the BRIC workers spend
the additional money they earn across all 9 consumption categories the average carbon intensity of their consumption was greater than the average carbon intensity of Western European clothing consumption. It is also worth noting that we would expect a dollar spent in BRIC to stimulate substantial economic activity within BRIC, and to purchase more goods than a dollar in Western Europe (because price levels in BRIC are lower than in Western Europe). Therefore the fact that the energy system in BRIC tends to be more carbon intensive than in Western Europe\textsuperscript{28} (IEA, 2015) would contribute towards the overall increase in emissions. Indeed, Table 6-2 shows that the only region to see increases in carbon emissions is BRIC.

Table 6-1 Change in Labour compensation relative to that provided by the 2005 Western European Clothing supply chain by world region in each scenario.

<table>
<thead>
<tr>
<th></th>
<th>Slow Fashion</th>
<th>Willing to Pay</th>
<th>Business as Usual</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRIC</td>
<td>119%</td>
<td>134%</td>
<td>123%</td>
</tr>
<tr>
<td>OEU</td>
<td>-9%</td>
<td>-2%</td>
<td>-7%</td>
</tr>
<tr>
<td>OAC</td>
<td>-6%</td>
<td>-6%</td>
<td>-7%</td>
</tr>
<tr>
<td>OLAC</td>
<td>-9%</td>
<td>-4%</td>
<td>-8%</td>
</tr>
</tbody>
</table>

Table 6-2 Change in Carbon emissions relative to those embodied in the 2005 Western European Clothing supply chain by world region in each scenario

<table>
<thead>
<tr>
<th></th>
<th>Slow Fashion</th>
<th>Willing to Pay</th>
<th>Business as Usual</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRIC</td>
<td>22%</td>
<td>29%</td>
<td>24%</td>
</tr>
<tr>
<td>WEU</td>
<td>-5%</td>
<td>-13%</td>
<td>-8%</td>
</tr>
<tr>
<td>OEU</td>
<td>-10%</td>
<td>-4%</td>
<td>-9%</td>
</tr>
<tr>
<td>OAC</td>
<td>-5%</td>
<td>-5%</td>
<td>-5%</td>
</tr>
<tr>
<td>OLAC</td>
<td>-3%</td>
<td>-1%</td>
<td>-3%</td>
</tr>
</tbody>
</table>

\textsuperscript{28}This is not strictly true, Brazil for example has very low carbon intensity in its energy system. However, in 2005, Chinese and Indian energy systems were very high carbon intensity (see in text citation for details).
6.5 Discussion

6.5.1 Respending effects are potentially important

The principal result from this analysis is that global respending effects have substantial potential for offsetting both the unemployment effects and carbon savings associated with reduced consumption caused by living wage price increases. All our scenarios find that paying living wages in BRIC increases BRIC income (despite reductions in Western European consumer spending) and spending of this income leads to an overall increase in employment and carbon emissions (holding all else equal). This is a significant result for two reasons. First (as we reported in Chapter 2) there is debate over the existence of the employment multiplier effect if sweatshop wages are increased (Coakley and Kates, 2013, Sollars and Englander, In Press). Second, the global respending effect leads to an overall increase in environmental impacts, due the enhanced development in BRIC. The question is: to what extent does the global respending mechanism have real world credibility?

As we saw in Chapter 2, evidence for the employment multiplier from wage increases has some academic precedent. Drawing on the work of Hall and Cooper (2012), Schmitt (2015) includes “increases in demand” in his list of potential channels of adjustment for higher minimum wages in the USA. Additionally, Magruder (2013) examines data from 1990s minimum wage increases in Indonesia and finds evidence that the minimum wage increases in Indonesia increased full time waged employment by creating additional demand in Indonesia.

The Magruder (2013) paper is especially interesting from our point of view because it is applied to a developing country setting and because Powell and Zwolinski (2012) use an earlier analysis of minimum wage increases in Indonesia to argue against sweatshop activism (Harrison and Scorse, 2010). Harrison and Scorse (2010) found that a 100% increase in the
minimum wage reduced employment by 12-36% while Magruder (2013) reports that the same minimum wage increase increased formal employment by 10% through respending effects. Magruder also replicates the Harrison and Scorse study, using a difference-in-difference (DD) approach (of the type Harrison and Scorse apply) and arrives at the same results as Harrison and Scorse. But, when using his alternate (difference-in-spatial-difference, DSD) method Magruder finds an increase in employment over the same time period as Harrison and Scorse’s study. Magruder convincingly argues that the DSD is the superior approach as it generalises the difference-in-difference method, loosening its assumption of symmetric trends in labour markets so that they can be non-parametric. As Magruder (2013, P.55) puts it “*Given that the DSD assumption is strictly weaker than the DD assumption...whenever the DD estimation is valid, the DSD is as well, [therefore] we must prefer the DSD [result].*”

Additionally, there is evidence to suggest that our model misses mechanisms that would exaggerate the actual impact of respending on both BRIC employment and global carbon emissions. Our model treats all outputs from a given sector as homogenous. In reality it is established that there are differences in the production technology of goods for export and for domestic markets (e.g. Clerides et al., 1998, Jiang et al., 2015). A recent body of work uses specially constructed input-output tables to distinguish between the effects of production for domestic markets and for exports (Chen et al., 2012, Dietzenbacher et al., 2012, Jiang et al., 2015). These studies typically find that production for domestic markets generates more employment, more value added and more carbon emissions than goods for export. For example, research on China finds that exports generate less domestic value added and less employment than production for domestic markets (Chen et al., 2012). This is principally attributed to the fact that production for domestic markets in China use substantially fewer imported intermediate goods than production for exports. Moreover, Chen et al., (2012) show that this discrepancy is even greater in processing exports of which make up a major part of China’s
involvement in the clothing supply chain (Pun Ngai, 2007). Likewise, Dietzenbacher et al., (2012) show that distinguishing between processing exports and normal production reduces the carbon footprint of Chinese exports, something that can be partially explained by the work of Jiang et al., (2015) who show that firms receiving foreign investment are more energy efficient than Chinese owned firms.

### 6.5.2 Implications for supply chain living wages as sustainability strategy: good but not sufficient?

The finding that respending effects may increase global carbon emissions is potentially problematic for the idea that more equitable distributions of income can constitute a sustainable consumption strategy (Fletcher, 2008, Clift et al., 2013). Moreover, this finding supports a critique of consumption based strategies made by Alcott (2012), who argues that if a given expenditure uses fewer natural resources than an alternative expenditure it is likely that a larger share of that expenditure goes to labour and, crucially, that labour has an embodied environmental impact.

However, there are two caveats to be made here. First, our conceptualisation of slow fashion in this chapter has been purposefully simplistic to aid the analytical process. Most authors see these ideas as broader than simply paying a living wage, conceptualising them as ‘systemic changes’ encompassing but not limited to the more equitable distribution of income along the supply chain (Fletcher, 2010). Likewise, consumers see sustainable fashion as more than living wages. For example, a need for increased quality and durability and a ‘natural’ quality (Lundblad and Davies, In Press), all of which could feasibly lead to further carbon reductions. Nonetheless, the core issues, (clothing is relatively low carbon, a dollar in BRIC generates more carbon than a dollar in Western Europe) remain.
But, perhaps more importantly, in our analysis the increase in emissions all occurred within BRIC itself and there is a case to be made that increased per capita carbon emissions in BRIC represents a more equitable sharing of the global carbon budget (Elzen et al., 1992, Pan et al., 2015). Moreover, our estimates of increases in carbon emissions are lower than our estimates of the increases in employment. Put another way, all of our scenarios lead to substantial increases in BRIC employment relative to that originally supported by Western European consumption of clothes for around a 6% increase in carbon emissions (relative to those originally attributable to Western European clothing consumption). Therefore, we are seeing substantial social benefit for a relatively low carbon cost that could be mitigated in other ways. For example, it has been argued that a major principal sustainability challenge faced by developing and emerging economies is to ‘leapfrog’ from their current production and consumption systems to more sustainable ones (Tukker, 2005, Schäfer et al., 2011). The premise of these arguments is that developing countries are not yet as locked in to unsustainable systems as developed countries, and in many cases are going through a period of investment in infrastructure that will shape the future of the society. This provides a leverage point to make future production and consumption more sustainable. If supply chain living labour compensation is part of a suite of initiatives including some that reduce the environmental impact of BRIC production and consumption, then the increased carbon associated with respending effects could be substantially reduced.

It is also interesting to note that there was relatively little difference across all indicators between our slow fashion scenario and our business as usual scenario. This potentially indicates two things. First, as above, our slow fashion scenario was too narrowly defined. The literature on slow fashion typically emphasises additional “quality” gains leading to greater (perceived) durability and therefore potentially larger reductions in real consumption than we modelled (Clark, 2008, Lundblad and Davies, In Press). On the other hand, it suggests that living wage
strategies can be employed with relatively little need to bring consumers on board. That is, scenario three suggests that current behaviours would be sufficient to increase BRIC employment at relatively low carbon cost.

In light of the findings discussed in this section we suggest that our results imply that paying a supply chain living wage is a potentially useful but not sufficient tool for moving toward sustainability.

6.5.3 Limitations and Future Research

Finally, it is worth commenting on the limitations of this analysis. The scenarios we consider are highly specific, focusing on the simplified scenario that Western European firms will enforce living wages on their own accord, pass all associated costs to consumers and that their suppliers will not change their production technology. The first problem here is that it is very difficult to enforce wages in the supply chain, no matter what country the work is located in. For example, Bernhardt et al. (2008) provide an interesting overview of research finding numerous wage violations in apparel factories in the United States of America, while Rani and Belser (2012a) estimate that 33% of all waged workers in India 2009-2010 received less than the minimum wage. The second problem is that the examples we have of living wages being paid in clothing supply chains (McMullen et al., 2014, Egels-Zandén, 2015) only extend as far as garment factories. We have already established that this is insufficient to achieve social sustainability (see Chapters 3 and 5 and Mair et al., 2016).

Secondly, it is conceivable that firms would not pass all costs onto consumers. Our analysis showed that price increases would be likely to lead to reductions in consumption, unless there was a substantial deviation from our Business as Usual scenario. There are therefore incentives for firms not to pass costs through to consumers and instead to try to maintain physical sales. Similarly, we mentioned the channels of adjustment work (Schmitt,
2015, Hirsch et al., 2015). This work proposes multiple ways firms respond to labour cost increases of which price pass through is only one. Different firm responses would change our analysis, with effects on all indicators. In the next chapter we look at this in more detail, using a model that allows us to examine the impacts of different firm level choices.

Lastly, the assumption of constant production technology is suspect. In the literature there are typically two views held to be more likely than constant production technology. First, proponents of minimum and living wages argue that efficiency wage models of the labour market are most relevant and that workers on minimum or living wages will be more productive and therefore firm output will increase, dampening unemployment effects (for example, Arnold and Hartman, 2005). Conversely, opponents of living wages tend to argue that the living wage removes the incentive to produce in low wage countries by making automated processes more attractive (Powell and Zwolinski, 2012). The latter objection is interesting and certainly a legitimate concern. However, it is beyond the scope of this PhD. Because of our interest in the environmental impacts of the living wage strategy in the next chapter we construct a model with efficiency wage labour markets to allow us to examine the environmental effects of relying on increased productivity and sales to compensate living wages.

6.6 Conclusions

This chapter made several contributions to knowledge. Methodologically, our use of an input-output model is novel in living wage research and allowed us to do bring two new perspectives to work on living wages in apparel supply chains. First, exploring the effects of paying living wages in multiple countries in a high level supply chain is novel. As noted above, previous work has typically looked at product-specific supply chains and has only considered a labour cost increase in one country. Second, we explore potential respending effects, allowing us to contribute to the limited evidence base (see Chapter 2) on employment multipliers in the
context of sweatshops and living wages. Moreover, by incorporating carbon emissions into the analysis we also contributed to sustainable consumption (and in particular slow fashion) literatures.

The key finding from our analysis is that in the case of full price pass-through to Western European consumers, increased demand in BRIC may counteract the small disemployment effects caused by reductions in physical consumption in Western European consumption. However, these same findings apply to carbon emissions: all scenarios lead to increases carbon, thus highlighting the need for efforts to decarbonise infrastructure in developing countries.

These results go some way to answering the overarching question of this thesis: can supply chain living wages be part of a sustainability strategy? In particular, we have presented an answer to the question with which we ended the last chapter (what effect would full price pass through have on carbon emissions and social sustainability indicators?). However, this chapter considered only a small subset of potential responses to a living wage, all of which may have different impacts on sustainability. In the next chapter we develop a dynamic model which focuses less on international trade and more on alternative mechanisms of adjustment.
Chapter 7  Channels of Adjustment and Supply Chain
Living Wages: a System Dynamics Sustainability Analysis

7.1 Introduction

The premise of this analysis is that firms and workers may respond to wage increases in a number of different ways, and the choices they make will affect the sustainability impacts of the wage increase. The model in the previous chapter assumed that Western European clothing retailers and Brazilian, Russian, Indian and Chinese (BRIC) workers had very limited responses to the implementation of the living wage. In this chapter we take a different approach, drawing on the Channels of Adjustment framework (Lester, 1946, Hirsch et al., 2015, Schmitt, 2015) and the slow fashion literature (e.g. Clark, 2008, Cataldi et al., 2010) to construct an exploratory model of the Western European clothing supply chain that emphasises BRIC worker and Western European retailer behaviour.

Specifically, we build a system dynamics model designed to allow an exploration of how the following mechanisms affect the socio-economic and environmental implications of paying BRIC workers in the Western European clothing supply chain a living wage:

1. **Western European retailer price flexibility**: prices reflect production costs, so increased supply chain costs are passed through to consumers and vice versa.

2. **Western European retailer profit margin flexibility**: firms adjust their target profit margins in response to changes in perceived consumer demand.
3. **Western European retailer wage compression**: retailers reduce the wages of their direct employees in order to absorb some of the increased supply chain costs.

4. **Reduced influence of fashion trends**: clothing goods have more classic designs, meaning that a greater proportion are sold rather than disposed of and fewer clothes are marked-down in clearance sales.

5. **More labour intensive production**: retailers emphasise craftsmanship, and uniqueness, requiring a move to more traditional production techniques and limited production runs which make manufacturing more labour intensive.

6. **‘Efficiency wage’ effects (in BRIC and Western Europe)**: increasing pay motivates employees to work harder and reduces employee turnover (which increases average productivity, as experienced employees are more efficient than new employees). But, reducing pay reduces worker motivation, leading to lower labour productivity and increased turnover.

In our analysis, we combine different estimates of the relative importance of each of these mechanisms into four indicative scenarios.

Mechanisms 1-3 are drawn from descriptions of firms in the Channels of Adjustment framework (which documents observed ways firms have responded to increases in the minimum wage) while mechanisms 4-5 are taken from the slow fashion literature (which posits alternative futures for production and consumption of fashion goods). Typically, (though not exclusively) the two are not compatible. As an example, slow fashion argues that retailers should “*price garments higher... to reflect true ecological and social costs... making profit by selling fewer higher priced items*” (Fletcher, 2010 P.264). Consequently, the view that retailers
could reduce their profit margins to ‘absorb’ cost increases (as argued in the Channels of Adjustment framework) is not strictly compatible with slow fashion.

On the other hand mechanism 6 (efficiency wage effects) is compatible with both slow fashion and the Channels of Adjustment framework as it is a theory of the labour market (Akerlof and Yellen, 1986) rather than of firm behaviour. Efficiency wage theory posits that labour productivity is related to the wages workers are paid (Weiss, 1990). In our model workers both work harder for higher wages and are less likely to quit (Yellen, 1995, Taplin et al., 2003, Oka, 2012, Newitt et al., 2013, Egels-Zandén, 2015). Moreover, efficiency wage theory provides a potentially interesting link between slow fashion (where there is an absence of labour market theory) and more general arguments for higher wages (which often make appeals to efficiency wage theory; e.g. Kaufman, 2010, Wolfers and Zilinsky, 2015).

The primary contribution of this chapter is that it is (to the best of our knowledge) the first dynamic modelling study to explore living wages as a mechanism for making consumption more sustainable. It also makes a broader contribution in constructing and applying the first system dynamics model incorporating either the Channels of Adjustment framework or slow fashion concepts. As the first work in these areas, the analysis is principally exploratory.

7.2 Model Description and Data

Here we outline our development of a system dynamics model of the Western European clothing retail supply chain. System dynamics models have two core variable types: stocks and flows. Stocks represent the accumulations in a system (e.g. inventories or capital) while flows describe the rates of increase or decrease in stocks (e.g. sales or investment) (Kirkwood, 1998). Stocks, flows, and the links between them form the basis of stock and flow diagrams, which correspond to a system of differential equations. Due to the nonlinearities and high order of
even small system dynamics models, these equations are solved by adding a small timestep into the differential equations and using numerical simulation methods\textsuperscript{29} (Sterman, 2000). The model was built in STELLA and we present model equations in STELLA’s native format, to aid direct interpretation of the simulation process.

The model consists of a set of interlinked modules, covering production of intermediate goods, the physical production and accounting structures of Western European clothing retailers, price-setting, and consumer demand. The resulting model is fairly complex, with around 300 equations. Therefore, we do not describe the entire model structure here. Instead, section 7.2.1 provides an overview of the major causal loops governing the behaviour of the model and the remaining sections provide more detail on the elements of the model with the most direct impacts on our results (price setting in section 7.2.2; labour in section 7.2.3; physical consumption and production in section 7.2.4). A full list of model equations and a copy of the model itself can be found in Appendix H\textsuperscript{30}. Finally, section 7.2.5 describes the scenarios used in the analysis.

7.2.1 Causal Loop Model Description

The majority of the behaviour of the model is driven by the interactions of eight causal loops. Five are balancing loops (an increase in variable X starts a series of events that leads to a reduction in variable X) and three reinforcing loops (an increase in X leads to a further increase in X). Figures 7.1-7.9 build the causal loop description of the model, starting with the first causal loop (B1) and adding each subsequent loop. Each figure is a causal loop diagram.

\textsuperscript{29} STELLA offers three alternative methods for solving the model equations. The results presented here were obtained using Runge-Kutta 4 integration method. However, the results do not vary substantially with the other methods, something that can be easily verified by running the model under the different integration methods (Appendix I).

\textsuperscript{30} STELLA is needed to view and run the model. A trial version can be downloaded for free at: http://www.iseesystems.com/community/downloads/STELLA/STELLADemo.aspx
The arrows that connect variables represent causal relationships, all else being equal. Arrows marked with a ‘+’ show that the connected variables change in the same direction (i.e. an increase in X leads to an increase in Y). Arrows marked with a ‘–’ indicate that the connected variables change in opposite directions (an increase in X leads to a decrease in Y). Balancing loops are labelled ‘B’ and reinforcing loops are labelled ‘R’. Delays in causal relationships are marked by two parallel lines crossing the connecting arrows.

The *Price-Demand-Target Profit Margin* balancing loop, B1 (Figure 7-1) shows that when prices increase, consumers demand less of that product. Retailers adjust to long term reductions in consumer demand by reducing their target profit margins. All else being equal, this reduces prices which increases demand. Each adjustment process takes time as each set of actors has to both perceive the change in circumstance and then react to it.

![Figure 7-1 Price-Demand-Target Profit Margin balancing loop B1](image)

B1 reflects our assumption that firms use a variant of full-cost pricing (full details in 7.2.2 below). Under full-cost pricing firms estimate their total production costs per unit of output and multiply this by a target profit margin (or ‘markup’) (Nubbemeyer, 2010). We assume that this target profit margin is sensitive to long term changes in perceived consumer demand. This allows us to explore the premise that firms can adjust their target profit margins to accommodate production cost increases, as suggested by the Channels of Adjustment framework (Schmitt, 2015).
The *Price-Demand-Excess Inventory* balancing loop, B2, (Figure 7-2) shows that when price increases, consumer demand falls, causing excess inventory to increase. Clothing retailers respond to this by reducing the price of the unsold goods which reduces the average price. B2 reflects the commonly observed practice of clothing retailers marking down clothes that are now unfashionable, having not been sold before a new collection is introduced (Mattila et al., 2002, Caro and Gallien, 2012).

![Figure 7-2 Price-Demand-Excess Inventory balancing loop, B2 added to B1.](image)
Figure 7-3 adds the Price-Demand-Physical Production-Excess Inventory reinforcing loop, R1. R1 shows that retailers respond to (estimated) increases in demand by increasing production, which increases excess inventory, which reduces price, which increases demand. Delays occur as production is not instantaneous, and as result increases in demand can only effect future levels of production. Moreover, retailers cannot predict demand perfectly and will therefore respond to changes in estimated demand. This potentially introduces delays, and also means the link between demand and production is variable. R2 directly interacts with both B1 and B2.
The *Excess Inventory – Physical Production* balancing loop, B3, (Figure 7-4) shows that as excess inventories (unsold stock) increases, physical production decreases. The assumption here is that some of this excess inventory can be sold on (albeit at a lower price, see B2), reducing the required level of production. In turn, this reduces the level of production which reduces the excess inventory level. This loop directly interacts with B2 and R1, and indirectly interacts with B1.

Figure 7-4 Adding the Excess Inventory – Physical Production balancing loop, B3.
The **Price-Demand-Long Run Production Forecast-Investment-Production Costs** loop, B4, (Figure 7-5) shows that price increases drive reductions in demand; long term reductions in demand reduce the long run production forecast in turn decreasing investment and production costs. Reduced investment decreases production costs in two ways: 1) reductions in the size of the capital stock reduces depreciation costs and 2) depending on how the investment is financed, reduced investment means lower levels of debt which means lower interest costs. B4 reflects our assumption of full-cost pricing. B4 directly interacts with the other Price and Demand loops, B1, B2 and R1, and indirectly interacts with B3.

Figure 7-5 Price-Demand-Long Run Production Forecast-Investment-Production Costs balancing loop, B4.
Figure 7-6 adds the second reinforcing loop, R2 (Price-Demand-Long Run Production Forecast-Investment-Physical Production-Excess Inventory). This loop emphasizes the link between investment and production. A price increase reduces demand which reduces long run production forecast which reduces investment. Reduced investment reduces maximum potential physical production (as capital stock degrades). In turn, this reduces excess inventory levels, which increases the price. R2 interacts directly with all the other loops.
The *Production Costs-Retail Wage Compression-Retail Wage Rate* loop, B5, (Figure 7-7) shows that when production costs increase, retailers respond by reducing the wages they pay to their direct employees. This process is delayed because it assumes that retailers slowly introduce these changes as freezes in nominal wages etc. (Schmitt, 2015). Lower wage rates reduces production costs. B5 directly interacts with B4 and indirectly interacts with all other loops.

*Figure 7-7* Adding the Production Costs-Retail Wage Compression-Retail Wage Rate loop, B5.
Figure 7-8 adds the last major causal loop driving model behaviour. This is the *Production Costs-Retail Wage Compression-Retail Wage Rate-Retail Labour Productivity* reinforcing loop, R3. R3 shows that when production costs increase, retailers reduce the wages they pay their employees (as in B5). However, this also reduces productivity, which increases production costs. Delays in the relationship between retail wage rate and productivity are caused by employees taking time to respond to the new wage rates. Delays between labour productivity and production costs are caused by the time taken for the retailer to adjust its workforce levels. R3 directly interacts with B4 and B5, and indirectly interacts with all other loops.

![Figure 7-8 Adding the Production Costs-Retail Wage Compression- Retail Wage Rate-Retail Labour Productivity loop, R3.](image-url)
Figure 7-9 adds the other key inputs (black arrows) and the primary indicators of interest (grey arrows). Non-labour supply chain costs are based on a linear production function, parameterised using the input-output analysis in Chapter 5. Exogenous changes to the wage rate paid to BRIC workers in the supply chain (denoted ‘supply chain wage rate’ on Figure 9) is the ‘shock’ to the system in each of our scenarios. All else being equal, increasing the supply chain wage rate increases supply chain labour costs. However, it also increases supply chain labour productivity, reducing the supply chain labour cost. The relationship between wage rates and labour productivity in the supply chain is modelled in the same way as in the retailer itself (2.2.4).

There are also three other exogenous factors affecting the system shown on Figure 7-9: the obsolescence rate, clearance markdown, and the product mix effect on labour productivity.
The obsolescence rate and clearance markdown represent the impact of fashion trends. The obsolescence rate determines how much stock is disposed of by Western European retailers if it is unsold in the initial retail period. This reflects the fact that some stock will not be sold (even at reduced prices) because it becomes ‘unfashionable’. Clearance markdown determines the amount by which goods are marked down in order to sell them even though they are now unfashionable. Reducing the influence of fashion trends is a common theme for slow fashion designers and researchers (Leslie et al., 2014), and so in the Less Fashionable and More Personal scenarios we exogenously vary these variables.

The product mix effect on labour productivity influences BRIC labour productivity (denoted ‘supply chain labour productivity’ on Figure 7-9) resulting from a move away from fast fashion products and into slow fashion products. Fast fashion is assumed to stress speed and high labour productivity in order to minimise costs, while slow fashion is assumed to stress craftsmanship, and traditional production techniques that require makers to spend longer on each garment (Jung and Jin, 2014). For simplicity, we assume that capital requirements are unaffected by this change.

Figure 7-9 also shows the three key outputs of the model for this analysis: tax adjusted net operating surplus earned by Western European clothing retailers (denoted ‘Retail Profit’ on Figure 7-9), material throughput in the Western European clothing supply chain (‘Material Throughput’ on Figure 7-9), and BRIC employment in the Western European supply chain (‘Supply Chain Employment’ on Figure 7-9). Retail Profit is defined in the usual way as revenue (sales multiplied by the retail price) minus the costs of production. Supply Chain Employment is a function of the amount of goods forecast to be produced (‘Physical Production’ on Figure 7-9) and the amount of workers required to produce those goods (the inverse of ‘Supply Chain Labour Productivity’ on Figure 7-9).
7.2.2 Prices

The average price faced by consumers is the average of an initial selling price and a marked down price (for previously unsold goods placed on clearance) weighted by the share of each type of good in the total inventory of goods for sale. The model price equations are,

\[ Av_{\text{Consumer Price}}(t) = Av_{\text{Consumer Price}}(t - dt) + \text{Change in } Av_{\text{Consumer Price}} \quad (7-1) \]

\[ \times dt \]

\[ \text{Change In } Av_{\text{Consumer Price}} \]

\[ = (\text{Initial Price} \times (1 - \text{Resellable stock as proportion of Inventory}) \]

\[ + \text{Marked Down Price} \quad (7-2) \]

\[ \times \text{Resellable stock as proportion of Inventory}) \]

\[ - Av_{\text{Consumer Price}} \]

Western European clothing retailers set the initial price based on a percentage markup over their average total production costs (a procedure known as ‘full-cost’ pricing),

\[ \text{Initial Price} = (\text{Costs} \times (1 + \text{Target Profit Rate}))/\text{Physical Output} \quad (7-3) \]

Total production costs are defined in the usual way for full-cost pricing: the sum of interest payments on liabilities, Western European clothing retailer labour costs, depreciation (which acts as a proxy for the costs of maintaining capital) and the cost of intermediate goods (including BRIC labour costs) (Godley and Lavoie, 2007, Nubbemeyer, 2010).

The full-cost pricing model is not the standard model of price setting (a more typical model would see firms as price takers who maximise profit by setting marginal revenue equal to marginal costs), however it is widely used by heterodox economists (Lavoie, 2006, Godley and Lavoie, 2007) and has a strong empirical basis. For example, in a survey of more than
14,000 European firms, Altomonte et al. (2015) find that 60% set prices, and of these 75% use a full-cost approach. Moreover, 75% of all firms surveyed from the Wearing Apparel sector use a full-cost pricing approach. These results confirm earlier empirical work (Hall and Hitch, 1939, Fabiani et al., 2005) and are consistent with descriptions of standard pricing practices of clothing retailers (Şen, 2008).

The default model assumption is for the target profit rate to be constant, but in two scenarios we assume it varies with long term (2 year) changes in demand (as average demand increases target profit rates also increase). We model this using a logistic function parametrised to give the relationships seen in Figure 7-10. The two relationships are not based in any empirical data (we are not aware of any such dataset). Rather, they are designed to provide two alternative conditions (high sensitivity and low sensitivity) for the model runs, with more rigorous parameterisation a potential area for future research.

![Figure 7-10 Sensitivity of Western European clothing retailer target profit margin to changes in consumer demand, all else equal. Change in demand is modelled as an index, where the initial demand level specified at the start of the model run is equal to 1.](image-url)
Marked down price is given by:

\[ \text{Marked Down Price} = \text{DELAY(Initial Price, 1)} \times \text{Percentage Markdown} \quad (7-4) \]

where \( \text{DELAY} (X,1) \) indicates that the variable \( X \) is lagged by one time-step, and the percentage markdown is a non-linear function of ‘resellable’ goods (goods unsold at their initial price that have not yet become obsolete) as a proportion of the total inventory of goods (Figure 7-11). In practice, markdown level is limited by a number of disparate factors (Şen, 2008) and retailers do not continuously markdown products until all stock is cleared. Therefore, we specify non-linear functions that plateau before 100% markdown. As in most retailers markdown decisions rarely follow scientific rules (Şen, 2008) we use three exploratory functions to describe alternative decisions. The high sensitivity function (black line in Figure 7-11) represents the default case, having an average markdown in equilibrium of 25% and a maximum possible markdown of 70% (values in line with the literature: Fisher et al., 2000, Heching et al., 2002, Şen, 2008, Andersson and Storm, 2013). The moderate and low sensitivity functions assume alternative markdown decisions made by retailers.

![Figure 7-11 Relationship between markdown percentage and resellable goods as a proportion of inventory.](image)
7.2.3 Employment and Labour Costs

The Western European clothing retail and BRIC employment models have the same underlying structure, based on a broadly institutional view of labour markets. In particular, we emphasise the role of market demand and the relationship between labour productivity and wages (Lester, 1946, Akerlof and Yellen, 1986, Yellen, 1995, Kaufman, 2010, Hirsch et al., 2015).

Employers estimate their labour requirements according to,

\[ Employees_{\text{Required}} = \text{Physical Output} \times Employee_{\text{Intensity}} \]  (7-5)

where \text{Physical Output} is an index of actual output and \text{Employee_{Intensity}} is employees required per unit of physical output. Employers hire more employees if the stock of employees is less than the number of employees required. In the alternative case (i.e. \text{Stock of Employees} \geq Employees_{\text{Required}}) employers let their stock of employees decline as workers leave. Workers are not fired in response to short run demand changes as firms face costs in employing new workers. In most cases employment falls rapidly without additional firings due to high standard turnover rates, which we assume are 13% in Western European retailers (Siebert et al., 2006, Siebert and Zubanov, 2009) and 35% in the BRIC parts of the supply chain (Roberts, 2006, Beamish, 2006). Accordingly, the stock of employees is determined by the following system of equations.

\[ Stock_{of\ Employees}(t) = Stock_{of\ Employees}(t - dt) + (New_{Hires} - Leavers) \times dt \] (7-6)
\[
\text{New Hires} = \text{Employees Required} - \text{Stock of Employees} \\
+ \text{Leavers}
\] (7-7)

\[
\text{Leavers} = \text{Turnover Rate} \times \text{Stock of Employees}
\] (7-8)

Market demand influences these equations through \textit{Physical Output} (which is a function of demand, see 7.2.4), while the relationship between wages and labour productivity effects \textit{Employee Intensity} and \textit{Turnover Rate}.

We model the effect of wages on changes in \textit{Employee Intensity} and changes in \textit{Turnover Rate} as non-linear functions. We assume that the changes in wage rates will only affect productivity turnover rate across a set range. The logic here is that (all else equal) there are limits to an employees productivity (for example). Writing a change in either \textit{Employee Intensity} or \textit{Turnover Rate} as \textit{Change in X} the general form of our model equation is,

\[
\text{Change in } X = \text{Upper Limit} / (1 + b \times \exp(-\text{Sensitivity to Wage Change} \\
* \text{SMTH1}(\text{Wage Change}, 4)))
\] (7-9)

where \textit{Upper Limit} is the upper limit of the curve, \textit{b} is a constant and \textit{SMTH1()} is a first order exponential smoothing function used to replicate information delay (widely used in system dynamics modelling, see, for example, Sterman, 2000), so \textit{SMTH1}(\textit{Wage Change}, 4) indicates that workers respond to changes in the wage change averaged over 4 time-steps (equivalent to 1 year in our model runs).

For our analysis we define two sensitivities to wage rates, high sensitivity and low sensitivity. For these we choose parameters that give the relationships (for a range of variables
likely to be seen in our scenarios) between wage changes and changes in $Employee\_Intensity$ and $Turnover\_Rate$ shown in Figure 7-12 and Figure 7-13.

Figure 7-12 Relationship between wage changes and employee intensity and employee turnover rate in Western European clothing retailers
Figure 7-13 Relationship between wage changes and employee intensity and employee turnover rate for BRIC supply chain workers.

Although initial turnover rates are based on literature estimates and initial employee intensity from input-output tables (Appendix I) we stress that the relationships in Figure 7-12 and 13 are exploratory. There is a large literature empirically testing efficiency wage claims, but it is often conflicted or focused on variables not included in our model, such as perceived worker effort (e.g. Hannan, 2005) or supervision rates (e.g. Georgiadis, 2013). As a result, it is beyond the scope of this thesis to fully calibrate these relationships. Instead, the differences between the curves are based on the principle that Western European employees are likely to be more sensitive to wage reductions than BRIC employees are to wage increases. This is because European employers report substantial concerns around employee retention and
productivity loss in the face of wage reductions (Du Caju et al., 2015). On the other hand, the literature is conflicted on the relationship between wages and worker productivity. Some studies report that supervisors expect increases in wage rates improve productivity and employee turnover in developing countries (Stigzelius and Mark-Herbet, 2009, Egels-Zandén, 2015). However, others argue that employers often use mechanisms such as ‘piece-rates’\(^{31}\) (Singh, 2003, Li and Edwards, 2008) which limit the effects of efficiency wage. Likewise, it has been reported that the relationship between wage rates and quit rates is weak in developing countries due to low wage expectations (Jianga et al., 2009).

Finally, turnover rate and employee intensity both effect labour costs. We define labour costs as:

\[
\text{Labour Compensation} = \text{Hours Worked} \times \text{Lab Comp Rate} 
\]

where \(\text{Lab Comp Rate}\) is wages plus social security costs per hour and \(\text{Hours Worked}\) is a function of the number of employees and their relative experience, where new hires are less efficient than experienced employees. We assume that for their first three months, new hires must work 30\% more hours for the same output as experienced employees (Newitt et al., 2013).

\section*{7.2.4 Physical Consumption and Production}

We model physical output, physical sales, physical demand variables (and their associated stocks and flows) as indices, with initial demand being the baseline (i.e. initial physical demand = 1). As we start the model in equilibrium, initial physical demand and initial physical sales are equal. Therefore, physical consumer demand is based on a simple price elasticity of demand equation,

\(^{31}\) Payment based on output, rather than hours worked.
\[ \text{Consumer_Phys_Demand} \]  
\[ = \text{Initial_Physical_Sales} + \text{Change_in_Phys_demand} \]

\[ \text{Change_in_Phys_demand} \]
\[ = \text{Price_Elasticity_of_Demand} \]
\[ \times \text{SMTH1(Percentage_Price_Change, 4)} \]

Western European clothing retailers estimate future demand by extrapolating current trends in smoothed consumer demand 3 months ahead (Short_Run_Demand_Forecast). To arrive at their desired production level, retailers add an additional 30% to the demand forecast to account for demand uncertainty (Stock_held_for_Demand_Uncertainty)\textsuperscript{32} and then take away their anticipated resellable stock.

\[ \text{Short_Run_Desired_Production}(t) \]
\[ = \text{Short_Run_Desired_Production}(t - dt) \]
\[ + (\text{Change_in_Short_Run_Desired_Production}) \times dt \]

\[ \text{Change_in_Short_Run_Desired_Production} \]
\[ = (\text{Short_Run_Demand_Forecast} \times (1 + \text{Stock_held_for_Demand_Uncertainty}) \]
\[ - \text{SMTH1(Resellable_Stock, 2))} \]
\[ - \text{Short_Run_Desired_Production} \]

\textsuperscript{32} The 30% figure is not arbitrary. Combined with our equilibrium inventory values a 30% buffer gives a sell through rate (the percentage of stock sold at its initial price) of \textasciitilde70%. This lies in the middle of literature estimates (Mattilla et al., 2002).
Actual production (physical output) is then the desired production unless it is limited by the available capital stock\textsuperscript{33}.

Physical output accumulates as inventory which can be purchased by consumers. Inventory which is not sold at the initial price is either marked down and becomes ‘resellable’ (see 7.2.2) or becomes obsolete and is disposed of. The ratio of resellable to obsolete goods is determined by the obsolescence rate. By default this is set at 30\% (as this rate of obsolescence means ~20\% of all goods are sold at their marked down price, in line with literature estimates (Mattila et al., 2002, Kumar and Linguri, 2006)). The obsolescence rate, markdown pricing structure, and price elasticity of demand determine the influence of fashion trends on physical output.

\textbf{7.2.5 Data}

A wide range of data was used to parametrise the model (for a full list see Appendix I) and this was drawn from a range of sources. However, the bulk of the data are taken from sources or analysis from earlier in the thesis. Supply chain data are taken from the input-output analysis carried out in Chapter 5 (including BRIC wage rates, supply chain employment data and non-labour intermediate goods costs). Likewise the estimated living wage rate was taken from Chapter 4; data on social security are based on the work of the Social Security Association (also used in Chapter 4 (SSA, 2015)); and the standard consumer price elasticity data are taken from Muhammad et al., (2011), used in Chapter 6.

For Western European clothing retail data we primarily used the H&M Annual Report for 2004/5 (H&M, 2005), scaling values up to the sector level by assuming H&M had a 2% 

\textsuperscript{33}Capital stock is determined by levels of investment through a simple accelerator function. Accelerator functions model net investment as proportion of the gap between the current and the desired (based on sales forecasts) capital stock. These are widely used (see, for example, Godley and Lavoie 2007, Jackson and Victor 2015) and so for the sake of brevity we do not give more detail here.
market share in Western Europe (based on market share data in Bjellend et al., 2010, and Cravo, 2014, see Appendix I). H&M was chosen as a fashion retailer with a focus on Western Europe. There are clear limitations to only using data from one firm. For example, H&M had entirely self-funded their expansion up until 2005 and as a result we assume zero liabilities in the model equilibrium state. This is unlikely to be the case in reality and the impact of alternative liability conditions would make for an interesting future research project. Where data for H&M were not available we used values based on estimates or descriptions of behaviour in the literature, as discussed above.

7.3 Scenarios

In this analysis we examine four possible scenarios, two are based on the view of firms proposed by the Channels of Adjustment framework (Stable Actors and Unstable Actors) and two are based on Slow Fashion concepts (Less Fashionable and More Personal). In all scenarios, at year 0 the model is in an equilibrium state and the increase in the BRIC wage rate begins in year 2.5. The BRIC wage rate follows a logarithmic growth curve until it reaches the living wage rate of 0.75 USD, (which is approximately double the original BRIC wage rate see Chapter 4) at year 12.5 (Figure 7-14). In this way we assume a transitionary period to the living wage, rather than a pure step change. Table 7-1 summarises the qualitative differences between the scenarios (full quantitative descriptions are given in the user interface of the model, Appendix H). Subsections 7.3.1-7.3.4 provide more detail on each scenario.
Figure 7-14 The wage shock applied in all scenarios. The BRIC wage starts at ~0.39 USD per hour at year 0, and grows to ~0.75 USD per hour between year 2.5 and year 12.5.

Table 7-1 Mechanism settings across the four scenarios. ‘0’ denotes that the mechanism is not active in this scenario

<table>
<thead>
<tr>
<th>Channels of Adjustment</th>
<th>Stable Actors</th>
<th>Unstable Actors</th>
<th>Less Fashionable</th>
<th>More Personal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency Wage Effects</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Price Elasticity of Demand</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Influence of Fashion Trends</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Sensitivity of Profit to Consumer Demand</td>
<td>Low</td>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wage Compression</td>
<td>Low</td>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Product Mix Effect on Labour Productivity</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>High</td>
</tr>
</tbody>
</table>
7.3.1 Channels of Adjustment: Stable Actors

The Stable Actors scenario is characterised by mainly ‘low’ settings in Table 7-1 because it assumes all actors are relatively insensitive to change. In this way, Stable Actors represents a constrained form of the channels of adjustment framework: all channels are active but many will only be used in a limited way. Specifically, employee turnover rates and employee productivity are only slightly influenced by changes in wage rates (Low Efficiency Wage Effects; black lines on Figure 7-12 and Figure 7-13); Western European consumers are relatively insensitive to the price of clothing goods (Low Price Elasticity of Demand, -0.7); Western European clothing retailers only make small adjustments to their target profit margins in response to demand trends (Low Sensitivity of Profit to Consumer Demand; black line on Figure 7-10) and will only use wage compression to absorb 20% of any change in production costs (Low Wage Compression). As a result, Western European Clothing Retailers rely heavily on markdowns (High Influence of Fashion Trends; grey solid line Figure 7-11) and consumer price increases as mechanisms to adjust to production cost increases.

7.3.2 Channels of Adjustment: Unstable Actors

The Unstable Actors scenario assumes that workers and Western European clothing retailers are sensitive to changes in model conditions (but consumers remain insensitive, as in Stable Actors). Therefore, Unstable Actors represents a form of the Channels of Adjustment framework where actors freely use all channels of adjustment. It is characterised by mainly ‘high’ settings in Table 1: employee intensity and turnover rates are closely tied to wage rates (High Efficiency Wage Effects; grey lines Figures 7-12 and 7-13); Western European clothing retail target profit margins are highly sensitive to demand trends (High Sensitivity of Profit to Consumer Demand; grey line, Figure 7-10) and Western European clothing retailers are willing to use wage compression to absorb 100% of any change in production costs (High Wage
However, Western European clothing retailer pricing practices do not change and they still use markdowns (*High Influence of Fashion Trends*; grey solid line Figure 7-11) and consumer price increases to absorb cost increases.

### 7.3.3 Slow Fashion: Less Fashionable

*Less Fashionable* assumes Western European clothing retailers introduce living wages as part of a broader shift towards a business model inspired by slow fashion. Therefore, Western European retailers are assumed not to adjust their target profit margins in response to falling consumer demand but instead pass all cost increases through to the consumer (these new prices better reflect the ‘true’ social cost of production) (*0 Sensitivity of Profit to Consumer Demand*). Western European clothing retailers focus on more classic garment designs, meaning fewer garments have to be disposed of if not sold in a given retail period and those that are not disposed of are not marked down as much in clearance sales (*Moderate Influence of Fashion Trends*; grey dashed line, Figure 7-11; obsolescence rate falls from 30% to 20%). It is assumed that Western European retail firms can only achieve this alongside shifts in consumer preferences (*High Price Elasticity of Demand*; -1). *Less Fashionable* also assumes that employee turnover and employee intensity are closely tied to wages (*High Efficiency Wage Effects*, Grey line, Figure 7-13). This reflects our interest in the interaction between increased productivity and slow fashion.

### 7.3.4 Slow Fashion: More Personal

*More Personal* is characterised by further reductions in the influence of fashion trends, achieved by a new emphasis on craftsmanship, traditional production techniques and limited production runs by Western European clothing retailers. Therefore, *More Personal* represents a more radical form of slow fashion business model than was implemented in *Less Fashionable*. All settings are the same as in *Less Fashionable*, but the new emphasis on
unique, crafted, goods reduces obsolescence rates to 10% and means much lower markdowns are used (Low Influence of Fashion Trends; grey solid line Figure 7-11). All else equal, the use of traditional production methods increases BRIC employment intensity by 50% (High Product Mix Effect on Labour Productivity).

7.4 Results

7.4.1 Overview of Responses in Physical Output, BRIC Employment and Western European Clothing Retailer Profit

Figure 7-15 shows the change in physical output (Panel A), BRIC employment in the Western European clothing supply chain (Panel B) and post-tax profit earned by Western European clothing retailers (Panel C), for the four scenarios. All three indicators start in equilibrium and have achieved or are approaching a new equilibrium at year 30 of the simulation (27.5 years after increases in the BRIC wage rate begin or 17.5 years after BRIC workers are paid the full living wage rate).

34 More Personal is the only scenario where our 3 headline indicators don’t equilibrate by year 30. In More Personal, physical output, employment, and profits oscillate with decreasing amplitude until ~year 45 when they reach new equilibrium values. Overall dynamics are not substantially different from those seen in Figure 15 (verifiable by altering the length of the model run in Appendix H) and so we use the 30-year mark to keep our figures manageable.
Figure 7-15 Effect of paying BRIC workers in the Western European clothing supply chain a living wage on physical output (Panel A), BRIC employment in the Western European clothing supply chain (Panel B) and post-tax profit earned by Western European clothing retailers (Panel C). All figures show an index normalised to initial model values and are unitless. Solid black line = Stable Actors; long-dash black line = Unstable Actors; short-dash grey line = Less Fashionable; dotted grey line = More Personal. BRIC wage rates increase between 2.5 and 12.5 years.
Physical output has the least variation across the four scenarios, all of which achieve only modest reductions: after 30 years physical output is 89-98% of the initial equilibrium value. Conversely, the 30 year values for BRIC employment in the Western European clothing supply chain and post-tax profit earned by Western European clothing retailers are 60-88% and 77-124% of the initial equilibrium values respectively. Profit is also the only variable to show a clear difference in trend between the Slow Fashion scenarios (which are found to increase profit) and the Channels of Adjustment scenarios (which are found to have no effect or to decrease profit).

Overall, the system is relatively insensitive to changes in the BRIC wage rate: the BRIC wage rate was almost doubled and all changes are smaller than this. The insensitivity of the system to BRIC wage rates is emphasised by Table 7-2, which shows the elasticities of physical output, BRIC employment and Western European clothing retailer profit with respect to changes in BRIC wage rates (calculated using 30 year simulation values).

<table>
<thead>
<tr>
<th>Table 7-2 Percentage change (elasticities) in Physical Output, BRIC employment and Western European Retailer Clothing Profit for a 1% increase in BRIC wage rates. Calculated using 30 year values from the simulations.</th>
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<tbody>
<tr>
<td>Stability</td>
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<tr>
<td>Physical Output</td>
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<tr>
<td>BRIC Employment</td>
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<tr>
<td>Western European Retailer Clothing Profit</td>
</tr>
</tbody>
</table>
7.4.2 Explaining Responses in Physical Output

The reductions in physical output are all relatively small because price increases are relatively small across all four scenarios (Figure 7-16). These price increases are relatively small for two reasons. (1) BRIC labour costs are only a very small part of the total price (Figure 7-17); and (2) in each scenario several mechanisms act to reduce the overall price in the face of production cost changes. For example, in all scenarios productivity gains seen in BRIC after the wage increase act to mitigate some of the associated cost, while in the slow fashion scenarios reduced obsolescence rates also reduce production costs. Likewise, our assumed price elasticities of demand: -1 (Less Fashionable, More Personal) and -0.7 (Stable Actors, Unstable Actors), limit the total reductions in physical output that result from price increases. Using a more complex consumption function that allowed a broader description of consumer behaviour may change this result.

![Figure 7-16 Change in Average price faced by Western European consumers (including mark downs), Initial Price is 1.](image)
It is also worth noting that the larger increase in price in Unstable Actors is only an indirect effect of the BRIC wage increase. Most of the price increase in Unstable Actors is the result of productivity losses among Western European clothing retail employees. The reduction in Western European retailer wages means that more employees have to be hired for the same output, and there is higher quit rate.

Alongside price, the other important factor influencing physical output is the influence of fashion trends: as fashion trends become less influential physical output falls. Primarily, fashion trends influence physical output by lowering obsolescence rates which means a greater proportion of future demand can be met with unsold inventory. The influence of fashion trends explains why More Personal is the scenario that appears most responsive to changes in the BRIC wage rate in terms of physical output, despite having the smallest price increase.

However the extent to which the influence of fashion trends can reduce physical output by is limited by the fact that in the initial equilibrium state 72% of newly produced goods are sold immediately, only 8% become obsolete and 20% are sold at marked down prices (as
discussed in above, these figures are in line with literature estimates). Consequently, even reducing obsolescence rates to zero would have a relatively limited impact on production. This explains why the slow fashion scenarios only achieve modest reductions in physical output despite combining both the BRIC living wage price increase and reduced obsolescence rates.

7.4.3 Explaining Responses in BRIC Employment

We suggest that the productivity enhancing effects of the living wage exacerbate the job losses caused by reductions in physical output. The fundamental mechanism is that increased BRIC wage rates increase labour productivity in BRIC which reduces the number of BRIC employees needed per unit output. While this acts to reduce the total cost increases associated with paying a living wage (because fewer workers need to be paid the higher wage) it also directly reduces the level of employment. In our scenarios labour productivity does not increase by enough to make the living wage cost-neutral (in fact, labour compensation per unit output rises in all four of our scenarios (Figure 7-18)). Additionally, the other mechanisms (such as profit reduction) are not sufficient to cancel out this cost increase. As a result, prices increase (Figure 7-16, above), and BRIC employees face two mechanisms reducing employment opportunities: productivity gains and reduced consumer demand (though this does not account for potential respend effects).

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35 Note that our slow fashion scenarios do not encompass every possible facet of slow fashion. Therefore our results should not be interpreted as meaning that all forms of slow fashion have such limited potential to reduce physical output.
7.5 Explaining Responses in Western European Clothing Retailer Profit

Western European clothing retailer profit has the largest variation across the four scenarios (Panel C, Figure 7-15), primarily because Less Fashionable and More Personal see increases in profit while Stable actors and Unstable Actors see reductions in profit that are of comparable magnitudes to their reductions in physical output and employment. The increases in profit are the only increases in any of our three headline indicators.

The profit increases in Less Fashionable and More Personal are due to the reductions in the influence of fashion trends. The influence of fashion trends affects profits in two ways. 1) Lower obsolescence rates reduces production costs as fewer goods have to be produced to meet demand. This reduces the effect of the BRIC wage increase on production costs. 2) Reduced clearance markdowns means more goods are sold at a higher price. Moreover, this price increase is compounded by the use of a constant target profit rate so that as production costs rise the initial selling price also rises. This combined reduction in costs and increase in selling price leads to increases in operating margins for Western European clothing retailers in
the slow fashion scenarios (Figure 7-19). It is worth noting here that this result is counter intuitive and is dependent on a shift in consumer preferences (away from ‘fashion’ and towards classic designs) and sector wide action, both of which run counter to current trends.

![Graph showing percentage operating profit margin over time for different scenarios](image)

**Figure 7-19 Western European clothing retailer operating profit margin**

Figure 7-19 also shows that operating profit margin falls in the **Stable Actors** (by 1 percentage point) and **Unstable Actors** (by 5 percentage points) scenarios, which is commensurate with the reductions in profit that we see in these scenarios. Profit falls in these scenarios because production costs increase: as established above, productivity increases in BRIC are not sufficient to offset the cost of wage increases, while wage reductions for Western European clothing retail workers leads to substantial productivity loss, increasing Western European clothing retailer production costs in both **Stable Actors** and **Unstable Actors**. Moreover, as prices rise and physical output falls, retailers in these scenarios reduce their target profit margins (Figure 7-20) which also acts to reduces profits.
7.6 Discussion

The modelling exercise in this chapter highlights several difficulties and limitations of BRIC living wages as a mechanism for making Western European clothing consumption more sustainable. All of our scenarios saw substantial reductions in BRIC employment for relatively small reductions in material throughput.

This result is surprising because the Channels of Adjustment framework has been proposed as an explanation for why empirical studies commonly find that minimum wages have very small or no disemployment effects (Schmitt, 2015). For example, Hirsch et al. (2015) examine the case of a 13% wage increase in a chain of restaurants in the USA. They estimate that the cost of compliance is around 4% of the consumer price (similar to our simulated cost increase), and find employment elasticities that are not significantly different from zero. They present evidence to suggest that this is attributable to a combination of different channels of adjustment. Notably they highlight the role of productivity gains, price increases and wage compression.

The discrepancy between our model results and the existing channels of adjustment could be for one of several reasons. One possibility is that we do not have an adequate
representation of efficiency wage theory. One strand of efficiency wage theory not accounted for in our model is the idea that the wider context moderates how employees respond to wage changes. Hannan (2005) finds that wage increases motivate employees to work harder if the increase comes when firm profits are falling than if it comes when the firm is increasing profits. Similarly, Lee and Rupp (2007) argue that reductions in the wages of airline pilots did not affect their productivity because pilot wages were already relatively high and so affected pilots concluded that their new wages were still “fair”. It is possible that similar mechanisms are at work in the restaurants studied by Hirsch et al. (2015). Those whose wages were reduced (for wage compression) may not have reduced their effort level if they still perceive their wages to be fair or consider the firm to be under pressure.

In a similar vein, we may overestimate the effects of wage increases on labour productivity. In his seminal paper, Akerlof (1986) argues that efficiency wages work because they represent an exchange of gifts. Employers give their employees a ‘gift’ in the form of a wage greater than they would receive elsewhere, and employees reciprocate with the ‘gift’ of working harder than they would elsewhere. It may be that if all workers in a sector (or supply chain) receive a wage increase, or if the wage is not given voluntarily, then workers would not increase their productivity to the extent that we suggest.

On the other hand, it is possible that the Hirsch et al. (2015) study finds very small disemployment effects because the restaurants they study are able to increase their total output for reasons unrelated to channels of adjustment. Expenditure on food away from home shows a general growth trend in the US over the period covered by Hirsch et al. (Economic Research Service, 2016). This is likely to be driven by factors other than wage induced productivity gains and may have been sufficient to override any disemployment effects from productivity gains. For example, it could be the result of a multiplier effect – increased wages boosting
consumption (see our discussion of responding in Chapter 6 and Hall and Cooper, 2012, Magruder, 2013). This mechanism was not included in the model developed here as it was assumed that Western European retailers did not have large presences in developing countries.

Our result is less puzzling keeping this factor in mind, as it allows us to interpret our finding through the lens of the ‘productivity trap’. Jackson and Victor (2011 P.102) describe the productivity trap at the macro-economic level:

“Improving the efficiency of the economy with respect to labour inputs stimulates demand by driving down costs and contributes to a positive cycle of expansion. But crucially it also means that fewer people are needed to produce the same goods from one year to the next. As long as the economy grows fast enough to offset this increase in labour productivity, things go well. But if it does not, then increased labour productivity means that there is less work available in the economy.”

Our simulation results are showing this dynamic at the sector level. The key mathematical relationship here is equation (7-5) (section 7.2.3; Employees_Requird = \( \text{Physical\_Output} \times \text{Employee\_Intensity} \)), which can be redefined in terms of labour productivity (physical output per employee, equal to the inverse of employee intensity),

\[
\text{Employees\_Required} = \frac{\text{Physical\_Output}}{\text{Labour\_Productivity}} \quad (7-15)
\]

Equation (7-15) makes it clear that an increase in labour productivity reduces employment unless output grows sufficiently compensate.

As our causal loop diagram showed (Figure 7-9), the only way productivity can alter output is by reducing production costs which would reduce prices thus influencing demand levels. As Oka (2012P. 4) puts it “improved productivity ... would allow supplier firms to offer better quality products for competitive prices, leading to increased business.” However, at the
supply chain level (rather than individual firm level) there is limited scope for increasing business: firms have to stimulate total demand levels, rather than simply expanding their own market share. Moreover, even with fairly generous assumptions about potential labour productivity gains our simulations find that the living wage increases the cost of labour to employers. That is, the productivity gains are not sufficient to reduce the cost of labour to employers in the face of the simulated wage increases. As a result, prices increase instead of decrease (though they increase by less than they would have done without the labour productivity increase) and (all else equal) demand falls.

Additionally, we suggest that our disemployment result is likely to be robust to a range of alternative productivity/wage relationships\textsuperscript{36}. In all of our scenarios we find that BRIC labour costs are a very small proportion of Western European consumer prices (3-6\%) and that doubling the BRIC wage rate had a similarly small effect on Western European consumer prices. These findings are similar to our previous analysis in Chapter 4 and other work on apparel supply chain living wages (Pollin et al., 2004, WRC, 2005, Miller and Williams, 2009) and imply that even if a BRIC living wage rate reduced productions costs it would lead to such small changes in price that any increases in Western European clothing demand are unlikely to be large enough to create more jobs than are lost through productivity gains. This is especially likely to be the case for goods that are relatively demand inelastic, such as clothing (as demand increases less than proportionally with reductions in price).

In summary, we suggest that our analysis implies that rather than supporting the living wage as a mechanism for sustainable consumption, efficiency wage effects might limit the effectiveness of the living wage as a mechanism to make consumption more sustainable. In line with the literature (Arnold and Hartman, 2005, Oka, 2012), we suggest that efficiency

\textsuperscript{36} This is supported by a simple sensitivity analysis of these relationships shown in Appendix J and can be further explored by altering the relevant parameters in the model interface in Appendix I.
wage effects could reduce the price increase associated with paying the living wage. However, we note that this would also limit reductions in physical output while at the same time potentially exacerbating job losses. Therefore, the existence of efficiency wage effects ought to be of concern to those interested in strategies that rely on mechanisms to increase wages in supply chains such as some forms of slow fashion, especially as this perspective tends to be explicitly anti-growth (Fletcher, 2010).

That said, we stress two qualifying factors. First our analysis is exploratory, both better parametrisation, more sensitivity analysis, and more detailed investigation of alternative structures could change our results. In particular alternative models of firm behaviour may not support our finding that increased productivity reduces employment. For example, if we assume that firms seek to minimise their costs, then an increase in labour productivity following the wage increase may cause employers to substitute labour for capital. However, this will only occur where the BRIC labour compensation costs per unit output are less after the wage increase than before, something that does not occur in any of our scenarios. It is further undermined by the fact that work in BRIC in the clothing supply chain is already not very capital intensive, even where it could be mechanised (see our discussion of BRIC garment factories and cotton production in Chapter 3, Section 3.2).

Another model that would challenge our findings is an alternative efficiency wage model: the shirking model. The shirking model predicts that higher wages reduce worker shirking and therefore allow firms to hire additional floor workers instead of supervisors, leading to net employment gains (or at least dampen disemployment effects) (Georgiadis, 2013). However, this still does not avoid the issue that firms will only hire these workers if they need them to respond to increases in demand.
Likewise, our scenarios all assume sector wide action. This makes our results highly speculative. *More Personal*, for example, assumes all firms move to more labour intensive production. If some firms retain a business model that pursues labour productivity (and consumers retain a preference for fast fashion), slow fashion firms would lose market share to fast fashion businesses.\(^\text{37}\)

Finally, our last scenario (*More Personal*) suggests that other ideas in the slow fashion and Industrial Ecology literatures could act to mitigate the productivity trap. Jackson and Victor (2011 P.104) argue that we can find our way out of the productivity trap by “*resisting labour productivity growth*”. This reflects the language and ideas of various researchers working in this area. Clark (2008) highlights models that stress craft techniques, hand-made design and traditional production such as the Coopa-Rooca: a women’s sewing co-operative based in a slum in Rio de Janeiro, Brazil who produce original hand-made items using regionally specific techniques (Clark, 2008, p. 432). Likewise, Clift et al. (2013) argue that products with a high (skilled) labour content must be a key component of sustainable consumption

### 7.7 Conclusions

This chapter (as far as we are aware) contributed the first system dynamics model of a Western European clothing supply chain that focused on Channels of Adjustment and slow fashion views of firm and worker behaviour. The model was parameterised using data from the literature, H&M financial accounts, and the input-output and living labour modelling from earlier in this thesis. We presented four indicative scenarios describing alternative ways that firms and workers might respond to the introduction of a supply chain living wage in developing countries and used these to guide model runs.

\(^{37}\) We are grateful to an external reviewer currently involved in implementing minimum wage legislation in the UK for this observation.
Our analysis suggests that large increases in the developing country wage rate results in only small reductions in physical output, and that productivity gains may limit the potential for living wages to reduce material throughput and lead to disproportionality large reductions in developing country employment. We identify the latter effect as a meso-scale application of the productivity trap described at the macro level by Jackson and Victor (2011). Therefore, we argue that efficiency wage effects should be viewed as a challenge to slow fashion and other strategies based on labour market interventions.

On this basis we suggest that slow fashion advocates, and other researchers working to raise wages and improve livelihoods in developing countries, should focus their efforts on strategies that resist the productivity trap and we highlighted examples of this kind of work. We also noted a link between our productivity trap result and the findings of Chapter 6 which stressed that rebound effects have the potential to boost total demand as the result of a living wage. In our final discussion chapter, we will return to both of these points and evaluate their implications for sustainability when taken together.
Chapter 8  Conclusions

8.1 Introduction

The central challenge of sustainable consumption and production is to reduce environmental damage while allowing all people to live good lives (Jackson, 2011, Ekins and Lemaire, 2012). Because of the difficulties associated with this challenge (Arto et al., 2014, Erickson et al., 2012) this thesis set out to investigate how an intervention designed to improve the socio-economic conditions of developing country workers might also deliver broader sustainability goals. Synthesising the results presented in the thesis, this chapter argues that paying supply chain workers a living wage is likely to represent a strong step toward sustainability, albeit one that is not sufficient alone. We argue that alongside other policies (including efforts to reduce the environmental impact of developing country consumption and moves to reduce labour productivity) supply chain living wages and other similar initiatives could play a useful role in delivering sustainability. This theoretical insight is developed from the three key contributions of the thesis.

In brief, (1) the thesis has contributed to the existing evidence bases that show that affluent country consumption is a major driver of environmental impact and that the lifestyles of affluent country consumers are dependent on the unfair wages paid to workers in developing countries (Chapter 3, 4 and 5; discussed in section 8.2). These are both issues that paying supply chain living wages could potentially help alleviate. (2) Our modelling work presented a mixed picture of the social impacts of paying BRIC workers a living wage (Chapters 6 and 7; discussed in 8.4). Respending effects could lead to increased BRIC employment, but productivity gains could lead to reduced BRIC employment. Therefore we have argued that alongside wage increases, a range of craft-based (or similar) initiatives that focus on providing
good work and high quality products should be pursued rather than chasing labour productivity gains. Finally, (3) our model analyses also suggested that paying BRIC workers a living wage would have only marginal impacts on the environmental impact of Western European consumption and could lead to overall increases in environmental impacts once increased consumption in BRIC is accounted for (Chapters 5, 6 and 7; discussed in Section 8.3). By increasing developing country impacts and reducing developed country impacts, improving supply chain labour conditions may be a way to distribute environmental impact more equitably. However, it will not reduce environmental damage in absolute terms. Consequently we argued that initiatives to improve supply chain labour conditions should be coupled with investment initiatives that reduce the environmental impact of production/consumption in developing countries and further efforts to reduce the environmental impacts of developed country consumption.

The next sections discuss these findings in more detail, highlighting how each finding contributes to knowledge. The sections also discuss limitations relevant to each contribution and make recommendations for further research. Finally, section 8.5 concludes the thesis.

8.2 Consumption drives environmental impact and affluent consumers depend on unjust wage practices

This section elaborates the first key contribution from the thesis, which developed existing evidence bases to show affluent country consumption drives environmental impact (8.2.1) and is dependent on unfair wages (8.2.2). Specifically, we contributed detailed assessment of the Western European clothing supply chain and its attendant impacts.
8.2.1 Affluent consumption and environmental impact are linked in the Western European clothing supply chain.

In Chapter 3 we demonstrated that consumption and environmental impact of Western European Textiles and Clothing were closely linked between 1995 and 2009. Chapter 3 presented the first sustainability assessment of a textiles and/or clothing supply to include both socio-economic and environmental indicators at multiple scales over an extended time period. This assessment also contributed a novel application of the sub-systems input-output model framing, using it to allow more robust sector-level analyses. In our analysis we attributed growth in the carbon footprint of Western European clothing consumption between 2002 and 2007 to growth in consumer demand. Additionally, we noted that previous reductions in the carbon footprint typically occurred simultaneously with reductions in demand.

This finding is significant for two reasons. First it implies that reducing consumption could be useful in reducing environmental impacts, particularly in light of the likely limitations of attempts to decouple consumption from environmental impacts (Jackson, 2009). Secondly, it adds to the already considerable body of work finding that consumption is a major driver of environmental impact (e.g. Brizga et al., 2014, Feng et al., 2015, Wenzlik et al., 2015), thus building the evidence base.

However, it is worth noting that our interpretation of the results in Chapter 3 is simply based on comparing the carbon footprint trend to the consumption trend. Originally we intended to assess the impact of consumption and other factors on the carbon footprint using the more formal method of structural decomposition analysis (SDA) (see, for example, Arunima and Lan, 2016). This would have allowed us to mathematically decompose the changes in the carbon footprint into changes in supply chain structures and changes in final demand. Unfortunately, at the time the analysis in Chapter 3 was carried out there were no
constant price input-output tables (something necessary for an SDA) available to us for the full 1995-2009 period. Moreover, due to methodological difficulties\textsuperscript{38} the WIOD constant price tables had no timeline for release (Gouma, 2014) and this same difficulty prevented us from estimating the tables ourselves. These tables are, however, now available from WIOD\textsuperscript{39}, and an SDA would make an interesting complement to Chapter 3.

Similarly, it would be useful to extend our analysis in Chapter 3 beyond carbon emissions and the Western European textile and clothing supply chain. In this vein we note that since work on this thesis started, EXIOBASE has been released free of charge. EXIOBASE offers considerably more spatial and product detail than WIOD for the years 2000 and 2007. Additionally EXIOBASE has an extensive list of environmental extensions making a variety of complementary analyses possible (Tukker et al., 2014). This would be a significant step forward because (as we discussed in Chapter 2) non-carbon (and particularly the water impact) of clothing consumption is substantial. Expanding beyond Western European textiles and clothing consumption would also allow identification of other potential case studies.

Finally expansion of our model frameworks to include more sophisticated modelling of consumer behavior would allow a more thorough assessment of the sustainability of Western European clothing consumption. Our assessment focused on the production of clothes for Western European markets and did not include the impacts associated with their use or disposal phases. This could be remedied through more in depth scenario analysis to explore these highly uncertain areas (e.g. Allwood et al., 2006).

\textsuperscript{38} Estimation of the constant price input-output tables using the standard methods, including double deflation (see Miller and Blair 2009), resulted in unreliable (often negative) value added.

\textsuperscript{39} www.wiod.org
8.2.2 Wages in the Western European Clothing Supply Chain are Unfair.

We add to the body of work demonstrating that wages in clothing supply chains are unfair (e.g. Pollin et al., 2004; Merk, 2009). Two strands of evidence suggesting that wages in the Western European clothing supply chain were unfair were presented in this thesis. First, Chapter 3 highlighted a potential inequity between the wages of Western European and BRIC workers in the Western European textiles and clothing supply chain, estimating that Western European workers earned 30 times more than BRIC workers (at market exchange rates). This was further investigated in Chapter 5, using a novel dataset and the novel concept of living labour compensation (introduced in Chapter 4).

Living labour compensation is an extension of the established living wage concept to include social security payments, thereby more fully reflecting the cost of living wages to employers. Unlike living wages, the living labour compensation concept is directly comparable with labour compensation, thus allowing normative assessments of fairness to be incorporated into national accounting frameworks. Chapter 4 estimated the first comparable living wage and living labour compensation estimates for Brazil, Russia, India and China (BRIC). Chapter 5 developed these into first of their kind living labour compensation satellite accounts, compatible with the World Input-Output Database. Using these satellite accounts (in conjunction with an input-output model) Chapter 5 estimated that paying BRIC workers in the Western European clothing supply chain a living wage would almost double the cost of the BRIC labour in the Western European clothing supply chain.

This finding is significant principally because it indicates that many BRIC workers in the 2005 Western European clothing supply chain received unfair wages. Our estimate of the cost of employing BRIC workers on a living wage implies many BRIC workers in the 2005 Western European clothing supply chain were not paid a wage high enough to allow them to
live a decent life; something that many stakeholders agree is unfair (Anker, 2011b, Clean Clothes Campaign, 2015, Vaughan-Whitehead, 2014). In this way our results from Chapter 5 also support the macro-level studies that find inequities between labour conditions in developed and developing countries (e.g. Alsamawi et al., 2014a). Similarly, the finding that wages are (on average) below the living wage adds to the case for using BRIC living wages in order to improve the social conditions of workers in the supply chains supplying affluent consumers.

However, there are several limitations affecting the finding of unfairness in wages. Firstly, the use of MERs instead of PPP in Chapter 3 is problematic as it is likely to over-emphasise the differences between labour compensation in BRIC and in Western Europe. This is also a problem for other social accounting work that looks at income across different countries. For example, Alsamawi et al. (2014a) compare average incomes in different countries valued at MER and on this basis identify “servant” and “master” countries. To an extent, application of MERs in this thesis is mitigated by use of the living labour compensation in Chapter 5, because, unlike MERs, living labour compensation does take into account country specific issues. Nonetheless, a similar study using PPP time series data would be extremely interesting. Recent work has constructed a set of WIOD compatible PPP conversion factors (Inklaar and Timmer, 2014). However, these are only available (at present) for 2005, and expanding them to a full time series is likely to be a difficult process. An intermediary approach maybe to apply the PPP estimates from Inklaar and Timmer (2014) and compare these to our 2005 estimates and our living wage estimates.

Secondly, our estimates of living wages (Chapter 4) apply the Engel coefficient in a mechanistic manner, which has been shown to be problematic (Anker, 2011a). Those looking to improve on our living wage estimates are advised to investigate the more detailed

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40 PPPs are not, however, a panacea for inter-country comparison of income. See Anker (2011b) for a discussion of the problems associated with using PPP to examine poverty and related issues.
methodologies discussed in Chapter 4. Finally our estimates of living labour compensation are only for four countries and only for one year. Although (as discussed above), this is more countries than are usually examined in clothing supply chain studies, extension to additional countries would allow us to make more general claims about fairness. Likewise extending our estimates of living wages and living labour compensation throughout the WIOD time series would facilitate a more comprehensive assessment of the fairness of living wages in the Western European clothing (and other) supply chains.

8.3 Paying BRIC workers in the Western European clothing supply chain is likely to lead to a more equitable distribution of environmental impacts.

Our interpretation of the results presented in this thesis is that overall, initiatives to improve the social conditions of workers in the clothing supply chain are likely to redistribute environmental impacts more equitably, rather than substantially reducing them. This is significant because increased supply chain wages and safety have been proposed as a way to reduce the environmental impacts (e.g. Fletcher 2007; Clift et al, 2013). There are three pieces of evidence presented in this thesis that suggest that payment of a supply chain living wage would not (alone) lead to reductions in environmental impact but may lead to a fairer distribution of impacts.

First, there are only likely to be marginal reductions in the environmental impact of affluent consumption as a result of increasing supply chain wages. Chapter 5 estimated how consumer prices would change assuming that the additional costs of paying BRIC workers in the Western European clothing supply chain a living wage were passed completely to consumers. The use of an input-output model and the living labour compensation concept to assess the additional costs of living wages in Chapter 5 contributed a more comprehensive price pass through estimate than was previously possible in the literature. Nevertheless Chapter 5
estimated that Western European clothing prices would increase by only around 6%, in line with those already in the literature (e.g. Pollin et al., 2004, Miller and Williams, 2009). This is a relatively small price increase that we would expect to lead to small reductions in Western European consumption. This was confirmed for a range of alternative consumer responses in Chapter 6. Chapter 6 estimated that reductions in the carbon footprint of Western European clothing following payment of the living wage to BRIC workers would be small (approximately 4-5%).

Moreover, when the additional consumption in BRIC countries (due to increased wages) was accounted for these marginal reductions disappeared entirely. This was attributed to the fact that the living wage price increase (though small from the perspective of Western European consumers) represented a substantial wage increase in BRIC, leading to considerable additional spending. The translation of a large supply chain wage increase to small consumer price increases is in line with other studies looking at the cost of other developing country labour in apparel supply chain contexts (Pollin et al., 2004, Miller and Williams, 2009). The result of a potential increase in total carbon emissions is significant because it suggests that the net environmental benefits of paying increased wages for developing country workers are limited, if they are not adopted as part of a suite of sustainability policies.

However, it remains the case that there is a strong equity-based argument that supports per capita increases in carbon emissions (and other environmental impacts) in developing countries. Nonetheless, because climate change is a global issue (and because developing countries will arguably suffer the worst effects), the risk of a net rise in environmental impacts underscores the need for further reductions in the environmental impact of affluent country consumption. Therefore, we would argue that payment of supply chain living wages is a necessary but not sufficient step toward sustainability.
An example of the kind of steps we would like to see being taken alongside improvements in supply chain labour conditions is investment in sustainable infrastructure. The finding that the additional spending in BRIC could lead to overall increases in environmental impact was partially attributed to the relative carbon intensity of BRIC marginal consumption relative to Western European marginal consumption. This result is important for as it implies that raising material standards of living in developing countries could have additional environmental impacts that are larger than the associated reductions in impacts from the reduction in affluent country consumption, given current systems of production. It follows that strategies that increase the material wellbeing of developing country workers should, as discussed in Chapter 6, also look to help them “leapfrog” to sustainable consumption and production (Tukker, 2005, Schäfer et al., 2011). There is, however, a risk that firms may respond to increased wages by squeezing other costs – such as capital investment – meaning that at the firm level such investment may be challenged by wage increases.

Chapter 7 (in which the dynamic supply chain model was applied) largely confirmed the result of Chapter 6 that paying BRIC workers in the Western European supply chain a living wage would only marginally affect environmental impacts (estimating that physical output would fall by 1-11% following introduction of the living wage). However, it is worth noting that the model in Chapter 7 shows a considerably greater range than the model in Chapter 6. This range can be attributed to the greater heterogeneity of the policies enacted alongside the wage change in the model scenarios in Chapter 7 compared to Chapter 6: Chapter 6 assumed that the only action taken was to increase BRIC wage rates, whereas Chapter 7 also assumed other changes (such as reducing the influence of fashion trends). Together with our results on rebound effects from Chapter 6, the variance in environmental impacts in Chapter 7 underlines the need to consider the policies enacted alongside supply chain interventions very carefully.
As the principal evidence base for this finding comes from model based analysis, it is worth discussing model limitations here. There are several limitations to our models and these qualify our results. First, neither the model applied in Chapter 6 nor the model applied in Chapter 7 is complete in the sense that they encompass all the possible labour market interventions or all the aspects of slow fashion described in the literature (as noted in Chapter 1.3.1). However, the extent to which it would be useful to try to develop a single model that could show all such ideas is debatable. Although our models were much simpler than many others available in the literature, the remaining complexity of the models meant that large portions of model process and detail were not included in the main body of this thesis. This is problematic as it, to some extent, obscures the structures that drive model results and reduces learning from the models by the reader. To mitigate this we are currently working on adapting the model so that it can be hosted online, allowing more direct interrogation of the model itself.

An alternative route would be to develop simpler analytical models that further explore the specific tendencies within production systems than to make our models more and more ‘complete’ (complex). This would allow the models to be fully described in the text, increasing their transparency and accessibility to the reader. The problem faced in developing models for this thesis is common to all modelling work: there is a tension between simplicity (which makes models usable) and complexity (which makes models useful).

Linked to this, our models were based on highly stylised data. This was most obvious in Chapter 7 where we specified graphical relationships with only a very limited grounding in empirical data. However, it was also true of the more empirically based models presented in Chapter 5 and Chapter 6. The data from the World Input-Output Database used in these models is often itself the output of models (Timmer, 2012)41.

41 For details see Timmer (2012), but two examples of models used in constructing WIOD are the SUT-RAS procedure, which was used to update the WIOD supply-use tables between years and the Perpetual Inventory
We have tried to mitigate the impacts of using such stylised data and models with (necessarily) limited representations of the world by discussing only the broad trends evident in our results rather than focusing on their detail. We have also attempted to highlight model assumptions and their implications throughout the thesis. Nonetheless, further investigation of our research questions with different models and different databases (or entirely different epistemological approaches) would be a useful extension to this research as it would view the problems from alternative perspectives, allowing a fuller understanding of the key issues and challenges.

8.4 If coupled with additional efforts focused on reducing labour productivity, paying developing country workers a living wage could have a net social benefit.

The question of whether paying developing country workers a living wage was a social benefit or a social hindrance was discussed in Chapter 2. It is currently an area of intense academic debate. This thesis has made several contributions to the debate, principally through looking at the potential impact of paying BRIC workers a living wage on BRIC employment. Chapter 5 considered the additional cost of paying BRIC workers a living wage in the context of three potential channels of adjustment, while Chapters 6 and 7 built on the relatively simple analysis of Chapter 5 by incorporating the channels of adjustment (to varying degrees) into two alternative simulation models.

Before discussing their results, it is worth noting that the models used in Chapters 6 and 7 both represent contributions independent of their results. Chapter 6 represents a

Method, which was used to estimate missing capital stock values. It is important to note that these models are not controversial, but they are models and their use emphasises the stylised nature of the datasets that were used in this thesis.
methodological contribution because it is the first time an input-output based modelling framework (variations on which have been widely applied in to other problems, see Choi et al., 2010, Mongelli et al., 2010, Chitnis et al., 2013, MaCurdy, 2015) has been applied to the issue of living wages in the academic literature. Chapter 7 developed and applied an alternative (exploratory) model with more sophisticated modelling of labour markets and firm behaviour than the model in Chapter 6. This model also incorporates more of the channels of adjustment and slow fashion frameworks than was possible in Chapter 6. To the best of our knowledge the model in Chapter 7 is the first attempt to explore either of these concepts in a dynamic supply chain model.

By emphasising different adjustment mechanisms, the models in Chapter 6 and 7 provide different perspectives on the social impacts of paying a supply chain living wage. The most striking result in Chapter 6 is the large employment multiplier effect (also referred to through the thesis as a respending effect). Our model estimated that through respending of the additional income earned as a result of the living wage payments, employment in BRIC could see substantial increases (relative to BRIC employment supported in the Western European clothing supply chain in 2005).

The analysis in Chapter 6 is not conclusive evidence of the presence of the employment multiplier effect that Coakley and Kates (2013) posit as a mechanism likely to reduce the disemployment effects wage increases. Our analysis cannot be conclusive because of the data limitations discussed above and the general restrictions of input-output models in assessing change in an economy; as noted in Chapter 6 and as has been talked about elsewhere in the academic literature (e.g. Wiedmann et al., 2007, Turner et al., 2009) input-output models have
very limited descriptions of the behaviour of various economic actors and their results with respect to changes in the economy must be interpreted very carefully\textsuperscript{42}.

However, that our results point to a large potential employment multiplier effect is fairly unambiguous and we identified and discussed precedents in the literature (e.g. Magruder, 2013, Hall and Cooper, 2012). Additionally, (as with carbon) the model misses detail on production methods that would lead to a larger effect. We conclude that our model adds weight to the notion that respending effects could be important and therefore require further investigation.

Finally, the discussion of social effects in Chapter 7 centered on the potential presence of a productivity trap which reflected the same basic mechanics as those described by Jackson and Victor (2011) at the macroeconomic level. The productivity trap in our model was due to using efficiency wage models of the BRIC labour market, which predict that worker productivity increases with wages. These models are generally thought in the living and minimum wage literatures to be a potential reason why employment might not fall after a wage increase, because the increase in labour productivity makes firms more competitive (Oka 2012, Schmitt, 2015). However, our model made it explicit that this is only the case at the sector level if the productivity gain is sufficient to reduce the final price, leading to an increase in total output, a condition we judge unlikely. As a result, we conclude that far from looking to productivity gains to offset the costs of wage increases, supply chain living wages should be implemented alongside strategies to shift to production methods that are more labour intensive, such as craft based production. This, of course, is easier said than done and implies a systemic change such as that suggested by Fletcher (2010) in the fashion industry or more generally by Jackson and Victor (2011).

\textsuperscript{42} Though this is a condition of all model analyses.
8.5 Supply chain living wages: progress towards sustainability.

This thesis set out to explore how we might progress towards the holistic vision the sustainable development goals (SDGs). Amongst other things, the SDGs require strategies that can contribute to the eradication of poverty (goal 1) and reductions in inequalities (goal 10), help provide decent work for all (goal 8), and reduce environmental damage by transforming systems of production and consumption (goal 12). In this chapter we have argued that as part of a suite of approaches, paying BRIC workers in the Western European clothing supply chain a living wage can contribute to each of these goals.

Specifically, we have argued that the analyses presented in the thesis suggest that supply chain living wages could lead to small reductions in the environmental impacts of affluent country consumption while also increasing the social benefits of that consumption. We found that price increases due to paying a supply chain living wage would likely only be relatively small, but that this would probably lead to reductions in affluent country consumption, reducing associated environmental damage. We presented evidence in support of the presence of an employment multiplier effect, suggesting that this could be strong enough to ensure employment in developing countries would not fall as a result of the living wage being paid.

Likewise, though our analyses also identified challenges and trade-offs these are not insurmountable and do not negate the value of living wage interventions. For example, the increased income in developing countries associated with living wage payments is likely to lead to a small increase in environmental damage. But this is the result of enhanced development and may represent a more equitable sharing of per capita environmental damage. Furthermore, those areas of the world where people would most benefit from living wages are also those areas with the most scope for investing in newer, cleaner forms of production.
systems able to mitigate the additional damage. Similarly, though increased wages could undermine employment through productivity gains, this does not have to be the case, especially if producers work to avoid the productivity trap.

Consequently, our view is that production and consumption systems that emphasise ‘better’ rather than ‘more’ can help us progress to a more sustainable world.


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Appendix A. Input-Output Analysis: A Primer

A.1 Introduction

Developed by Wassily Leontief (1936, 1966) input-output analysis maps the intersectoral transactions within an economy. In this way it describes the supply chains of all the goods and services within an economy. In 1970, Leontief described its extension to analysis of environmental impacts and this ‘environmental’ input-output analysis is rapidly becoming the academic standard for carbon footprinting. In this appendix we outline the form and principals of economic input output analysis before describing how it can be extended to analysis of environmental impacts. This appendix provides a ‘textbook’ description of environmentally extended input-output analysis, drawing heavily from Miller and Blair (2009) and Leontief (1960)

A.2 (Economic) Input-Output Analysis

Input-output analysis was developed as a tool to analyse the connections between the various consuming and producing sectors of national economies. The common facet of all its extensions (including environmental input-output analysis) is the use of a set of linear equations to map the interdependence of the sectors. The coefficients in these equations are determined empirically from input-output tables, which are largely derived from national accounts. An input output table consists of observed data on transactions between industries for a given region and period of time. Table 1 is a simplified, hypothetical input-output table for a simple 3 sector economy over the period of a year.
An input out table for a hypothetical, 3 sector economy. Adapted from Leontief. All values are in $.

<table>
<thead>
<tr>
<th>From</th>
<th>Intermediate Consumption</th>
<th>Final Demand</th>
<th>Total Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>60</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>Manufacture</td>
<td>80</td>
<td>150</td>
<td>40</td>
</tr>
<tr>
<td>Services</td>
<td>50</td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>Other</td>
<td>30</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total Input</strong></td>
<td><strong>220</strong></td>
<td><strong>300</strong></td>
<td><strong>325</strong></td>
</tr>
</tbody>
</table>

The last row and column of the table show the annual input and output of each sector respectively. The highlighted sub-matrix is the transactions matrix ($\mathbf{Z}$) showing the inter-sector flows of products in the domestic market. For example, of the two hundred and twenty dollars’ worth of products produced by agriculture sixty dollars worth were consumed by agriculture itself, forty dollars worth was consumed by the manufacturing industries, one hundred dollars was consumed by services and twenty dollars went to the export market. Likewise, in order to produce two hundred and twenty dollars worth of goods the agricultural sector consumed eighty dollars of manufacturing goods, fifty dollars of services and imported 30 dollars worth of goods as well using sixty dollars worth of its own products. Viewed in this way we can also see that the production of agricultural goods is dependent on the demand stimulated by activities in other sectors.

Conversely, in any economy there are sales to consumers whom are largely exogenous to the production cycle of the economy. The needs of these consumers are largely independent of levels of production. By way of example, Miller and Blair (2009, p.11) note that government demand for aircraft is related to “national policy, budget levels, or defense needs”. Moreover, these goods are primarily produced for final use rather than as inputs to another product.
Therefore, these sectors are referred to as final demand. For simplicity, in our example final demand consists only of exports (more usually final demand is the sum of household consumption, non-profit organisations serving households, government consumption, gross fixed capital formation and exports).

The links between the different sectors can be described mathematically. Assume that the economy consists of $n$ sectors. Denoting $x_i$ as the total output of sector $i$, where $1 \leq i \leq n$, $z_{ij}$ as the elements of the transaction matrix i.e. transactions between the producing sector $(i)$ to the consuming sector $(j)$ (including transactions between $i$ and $i$, where $j=i$), and $y_i$ as final demand for the products of sector $i$, it is evident from table 1 that,

$$x_i = z_{i1} + \cdots + z_{ij} + \cdots + z_{in} + y_i = \sum_{j=1}^{n} z_{ij} + y_i \quad (A-1)$$

For a full input output table, this can be written in matrix form,

$$x = Zi + y \quad (A-2)$$

where,

$$x = \begin{bmatrix} x_1 \\ \vdots \\ x_i \end{bmatrix}, \quad Z = \begin{bmatrix} z_{11} & \cdots & z_{1j} \\ \vdots & \ddots & \vdots \\ z_{i1} & \cdots & z_{ij} \end{bmatrix}, \quad i = \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix} \quad \text{and} \quad y = \begin{bmatrix} y_1 \\ \vdots \\ y_i \end{bmatrix} \quad (A-3)$$

As in the main thesis text, bold lowercase letters to represent a column vector, and bold uppercase letters to represent a matrix. For those not familiar with matrix algebra, post multiplication of $Z$ by $i$, a column vector of ones, has the effect of summing the row entries of $Z$ (producing a column vector). Horst (1963) is a useful primer on matrix algebra with a social-science focus.
Equation (A-2) offers very little analytical opportunity; rather it provides a snapshot of the interdependencies of economic sectors in a given timeframe. In order to uncover the analytical power of input-output analysis it is necessary to introduce a key assumption, *sectors use inputs in fixed proportions relative to their total output, irrespective of changes in final demand* (an associated assumption is that economies of scale are not accounted for; purchasing one unit bears the same per unit cost as purchasing one hundred units).

This ratio is termed the technical coefficient and is defined as,

\[ a_{ij} = \frac{z_{ij}}{x_i} \]  

(A-4)

therefore,

\[ a_{ij}x_i = z_{ij}. \]  

(A-5)

Equation (A-2) can now be rewritten as,

\[ x_i = a_{i1}x_1 + \cdots + a_{ij}x_i + \cdots + a_{in}x_n + y_i = \sum_{j=1}^{n} a_{ij}x_i + y_i \]  

(A-6)

and for our example economy,

\[ x_1 = a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + y_1 \]  

(A-7)

\[ x_2 = a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + y_2 \]  

(A-8)

\[ x_3 = a_{31}x_1 + a_{32}x_2 + a_{33}x_3 + y_3 \]  

(A-9)

where 1, 2, and 3 represent agriculture, manufacturing and services respectively. \( y \) is final demand (exports), and all other notation is consistent with previous equations.
Equations (A-7)-(A-9) clearly demonstrate the dependency of inter-sector flows on sectoral outputs. However, typical questions for input-output analysis are often more interested in mapping these effects to final demand categories in order to examine supply chains, or examining the effects of forecast or hypothetical changes in demand, \( y \), on economic output, \( x \). For our example economy this is done by rearranging (A-7)-(A-9):

\[ y_1 = x_1 - a_{11}x_1 - a_{12}x_2 - a_{13}x_3 \]  
\[ y_2 = x_2 - a_{21}x_1 - a_{22}x_2 - a_{23}x_3 \]  
\[ y_3 = x_3 - a_{31}x_1 - a_{32}x_2 - a_{33}x_3 \]

then grouping like terms,

\[ y_1 = (1 - a_{11})x_1 - a_{12}x_2 - a_{13}x_3 \]  
\[ y_2 = -a_{21}x_1 - (1 - a_{22})x_2 - a_{23}x_3 \]  
\[ y_3 = -a_{31}x_1 - a_{32}x_2 - (1 - a_{33})x_3. \]

Setting,

\[ A = \begin{bmatrix} a_{11} & \cdots & a_{1j} \\ \vdots & \ddots & \vdots \\ a_{i1} & \cdots & a_{ij} \end{bmatrix} \]  
\[ I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \]

and terming \( A \) the technical coefficient matrix, equation 5 can be rewritten,

\[ y = (I - A)x \]  
(A-17)
which holds for any input-output table. Lastly, because matrix division is represented by multiplication by the inverse, equation 6 can be rewritten to find \( x \),

\[
x = (I - A)^{-1}y.
\] (A-18)

Equation (A-18) is the basic Leontief quantity input-output model (the alternate price model is discussed in 5.2.4 of the main thesis text) and constitutes the basic analytical unit of a majority of the extensions of input output analysis. \((I - A)^{-1}\), is termed the Leontief inverse and is often written as ‘\( L \)’. Conceptually, (7) can be thought of as:

\[\text{Output (E) = indirect requirements per unit final demand (unitless) * final demand (E)}\]

A.3 Environmental Input-Output Analysis

The standard method of environmentally extending economic input-output models is to derive a vector \( u \), whose elements, \( u_j \), have units of environmental impact per unit economic output,

\[
u = \begin{bmatrix} \frac{e_1}{x_1} \\ \vdots \\ \frac{e_j}{x_j} \end{bmatrix}.
\] (A-19)

where, \( e_j \) is the total direct environmental impact produced by sector \( j \). Denoting total greenhouse gas production from a given economy as \( c \) we can see that total carbon emitted by an economy is equal to the dot product of \( u \) and \( x \),

\[c = ux = u_1x_1 + \cdots + u_jx_j\] (A-20)

We can now substitute (A-18) into (A-20) to get,

\[c = u(I - A)^{-1}y\] (A-21)
the standard model of environmentally extended input output analysis (EIO). Conceptually, we are updating the total requirements matrix with emissions data. Thus instead of every unit of final demand stimulating a given amount of economic activity, a unit of final demand stimulates a given quantity of emissions.

References


# Appendix B. Sector classification system correspondence table

Table B3 Sector classification system correspondence table

<table>
<thead>
<tr>
<th>Chapter 3, of this Thesis</th>
<th>WIOD</th>
<th>NACE Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Agriculture</td>
<td>AtB</td>
</tr>
<tr>
<td>Energy and Resources</td>
<td>Mining and Quarrying, Coke; Refined Petroleum and Nuclear Fuel; Electricity, Gas and Water Supply</td>
<td>C;23;E</td>
</tr>
<tr>
<td>Textiles and Clothing</td>
<td>Textiles and Clothing</td>
<td>17t18</td>
</tr>
<tr>
<td>Other Manufactures</td>
<td>Food, Beverages and Tobacco; Leather, Leather and Footwear; Wood and Products of Wood and Cork; Pulp, Paper, Paper, Printing and Publishing; Chemicals and Chemical Products; Rubber and Plastics; Other Non-Metallic Mineral; Basic Metals and Fabricated Metal; Machinery, Nec; Electrical and Optical Equipment; Transport Equipment; Manufacturing, Nec; Recycling; Construction; Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel; Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles; Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods</td>
<td>15t16; 19;20; 21t22; 24; 25; 26; 27t28; 29; 30t33; 34t35; 36t37; F; 50; 51; 52</td>
</tr>
<tr>
<td>Services</td>
<td>Hotels and Restaurants; Inland Transport; Water Transport; Air Transport; Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies; Post and Telecommunications; Financial Intermediation; Real Estate Activities; Renting of M&amp;Eq and Other Business Activities; Public Admin and Defence; Compulsory Social Security; Education; Health and Social Work; Other Community, Social and Personal Services; Private Households with Employed Persons</td>
<td>H; 60; 61; 62; 63; 64; J; 70; 71t74; L; M; N; O; P</td>
</tr>
</tbody>
</table>
Appendix C. ‘Sense Check’: Gross Value Added Trends Including RoW

In section 3.3 we note that the labour compensation and returns to capital components of gross value added are not available for the Rest of the World Region. Consequently, the Western European Textiles and Clothing labour compensation and returns to capital PFs presented in the main text do not include contributions from the Rest of the World. Here we present the results of a sense check for the Western European Textiles and Clothing labour compensation and returns to capital PFs. Our sense check takes the form of a comparison of the Western European Textiles and Clothing Income PF with the Western European Textiles and Clothing Income-RoW PF. The income PF is the sum of the labour compensation and returns to capital PFs and represents gross value added generated at every stage of the value chain outside of the Rest of the World. The income-RoW PF represents the gross value added generated at every stage of the value chain, including the Rest of the World region.

Figure C-1 shows trends in the Western European Textiles and Clothing income and income-RoW PFs at the aggregate level. Trends are identical until 1999, when the income PF falls more quickly than the income-RoW PF. This illustrates that value added declined less rapidly in the RoW region than in the other model regions. After 2001, the income-RoW PF and Income PF recovered at similar rates until 2007 when growth in the income PF was slower than growth in the income-RoW PF. This suggests that between 2007 and 2008 value adding activities in RoW grew faster than the regional average.
Figure C.21 Comparison of the Western European textiles and clothing income and income-RoW production footprints

Figure C.2 shows the regional contributions to the income and income-RoW PFs. By definition, all trends are identical apart from the Other less affluent nations region, which includes the Rest of the World region. Figure C.2 confirms the results of Figure C.1, that relative to other regions, contributions to gross value added fell more slowly in the Rest of the World until 1999 and then began to grow before any other region. Figure C.2 also highlights that gross value addition in the Rest of the World did experience relatively high growth rates in the 2007-2008 period.

Together, Figures C.1 and C.2 suggest that the labour compensation and returns to capital PFs are underestimated. However, it is also clear that overall trends remain relatively unaffected. That said, we would expect production in the Rest of the World region (which includes, for example, Cambodia and Bangladesh) to be Labour rather than capital intensive. Hence we would expect most of the value added in this region to be in the form of labour compensation and as a result, the sense check implies that not including contributions from the Rest of the World region had the biggest effect on the labour compensation PF.
Figure C-22 Comparison of regional contributions to the Western European textiles and clothing income and income-RoW production footprints.
Appendix D.  Living Labour Compensation Detail

This Appendix is a Microsoft Excel spreadsheet. Please see the attached CD-ROM or
https://www.dropbox.com/sh/nqjqtxf3qo6nwvo/AABI_UJLuuvHui_5u5L68QiAa?dl=0.
Appendix E. Living Labour Compensation Satellite Account

This Appendix is a Microsoft Excel spreadsheet. Please see the attached CD-ROM or http://tinyurl.com/mairthesisdocs.
Appendix F. Moving Between Classification Systems and Price Concepts

The World Input-Output Database (WIOD) uses a modified form of the NACE (Statistical Classification of Economic Activities in the European Community) industrial classification system to describe economic transactions. Conversely, household consumption is usually recorded in the COICOP (Classification of Individual Consumption According to Purpose) classification system. Moreover, WIOD data is valued at basic prices, while consumer expenditure is valued at purchaser’s prices. In Chapter 5 we examine household consumption of clothing goods, as defined by COICOP, and in Chapter 6 we integrate of input-output model with various demand elasticities based on COICOP expenditures at purchaser’s prices. Therefore, we require coherent translation between the two classification systems and price concepts.

F.1 Converting Between Classification Systems

To convert between classification systems we follow Druckman and Jackson (2009) and Mongelli et al., (2010) in using bridge matrices. We do not convert directly between NACE and COICOP but instead use an intermediary classification (Classification of Products by Activity (CPA)), when going from NACE to COICOP and vice versa (because we will use CPA to convert between price concepts). We need a bridge matrix for each transition.

The mechanics for estimating each bridge matrix all follow the basic process used to transform Supply-Use Tables (SUTs) to symmetric input-output tables (Dietzenbacher et al., 2013, Miller and Blair, 2009). For example, to move from CPA to NACE we use the World SUTs from WIOD. The world supply table is best visualised as partitioned matrix with a NACE
(industry) classification for the rows and a CPA (product) classification for the columns. Where
the partitions on the diagonal show the domestic (within country) supply of products from each
industry, and the off-diagonal partitions (which would represent import/exports) are zero:

\[
V = \begin{pmatrix}
V_a & 0 \\
0 & V_b \\
\end{pmatrix}
\]  
\hspace{1cm} (F-1)

Where superscript letters are countries.

We then post multiply this by a partitioned vector, \( t = \begin{pmatrix} t_a \\ t_b \end{pmatrix} \), in which each partition shows
the total use of the domestically produced products (i.e. total use in CPA):

\[
B = V t^{-1}
\]  
\hspace{1cm} (F-2)

Where, \( B \) is a NACE by CPA matrix where each element of the partitions on the diagonal
indicates the share of domestic output of given product that is produced by a given industry.
This is well established as the fixed product sales structure transformation method (see Miller
and Blair (2009) and Dietzenbacher et al (2013) for more).

The other bridge matrices all follow similar processes, taking a matrix showing flows
from one classification to another and post-multiplying by the inverse of output in the relevant
classification system. To estimate CPA to COICOP (\( C \)) and vice versa (\( R \)) we use the
CPA/COICOP conversion table from the United Kingdom Office for National Statistics (UK
ONS, 2016). As this table is much more detailed than either the WIOD database or our elasticity
parameters we aggregate from 104 products to 59 and from 36 COCIOP categories to 9. As
this type matrix is rarely released by national statistical offices (Mongelli et al., 2010) we
assume that every country has the same conversion from CPA to COICOP as the UK. To estimate CPA to NACE ($B$) and vice versa ($D$) we use data from the WIOD world SUTs.

The difficulty of the move from COICOP to CPA is that the single COICOP category of clothing becomes several CPA categories and then several NACE categories. As the living wage price shock effects some CPA/NACE categories more than others, the relative shares in the respective bridge matrices are changed. As a result, we also estimate price adjusted bridge matrices for COICOP to CPA ($R_*$) and CPA to NACE ($B_*$).

**F.2 Converting Between Price Concepts**

While the bridge matrices translate between classification systems, we also need to convert between price concepts. In the modelling framework, NACE data is always in basic prices and COICOP data is always in purchaser’s prices. However, the CPA classification functions as an intermediary between the two price concepts. CPA is used as an intermediary because in the world use tables WIOD provide an estimate of household demand for each country\(^{43}\) in CPA at both basic and purchaser’s prices. From this information we derive a matrix, $M$, in which each element in a given column is the ratio of basic to purchaser’s prices for household demand from that CPA category. To convert household demand from basic prices to purchaser’s prices we take the entrywise product of the demand matrix (in CPA) and $M$. To convert from purchaser’s prices to basic prices we do entrywise division of the demand matrix by $M$.

**References**


\(^{43}\) This is not available for China as the Chinese base tables used by WIOD were already in basic prices (Gouma, 2015). Therefore for China we use net tax and margins data from Eora (Lenzen et al., 2012)

Gouma, R. 2015. RE: Email exchange, WIOD valuation matrices. Type to Mair, S.


Appendix G. Derivation of the price adjusted input-output model.

The price adjusted input output model is estimated by updating the transactions table and gross output vector from the World Input-Output Table so that it’s elements reflect a change in price, in our case the ‘new’ price of labour under the living labour compensation counterfactual. This updated table can then be used to estimate an input-output model in the usual way. This process follows Choi et al (2010), who estimate the impacts of a carbon tax in the United States Economy.

To update the transactions table \( (Z) \) so that it reflects the living labour compensation rate we multiply it by the price index estimate in Chapter 5 equation (5-4),

\[
Z' = \hat{p}Z
\]

Likewise, to estimate how the living labour compensation rate would have been reflected in gross output we multiply it by our price index,

\[
x' = \hat{p}x
\]

We then estimate the price adjusted Leontief inverse,

\[
L' = (I - Z'x^{-1})^{-1}
\]

and the price adjusted impact vector,

\[
u' = f'x^{-1}
\]

From which we can derive \( Q' \), the matrix of impacts per unit of final demand,

\[
Q' = \bar{u}L'
\]
Appendix H. Stella Model and Equations

This Appendix is a .STMX file, please see the attached CD-ROM or https://www.researchgate.net/profile/Simon_Mair2. The file requires STELLA to be installed. A free trial of STELLA (valid for 30 days) can be downloaded from http://www.iseesystems.com/store/products/trial.aspx.
Appendix I. Data used to calibrate Chapter 7 Model.

This Appendix is a Microsoft Excel file, please see the attached CD-ROM or https://www.researchgate.net/profile/Simon_Mair2.
Appendix J. Sensitivity Analysis of Chapter 7 Model.

This Appendix is a Microsoft Excel file, please see the attached CD-ROM or https://www.researchgate.net/profile/Simon_Mair2.