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Industrialisation, Innovation, Inclusion

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Abstract

Can industrialisation be socially inclusive? Is higher income inequality within and between countries the inevitable outcome of technology-driven industrial development? In this paper, prepared as background for the UNIDO's Industrial Development Report 2015, we examine the role of industrialisation and innovation in socially inclusive development. First, we define social inclusiveness and describe the relationship between technological innovation, structural change and social inclusiveness. Second, we discuss globalisation and technological innovation and their joint impact on income inequality. Third, we explore conditions under which technology-driven industrial development may be consistent with socially inclusive development. In our conclusions we emphasise the importance of education to enable workers to utilise technology, and of fiscal policies to strengthen the resilience of communities when rapid technological change causes disruptions in the labour market. Finally we argue that a 'social contract' between governments, their citizens and corporations is crucial for inclusive industrialisation.

JEL Classifications: L16, L26, O14, O15, O33
Keywords: Industrialisation, Inequality, Innovation, Labour, Manufacturing, Structural Change, Technology

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"It is iron and corn which have civilised men, and ruined mankind"
Jean-Jacques Rousseau, Discourse on Inequality, 1754

1 Introduction

Economic development consists of the structural transformation of a society based on low-productive traditional economic activities into an economy based on the production of complex products and services (Naudé et al., 2015). During this process a society becomes more technologically complex, more productive, and more affluent. Demographic shifts, facilitated by rising income and the uptake of modern technologies, contribute to better health, declining fertility rates, extensive enrolment in education, and urbanisation.

The manufacturing sector is important in structural transformation. It provides more productive employment and can catalyse technological innovation (Szirmai, 2012a). In less developed countries manufacturing is typically labour intensive. As a country develops, its manufacturing uses more capital and technology per labourer (Haraguchi, 2015), and raises the demand for skilled labour. A better skilled workforce, in turn, is an incentive for further technological innovation. Manufacturing can thus start off a virtuous cycle of education, innovation and productivity growth. The share of manufacturing in employment and value-added in developing countries have not declined[1] and, in constant prices, the share of manufacturing in the world GDP has in fact been stable over the past fifty years (Haraguchi, 2015). Industrial policies, aimed at stimulating manufacturing, thus remain essential for development (Szirmai et al., 2013).

The opportunities and challenges associated with manufacturing have become more complex over time. This has led to more diverse paths of structural transformation than before. Two important reasons for this phenomenon are (i) the pervasive and quickening pace of technological change, particularly in information and communication technologies (ICT),[2] and (ii) the globalisation and fragmentation of production across the globe.

Although technological innovation and globalisation can accelerate structural change, these forces are not without risk. The benefits from technology-led industrialisation in a globalising world may not be equally, or even fairly, shared among countries or citizens. Industrial development should therefore not be assumed to be inclusive. Instead, as the quote from Jean-Jacques Rousseau at the top of the page implies, the relationship between technological progress and society has been contentious since the first countries started to industrialise in the 18th century. Not everyone has been or will be able to access the opportunities that technological innovation and globalisation associated with industrialisation bring. Whereas manufacturing absorbed large numbers of low-skilled

[1] The share of manufacturing in the economies of developing and emerging countries has even increased. As Haraguchi (2015) documents, the employment share in manufacturing of developing countries rose from 11.6 per cent in 1970 to 14.0 per cent in 2010.

[2] 'The rate of adoption of ICTs within societies, including developing countries, over the past two decades has exceeded that of any previous technology' (UNESCO, 2014, p.3).

labourers in the past, technological change may be less labour-intensive now and in the future. Moreover, globalisation may cause technological innovation in manufacturing to benefit some countries or regions more than others. Hence 'as long as societies care about how inclusively the gains and opportunities from industrialisation are shared, technology and trade by themselves will not be sufficient for sustainable development' (Gries et al., 2015).

In recent times there has been a heated exchange about socially inclusive industrial development, given the rapid technological innovation and globalisation. In particular, two questions have been debated: Can industrialisation be socially inclusive? Is higher income inequality the inevitable outcome of technology-driven industrial development? In this paper, we examine and discuss these questions.

The paper is structured as follows. In Section 2 the notion of social inclusiveness is defined and the circumstances that bring about social exclusion identified. Furthermore, various approaches to measure social inclusion across countries and times are outlined. In Section 3 the relationship between technological innovation, industrialisation and social inclusiveness is discussed. Section 4 considers the way in which globalisation influences how technological innovation influences structural change and social inclusiveness. Section 5 explores the conditions for technology-driven industrialisation to be consistent with socially inclusive development. The importance of education and fiscal policies are stressed, as well as 'social' technologies that have the potential to facilitate inclusive industrialisation. The final section concludes.

2 Social Inclusiveness

2.1 Definition

People are part of a society if that society allows them to fully participate in 'all aspects of life' (UN-DESA, 2009, p.12). A socially inclusive society is a society that transcends 'differences of race, gender, class, generation and geography, and ensures inclusion, equality of opportunity, as well as capability of all members of the society to determine an agreed set of social institutions that govern social interaction'.[3] Socially inclusive industrialisation means that people have equal opportunities to share in industrial growth.

This definition indicates that the flip-side of social inclusion is social exclusion. The 'promotion of inclusion can only be possible by tackling exclusion' (UN-DESA, 2009). However, the causes of exclusion are many, including employment discrimination,[4] cultural biases and ignorance, although exclusion can also result from insufficient

[3] Expert Group Meeting on Promoting Social Integration, Helsinki, July 2008. See also the discussion in UN-DESA (2009).

[4] The ILO (Convention 111) defines discrimination as 'any distinction, exclusion or preference made on the basis of skin color, sex, religion, political opinion, national extraction or social origin, which has the effect of nullifying or impairing equality of opportunity or treatment in employment or occupation' (ILO, 2007, p.9).

resources (income and assets). Lack of sufficient income constrains people's choices, freedom and subjective well-being (Sen, 2008; Stevenson and Wolfers, 2013). A society marked by social exclusion will lack social cohesion,[5] and may descend into conflict. Conflict can lead to economic stagnation and certain patterns of growth, in turn, can fuel such conflicts (Brück et al., 2013).

There is a nuance between equality of opportunity and of economic outcomes such as income, wealth and employment. Equality of opportunity departs from the premise that 'it is a basic human right to be treated equally in terms of access to opportunities' (Rauniyar and Kanbur, 2009, p.40). Inequality of economic outcomes may be socially more acceptable if it is due to the differences in effort, and not due to differences in 'circumstances of life' that the individual cannot influence. These may include gender, place of birth, ethnicity or inherited disabilities (Brunori et al., 2013). Inequalities in income and wealth can incentivise effort and initiative. However, unfair and inordinate income inequality can slow down economic growth, reduce opportunities, perpetuate poverty and entrench inequality of opportunities.[6] People will be excluded from society even if they can vote and have constitutionally protected human rights, but lack financial and human capital. In this respect, pursuing social inclusion would also require reducing poverty and enabling decent jobs. The latter is important in poor countries where labour is the only asset of many poor households.[7]

Socially inclusive industrialisation therefore has to encompass both inclusive growth and development. Inclusive growth can be defined as both pro-poor, i.e. raising the income of the bottom of the income distribution proportionately more, and as income inequality reducing (Kanbur and Rauniyar, 2009; Anand et al., 2013). Inclusive development, in turn, also requires gains in health, better education outcomes and improved subjective well-being. It also includes how these are distributed between gender, age groups, people with and without disabilities, migrants and non-migrants, ethnic and minority groups. Various indicators of multi-dimensional well-being, which attempt to measure these aspects, have been developed (see e.g. Atkinson, 2003; Stiglitz et al., 2009; Alkire and Santos, 2010).

Based on the preceding discussion, inclusive industrial development can be defined as 'industrialisation that enables inclusive growth and that leads to improvements in the level and distribution of non-monetary dimensions of development'. Industrialisation that

[5] There is an extensive literature on the concept and measurement of social cohesion, dating back at least to Le Bon (1895). The OECD (2011) defines a socially cohesive society as one that 'works towards the well-being of all its members, fights exclusion and marginalisation, creates a sense of belonging, promotes trust and offers its members the opportunity of upward mobility'. In countries with high inequality, levels of trust are lower (see e.g. Brown and Uslaner, 2002).

[6] A growing literature documents the detrimental consequences of inequalities on growth and development, including health, education and infrastructure (see e.g. Persson and Tabellini, 1994; Banerjee and Duflo, 2003; Wilkinson and Pickett, 2009; Berg et al., 2012; Stiglitz, 2012; Piketty, 2013; Bintrim et al., 2014; Dorling, 2014; Ostry et al., 2014; Posen, 2014; Wolf, 2014). Benner and Pastor (2013, p.2) find that 'more equal societies tend to sustain growth longer'.

[7] Wage income is an important component of individual and household total income, and hence access to wage employment a relevant dimension of social inclusion. Note that wages are relatively more important in advanced economies, where they typically contribute 70 to 80 per cent of household income. They are less important in developing countries, where non-wage income, for instance from self-employment, constitutes a higher share of total income (ILO, 2015).

leads to fast economic growth at the expense of labour standards and job quality, health or the environment, that bypasses the youth or encourages child labour,[8] that discriminates against women and people with disabilities, or that increases vulnerabilities[9] to external shocks and natural hazards, will risk social inclusiveness. A key question is therefore: What does technological progress in industry imply for socially inclusive development? Before we answer this question, we first discuss how we measure social inclusiveness for purposes of this paper.

2.2 Measurement

There is no single measure of social inclusiveness. Society has to be considered from different angles to gauge how inclusive its inhabitants experience it to be. However, given that this paper focuses on industrialisation and social inclusiveness, we define social inclusiveness as growth that (i) reduces poverty and inequality, and that (ii) creates employment for the poor and vulnerable in society. In measuring *ex-post* whether industrialisation has been socially inclusive, we are therefore not only concerned with changes in levels and averages of various economic and non-monetary well-being indicators, but also with their distribution. In what follows we set out a number of indicators and measure social inclusiveness across various regions and time periods.

2.2.1 Poverty and Pro-Poor Growth

Tables 1 and 2 summarise the major trends and levels of a selection of these measures, and their relation to industrialisation and technological innovation in various regions.

In Table 1 the focus is on socially inclusive growth. While inclusive growth does not necessarily imply inclusive development, rising incomes and a more equal distribution of wealth are prerequisites for inclusive development. The World Bank has set as a goal to promote inclusive development through a 'sustainable increase in well-being of the lowest 40 per cent of the income distribution' (Cord et al., 2015, p.1). This means that the income growth of the bottom 40 per cent of the population carries all the weight in the promotion and evaluation of growth-enhancing policies (Kanbur and Rauniyar, 2009).

The table shows that between 2006 and 2011 all regions experienced economic growth, with the highest average growth rates in East Asia and the Pacific.[10] However, in terms of pro-poor economic growth there are differences between regions. In Latin America economic growth has been most pro-poor: the income growth of the bottom 40 per cent

[8] Generally countries with a larger GDP share deriving from industry have fewer children (age range between 5 and 17 years) in labour, as child labour is more prevalent in rural agricultural societies. For instance, in 2012 58.6 per cent of all child labour was in agriculture, compared to 7.2 per cent in industry (ILO, 2013).

[9] For a discussion of vulnerability, poverty, external shocks and natural hazards in the context of state fragility, see Naudé et al. (2009). Industrialising economies are more diversified than agricultural-based low-income economies and less vulnerable to shocks in commodity prices and declining terms of trade.

[10] There is no data available for earlier periods.

exceeded an average of 5 per cent per annum. In contrast, the bottom 40 per cent did not benefit proportionately more in sub-Saharan Africa, nor in the Middle East and North Africa.

Between 2005 and 2008 income inequality declined only in Latin America,[11] but increased in East Asia and the Pacific and in sub-Saharan Africa. In the East Asia and the Pacific region higher income inequality has been largely the result of higher income inequality in China. Here, manufacturing development has been fast-paced, but has been accompanied by higher income inequality.

The table also contains measures of industrialisation (the change in the share of value-added in industry and of technological innovation (R&D intensity).[12] The numbers show that the share of industry value-added declined in all regions except in the Middle East and in South Asia. The latter region, the second poorest in the world after sub-Saharan Africa, has experienced the highest industry growth (12.32 per cent) as well as income growth of the 40 per cent at the bottom of the income distribution. Because this growth has taken place with almost no change in the income distribution one may conclude that industrialisation and inclusive growth is possible. As far as growth in technological innovation is concerned (measured by R&D intensity), most R&D growth took place in Latin America, the region with the most substantial decline in income inequality.

Table 1: Patterns of Inclusive Growth, Inequality, Industrialisation and Technological Innovation, 2006 to 2011

Region	Income Growth of Bottom 40%	Income Growth of Total Population	Change in Income Inequality, 2005-2008	Structural Change*	R&D in GDP
East Asia and Pacific	4.96	3.92	12%	-3.79%	3.64%
Europe and Central Asia	3.52	2.91	4%	-5.91%	8.20%
Latin America	5.18	2.78	-6%	-5.07%	33.69%
MENA	2.21	2.11	2%	6.48%	
South Asia	4.14	2.77	1%	12.32%	-2.92%
Sub-Saharan Africa	2.19	2.05	6%	-7.99%	

Note(s): * Change in the share of value-added in industry. Authors' calculation based on World Bank (2013) and World Development Indicators Online.

In Table 2 the measures of inclusive growth are expanded to include measures of access to jobs and, as an example of further indicators of inclusiveness, female access to tertiary education, to measure equality of opportunities. Furthermore, this table covers data for a longer time period compared to Table 1.

The table shows that average income increased in all regions between the early 1990s and the end of the 2010s, particularly in South Asia and East Asia and the Pacific. In these two regions the Gini-coefficient also increased. However, the increase in the Gini

[11] This decline, in fact, started around 2000.

[12] The International Standard Industrial Classification of all Economic Activities (ISIC) is followed, which measures industry as consisting of activities in mining and quarrying (including oil production), manufacturing, construction and electricity, gas and water supply.)

coefficient has been rather small in South Asia and East Asia and the Pacific. The table also shows that female participation in higher education increased in all regions, reflecting better access of women to sectors where the demand for higher skills has been growing, e.g. services and industry, although in most countries women continue to present a minority.[13]

Table 2: Patterns of Socially Inclusive Development and Industrialisation, 1991 to 2013

	Sub-Saharan Africa		**South Asia**		**Latin America**	
	1991	2013	1991	2013	1991	2013
Unemployment Rate	8.3	7.7	4.5	3.9	6.9	6.2
GNI per Capita*	757	989	399	1,073	4,090	5,906
Poverty Rate	56.8	46.9	54.1	24.5	12.6	4.6
Gini Coefficient**	44.6	42.7	32.2	33.4	51.4	48.1
Women in Tert. Education***	32	40	31	41	48	54
Share of Industry Value-Added	33.1	27.8	25.1	29.4	34.7	32.4
	East Asia and Pacific		**Europe and Central Asia**		**MENA**	
	1991	2013	1991	2013	1991	2013
Unemployment Rate	4.7	4.5	9.4	9.6	12.0	11.2
GNI per Capita*	3,387	6,303	15,336	20,180		
Poverty Rate	57.0	7.9	1.5	0.5	5.8	1.7
Gini Coefficient**	35.7	36.4	25.1	30.6	41.8	35.9
Women in Tert. Education***	38	48	51	54	37	50
Share of Industry Value-Added	38.2	32.1	32.3	25.3	40.8	53.9

Note(s): * In constant 2002 USD. ** Estimates based on the median Gini coefficient of countries in the regions close to the years 1991 and 2013. *** In per cent, years: 1990 and 2007. World Development Indicators, Povcal and UN Population Database.

Unemployment declined in all regions except in Europe and Central Asia. It is also noticeable that over this period the poverty rate (measured by the headcount ratio) declined sharply in all regions. The difference in the poverty decline between sub-Saharan Africa on the one hand, and South Asia and East Asia and the Pacific on the other hand is striking: these three regions started out in the early 1990s with poverty rates well above 50 per cent, but East Asia and the Pacific managed to reduce the rate to around 8 per cent and South Asia to around 25 per cent by the end of the 2010s, while the poverty rate in sub-Saharan Africa declined much less. By 2015 around 47 per cent of Africa's population continues to live in extreme poverty. Moreover, if population growth is accounted for, the absolute number of people living in poverty even doubled over this period (Bluhm et al., 2014, p.8).[14]

[13] Female employment tends to be disproportionately higher in services in most countries. For instance, female workers in Latin America were distributed with 14, 13 and 71 per cent (respectively) between agriculture, industry and services in 1992. By 2011 the distribution had shifted towards 9, 12 and 77 per cent, indicating that relatively more jobs for women were created in services than in agriculture or industry.

[14] With regard to the first Millennium Development Goal (MDG) of halving the proportion of people whose income is below USD 1.25 a day (at 2005 PPP), sub-Saharan Africa has achieved only 35 per cent. In contrast, this target has already been met on a global level (World Bank, 2014).

2.2.2 Growth and Inequality Trade-Offs

There are noticeable differences between South Asia and sub-Saharan Africa in income inequality, unemployment and industry growth. South Asia is faring decisively better than sub-Saharan Africa: its unemployment rate is about half and the overall inequality level considerably lower. The industry's share of GDP increased in South Asia, but declined in sub-Saharan Africa. The period 2006 to 2011 saw a sharp divergence in industry growth rates between these two regions: industry grew by 12 per cent in South Asia, but declined by 7 per cent in sub-Saharan Africa.

High inequality in sub-Saharan Africa constrains pro-poor economic growth. Okojie and Shimeles (2006) review studies on economic growth and poverty reduction in Africa, and find that for countries with high initial levels of income inequality considerably faster growth is needed to reduce poverty. They conclude that in Africa 'poverty cannot be significantly reduced without reduction in income inequality' (Okojie and Shimeles, 2006, p.13). This finding may also be relevant for other countries and regions. For instance, Narayan et al. (2013, p.9) conclude that 'provinces in Thailand that made progress on reducing inequality were generally also the ones that experienced a faster growth of the bottom 40 per cent'. Growth reduces poverty faster in countries where incomes are more equally distributed.

Structural change that can provide more jobs to the poorest households is clearly vital for socially inclusive development. To refer once more to the case of sub-Saharan Africa, most labour is engaged in agriculture (59 per cent). This sector, however, has experienced the lowest growth in per capita income. According to the World Bank (2014), per capita growth in sub-Saharan Africa averaged at 2.6 per cent in the services sector and at 1.7 per cent in the industry sector between 2005 and 2011. In contrast, growth in the agricultural sector only amounted to 0.9 per cent.

Structural transformation in sub-Saharan Africa requires a greater reallocation of labour into manufacturing and a growth in labour productivity in manufacturing. Labour productivity in sub-Saharan African manufacturing is lagging far behind the world frontier (McMillan et al., 2014, p.14). For instance, in Ethiopia labour productivity in manufacturing is only 2 per cent of labour productivity in manufacturing in the United States. Even in the most advanced African economy, South Africa, average labour productivity is only 50 per cent of that of the United States (McMillan et al., 2014, p.13).

2.2.3 Recent Trends in Income Inequality

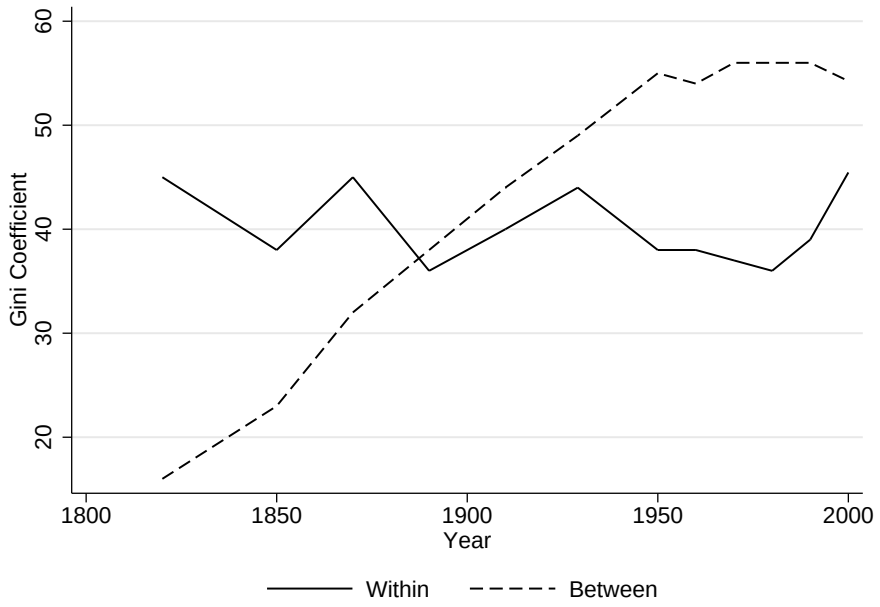
In this section we consider how income inequality have evolved. There is a growing concern in society, academia and policy making circles that income inequality is increasing and social inclusiveness diminishing since the 1970s.

The UNDP (2013, p.1) recently declared that the world is 'more unequal today than at any point since World War II'. A number of studies have equally concluded that income and wealth inequalities within and between countries have risen (e.g.

Wolff, 2006; Rodriguez and Jayadev, 2010; Atkinson et al., 2011; Davies et al., 2011; van Zanden et al., 2014). Moreover, the distribution of GDP per capita between countries has been diverging over time (Battisti et al., 2014). As a result the distribution of wealth has also become highly unequal: the top 1 per cent owns 48 per cent of global wealth (Credit Suisse, 2014).

Figures 1 and 2 depict the long-run trends in income inequality within and between countries. The first figure shows a huge increase in between-country inequality from 1820 to the 1950s. The rise in between-country inequality deteriorated after the industrialisation of the West. During the Industrial Revolution, technological innovations such as the steam engine and power looms were decisive in catalysing the structural transformation of the West (Zeira, 2008). The income surge in the countries where industrialisation first occurred, and the resulting higher between-country income inequality, have been described as the 'Great Divergence' (see Pritchett, 1997).

Figure 1: Global Income Inequality - Within- and Between Country Inequalities, 1820 to 2000



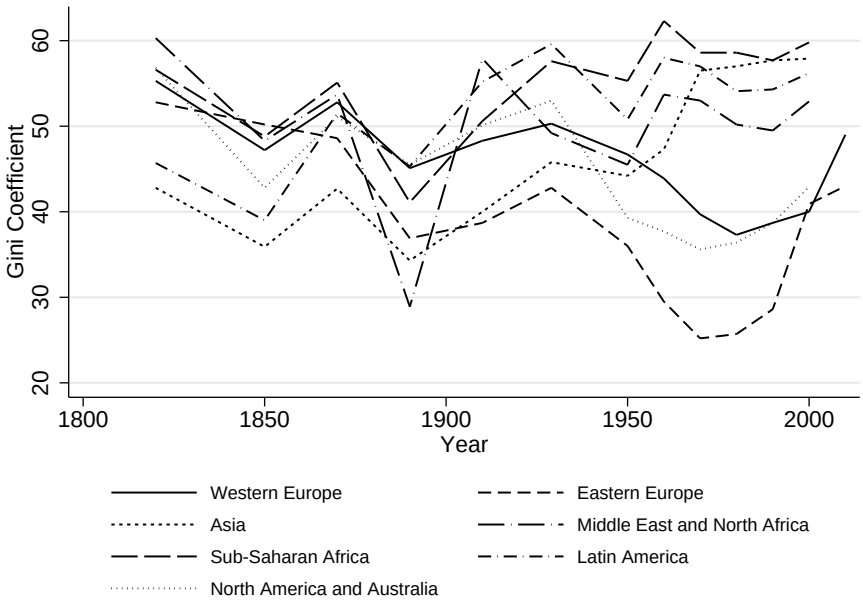
Note(s): Authors' compilation based on OECD (2014) data.

The second figure then shows that increases in inequality have been notable in Western and Eastern Europe, North America and Asia. It also shows that inequality has remained on a high level in Latin America and sub-Saharan Africa (World Bank, 2014).

The rise in within-country inequality since the 1980s has reversed the post-war declining trend. It is also for the first time that within-country inequality has seen an increase in terms of the distribution of value-added between capital and labour. Since the early 1980s, this share has changed in favour of capital (UNCTAD, 2012; Karabarbounis and Neiman, 2014). Figure 3 shows the share of labour compensation in GDP in a selected sample of advanced and developing countries over the past two decades.

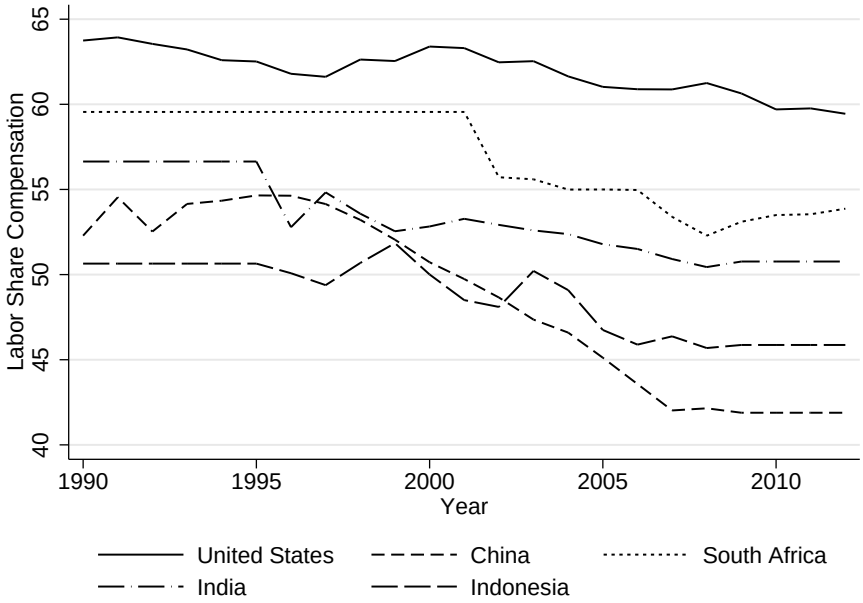
The share of wages (labour) in GDP has declined practically everywhere since the 1980s, and not only in advanced economies. This can be explained by a lower

Figure 2: Income Inequality within Countries - by Region, 1820 to 2000



Note(s): Authors' compilation based on OECD (2014) data.

Figure 3: Declining Share of Labour Compensation in GDP - Selected Countries, 1990 to 2012



Note(s): Authors' compilation based on data from the Conference Board Total Economy Database.

share accruing to labour within sectors, instead of between sectors. In other words, the increase in (functional) income inequality has been occurring despite structural change. Even within modern sectors the share of labour has experienced a decline (Rodriguez and Jayadev, 2010; Karabarbounis and Neiman, 2014). This occurred despite rising labour productivity, implying a 'disconnection' between growth in productivity and in wages (Mishel and Gee, 2012). The decline in the labour share of GDP has

been ascribed to an increase in the capital-output ration, due to a declining price of capital (Karabarbounis and Neiman, 2014), changes in trade openness (globalisation) and technological change (Hogrefe and Kappler, 2013).

Finally, although income and employment are important dimensions of inclusiveness, we need to point out that focusing only on income and employment may obscure consideration of the inclusion (or exclusion) of groups such as women, minorities, youth and the disabled. Measures of income inequality rely on vertical measures, i.e. measures that compare incomes between individuals rather than horizontal measures, which measure and compare incomes incomes between groups. The focus on income and employment therefore does not reflect 'per se' a preference for vertical measures in this paper, but rather reflects that vertical measures of income inequality (such as the Gini-coefficient) are more widely available compared to horizontal measures (particularly over longer periods of time). As Stewart (2008) argues, group inequalities are significant, but often ignored by policy makers at the perils of intra-group conflict and ethnic violence.

Given concerns about high and increasing income inequality in recent years, we explore the two main and interdependent causes: (i) technological innovations that characterise modern industrialisation, and (ii) the spread of technology and inequality through globalisation.

3 Technology and Inclusive Industrialisation

3.1 Concepts and Definitions

Technology can be defined as 'the state of knowledge concerning ways of converting resources into outputs that could be subject to patent protection' (OECD, 2011) and technological innovation the 'putting into practice of inventions' (Fagerberg et al., 2005). Structural transformation can then be defined as the change in the sectoral contributions to value-added and employment in an economy and its location of production. Finally, structural change amounts to structural transformation only when it enhances economic growth (McMillan and Rodrik, 2011).

Structural transformation is characterised by three structural shifts namely (i) a reallocation of resources from low to more highly productive uses, such as from traditional to modern sectors (industrialisation), (ii) a movement of labour from rural to urban areas (urbanisation), and (iii) a decline in population growth (demographic transition).

Technological innovation is prominent in all of the structural shifts mentioned. For instance, labour productivity will be stagnant without increases in the capital and technological intensity of production, because factor accumulation is subject to decreasing returns to scale. And urbanisation and demographic changes are facilitated by new technologies in housing, construction, transport, energy, communication and health, as well as the environmental impact, among others. Technological innovation consequently has an impact on economic, social and environmental dimensions and can contribute

towards social inclusive development (UNESCO, 2014).

3.2 Conceptual Approach

The importance of technological innovation for structural transformation is not disputed.[15] It is elaborated in various strands of theoretical literature, including neoclassical growth models, historical case studies, endogenous growth theory and evolutionary models (Hidalgo et al., 2010). Technological innovation generates new products and new processes, resulting in new patterns of demand, and ultimately in the ability for more people to participate in the economy in a meaningful way (see also Lipsey et al., 2005).

The Copenhagen Summit (1995) recognised the potential of ICT in improving participation of poor people in governance. In recent years the uprising in the Middle East highlighted the role that social media can play in this regard: 'as the communications landscape gets denser and participatory, the networked population is gaining greater access to information, more opportunities to engage in public conversation and speech, and a vastly enhanced ability to organise and undertake public action' (AfDB, 2012, p.12).

New technologies can have a positive impact on living standards through improving health, raising consumption or providing information, and through improving the nature and quality of jobs. Furthermore, technological innovations can reduce the environmental footprints of industry. It can reduce the amounts of non-renewable resource use and pollution per unit of output, through improving energy efficiency, resource efficiency, pollution prevention, pollution mitigation and recycling. Technological innovation can also change governance models and can improve government efficiency and transparency, resulting in more inclusive government. However, these are not foregone outcomes.

The risk is that technological innovation in governance can spur greater social exclusion. In the contemporary non-polar world there has been a strong trend towards decentralisation, devolution and fragmentation of government (see Haass, 2008). Technology can strengthen these trends. For instance, in Silicon Valley there are techno-entrepreneurs who strive to create exclusive utopian communities using *inter alia* technology. As described by Miles (2014),

> The tech world is particularly keen on leaving government behind to create its own utopia. Investor Peter Thiel has raised over USD 25,000 to build the world's first floating tech island, free from government constraints. Google CEO Larry Page wants to 'set aside a part of the world' for regulation-free tech experiments. And Balaji Srinivasan, the co-founder of genetics company Counsyl, calls 'Silicon Valley's Ultimate Exit' from civil society inevitable, and advocates for a techno-utopian island in the ocean.

[15] Development itself is often defined with reference to the technological sophistication of society, and the technological gap described as a measure of underdevelopment (e.g. Lavopa and Szirmai, 2014).

The European Commission's Joint Research Committee warns (in its publication 'Digital Europe 2030') that there is great uncertainty whether new technology will rather foster greater fragmentation and exclusion, or generate social inclusiveness (Misuraca and Lusoli, 2010).

As important as it is to prevent new technologies from contributing to social exclusion, an even greater challenge is to address the fact that the benefits of technology do not automatically accrue equally or fairly to all. As UNESCO (2014, p.6) points out there is a 'digital divide' between and within countries where 'developed countries have better ICT infrastructure, enjoy more pervasive ICT usage, and gain earlier access to ICT innovations than developing countries [...]. ICT access and use are less prevalent in groups that are socially or economically marginalised, such as women, youth, unqualified or subsistence workers, ethnic minorities and those with special needs or disabilities'. Technological innovations may result in patterns of growth and structural change that worsen income inequality. Indeed, ever since the Industrial Revolution, which led to higher income inequality, social protests have accompanied industrialisation [see Box 1].

As documented by de Haan (2015) in a background paper for the UNIDO IDR 2015, the interest in structural transformation and its challenge to social inclusiveness can be traced back to Émile Durkheim. His book 'De La Division Du Travail Social' (1893) was a response to the process of industrialisation that first Britain and then continental Europe and the United States experienced during the 19th century. Durkheim argued that the transformation from primitive to modern societies with their complex division of labour would be disorderly. However, these would gradually give way to more inclusive societies. Durkheim anticipated the positive views of 20th century economists such as Kuznets (1955) and Kaldor (1957) who considered rising inequality an inevitable early consequence when societies embarked on industrialisation, but who expected this to be eventually reversed.[16]

Kuznets (1955) proposed an inverse U-shaped relationship between inequality and GDP per capita (the Kuznets' curve). This makes intuitively sense if the productivity and wages of workers are low in the traditional (agricultural) sector, but rise once workers are reallocated to the manufacturing sector, since they will have more access to capital and technology.[17] The resulting wages in manufacturing (assuming wages reflect the marginal productivity of labour) will consequently raise inequality, at least initially. Differences in wages between sectors are thus largely explained by the technology and capital that benefit the productivity of workers in these sectors. Over time productivity and wages will also rise in agriculture, and inequality eventually start to decline again.

Inequality will also decline, since new modern sectors generate a demand for labour that has been made redundant by these new technologies. Hence technological innovation will not to cause job replacement, but only job 'displacement' over the long run. The Kuznets

[16] Kaldor (1957) argued that initial increases in income inequality would be beneficial because capital owners (entrepreneurs) save more than wage labourers, from which savings they could finance innovations and investments.

[17] The manufacturing sector in particular has been considered as somewhat special in the past, in that it is associated with more substantial absorption and generation of technological innovations (Szirmai, 2012a; UNCTAD, 2014).

hypothesis essentially assumes a 'trickle-down' effect from industrialisation (Piketty, 2004).

Box 1: Protests Against Technological Change - Past and Present

Industrialisation resulted in many workers in the textile industry losing their jobs. Thousands of weavers, who could no longer compete with machines, turned their anger on machines and tried to destroy them, becoming known as the 'Luddites'. The first well-known attacks of the Luddite movement began in 1811, and rapidly gained popularity. Agricultural labourers targeted threshing machines and textile workers power looms. Such riots led to reforms, as well as to the formation of trade unions.
Today polemical debates continue to surround technological innovation, with computers, robots and the Internet bearing the brunt. It has been claimed that 'Luddism in practice and theory is back on the streets' (Appleyard, 2014). According to Drum (2013) the Luddites were not wrong. They were just 200 years too early, because the Digital Revolution will put 'entire classes of workers [...] out of work permanently'.

An example of this job displacement effect is the invention of the internal combustion engine that caused huge job losses in the horse-drawn carriage industry, but eventually created new employment in the automobile industry. Therefore technological innovation has not only static effects in the once-off reallocation of labour but also dynamic effects such as facilitating the growth of productivity and output in modern, urban-based industries (Frey and Osborne, 2013).

This largely beneficial view of technological innovation and structural transformation implies that income inequality and social exclusion should be temporary. Persistent or rising inequalities would reflect institutional and policy failures that perpetuate technological gaps between sectors, regions and countries (Verspagen, 2004; Fagerberg et al., 2005; Szirmai, 2012b; de Vries et al., 2013; McMillan et al., 2014), or that fail to provide adequate social buffers in times of rapid change (Naudé et al., 2009).

Empirical evidence suggests that technological innovation can raise income inequalities over the short- and medium-term, and that technological gaps can be responsible for persistent inequality at the country and regional level. However, the evidence also bears out that increased inequality and social exclusion are not inevitable. Under certain conditions technology-driven industrialisation can be consistent with social inclusive development. It may even facilitate such development by creating new jobs, incomes and means to trade, communicate and connect. Before we explore these necessary conditions, we first outline the main views on how technology is currently responsible for higher income inequality.

3.3 The Race Against...

How can the technological innovations underpinning industrialisation drive rising income inequality? There are two related arguments which can also be implicitly found in Kuznets' and Kaldor's views. These arguments are based on empirical studies of labour markets and income inequality, and which have debated *inter alia* whether policy-makers are tackling 'a race of technology against education' and/or tackling a 'race against the

machine'.

3.3.1 The Race of Technology Against Education

Technology complements certain production factors more than others: it is 'skill-biased'. For instance, ICT requires relatively more high-skilled than medium- or low-skilled labour. With skill-biased technological change (SBTC), the relative wages of high-skilled labourers rise if the demand for high-skilled labour outstrips supply. The result will be higher (wage) inequality.[18] Between 1980 and 2005 the average increase in the skills premium (the wage ratio of college to high school graduates) across OECD countries has been 12 per cent. By 2005 college graduated workers earned on average 1.6 times more compared to workers with high-school education (Gancia, 2012).

Figure 4 shows that the rise in the skills premium has been also increasing in a number of developing countries (South Africa, Pakistan, Indonesia), but has been declining in others: most notably in the Russian Federation, but also in Brazil and Argentina (and generally in Latin America). The figure also suggests a positive relationship between the skills premium and income inequality, with the exception of the Russian Federation where income inequality has increased significantly despite the substantial drop of private rates to tertiary education.

Extending the quality and scope of higher education is a policy response to SBTC. The decline in the skills premiums in many developing countries, especially in Latin America, may therefore reflect the success of higher education policies. However, the better educational outcomes are in a country, the more profitable it is for firms to invest in new technologies that can make use of these skills. This is expected to raise the demand for educated workers, and set in motion a self-reinforcing cycle (Acemoglu, 2003; Bénabou, 2005). Wage gaps are then one of the outcomes of this 'race between technology and education' if education supply cannot keep up with demand (Mishel et al., 2013, p.4). So far many developing countries seem to have avoided falling short in the supply of highly skilled workers, either because of their success in expanding higher education, or because of a decrease in the demand for high-skilled labour,[19] or both.

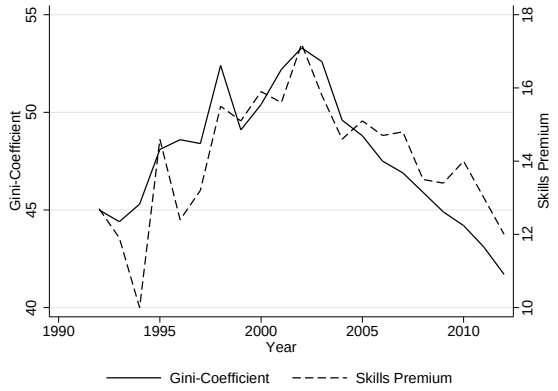
3.3.2 Race Against the Machine

Many new technologies (such as automation) increasingly replace medium-skilled workers. These workers tend to perform routine tasks that are more easily replaced by machines and robots (Acemoglu and Autor, 2011, 2012). They then descend down the occupational ladder, moving into 'jobs traditionally performed by lower-skilled workers [...] pushing low-skilled workers [...] out of the labour force altogether' (Beaudry et al., 2013, p.1). With wages for high-skilled workers increasing and wages for medium-skilled

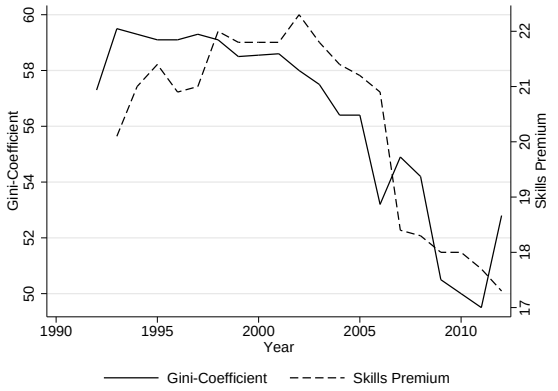
[18] Technological change has become skill-biased since the 1980s with the accelerated progress in ICT, such as the commercialisation of the IBM personal computer in 1981 and the development of the world wide web (www) at CERN in 1989 (Autor et al., 1998; Card and DiNardo, 2002; Goldin and Katz, 2010).
[19] Reflecting perhaps natural resource driven growth.

Figure 4: Rates of Return to Tertiary Education and Income Inequality, 1992 to 2012

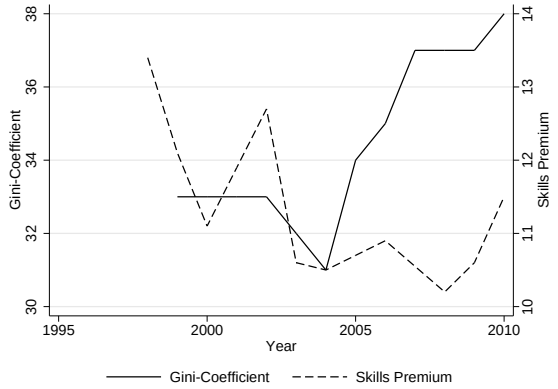
(a) Argentina



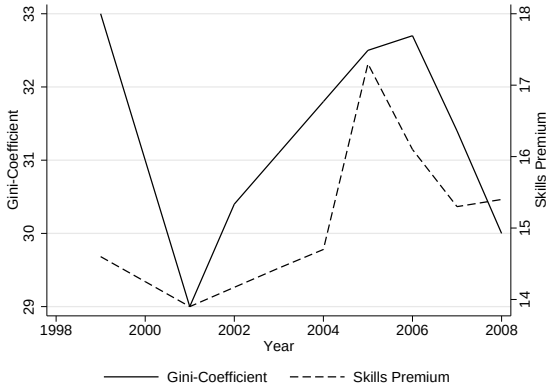
(b) Brazil



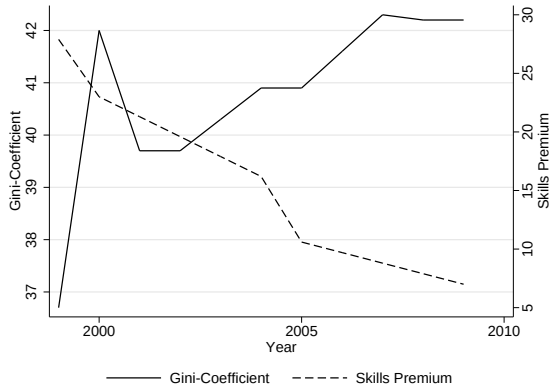
(c) Indonesia



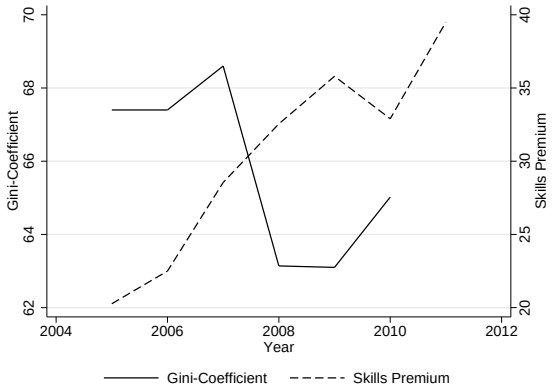
(d) Pakistan



(e) Russia



(f) South Africa



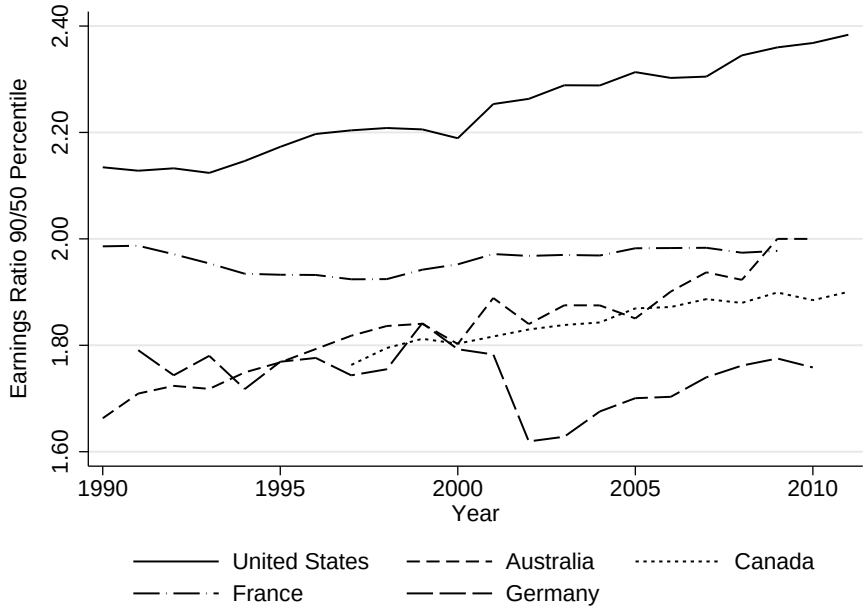
workers declining, and combined with a general higher unemployment of the low-skilled workers, labour market polarisation or labour market hollowing-out is the result (Goos and Manning, 2007; Lemieux et al., 2009; Beaudry et al., 2013). Relatively more jobs have been lost in medium-skilled and middle-income jobs since the beginning of the century, compared to other skill levels. For instance, Los et al. (2014) find that 80 per cent of all jobs lost in the United States between 1995 and 2008 were medium-skilled jobs. Michaels et al. (2010) find similar empirical evidence in other OECD countries.

Box 2: Technology and Inclusive Industrialisation in Africa

There is a need to improve productivity in all sectors of sub-Saharan Africa, and simultaneously to allocate more resources, including labour, to the most productive sectors and locations. This would result in both static and dynamic productivity gains.
However, SBTC and labour market polarisation effects of technology may complicate achieving this goal. For instance, the most productive sector in African countries is mining. This sector operates at the world technological frontier and is by nature heavily capital intensive. Most new mining technologies in processes or embedded in capital are job-replacing, especially of low-skilled labour that performs routine tasks. Given the complexity of mining operations and the global scale of mining companies, top managers and CEOs, as well as shareholders in mining companies, have been continuously earning higher wages and returns on capital invested. As such, the growth in mining exports has also contributed to growing income and wealth inequalities. While mining is very productive, it cannot absorb large quantities of labour. Despite high commodity prices, employment in mining has even declined in many of Africa's largest mineral exporters.
Page (2013) claims that technological innovation needed to deliver the required productivity gains in African manufacturing is out of immediate reach for most countries. Task-based production for export offers the best promise for industrial development. He further argues for a 'strategic set of public actions to support productivity growth, creating an export-push, encouraging industrial clusters, and attracting task-based production' (Page, 2013, p.265).

Figure 5 shows one measure of labour market hollowing-out, namely the ratio of gross earnings of workers at the 90th wage percentile to the 50th percentile. It shows that the ratio has been increasing, most substantially in the United States, but also in Canada and Australia. Labour market hollowing-out, however, is not a universal phenomenon: in France and Germany the ratio has been fairly constant over the past three decades.

Figure 5: Labour Market Hollowing-out: Gross Earnings at the 90th to the 50th Percentile, 1990 to 2011



Note(s): Authors' calculation based on OECD Labour Force Statistics Database.

3.3.3 Implications for Manufacturing

What are the implications of the race of technology against education and of the race against the machine for the manufacturing sector? Manufacturing has been a key sector driving growth and development in the past through its ability to absorb labour, and to channel it into more productive activities. The availability of new technologies since the 1980s and the recent acceleration of the pace in technological innovation in manufacturing have however cast doubt on whether manufacturing can continue to be a sector that drives inclusive industrialisation.

The nature of manufacturing has fundamentally changed in recent times. Increasingly, routine-task jobs are being replaced by technology (Marsh, 2012). As Gries et al. (2015) note 'industrial internet, advanced manufacturing, or industry 4.0 are the current buzzwords for the next cycle of industrial innovation'. It is expected that smart machines will also increasingly substitute non-routine tasks. Declining employment in manufacturing in advanced countries since the 1980s is expected to continue, and to become more pronounced in developing countries. Frey and Osborne (2013), using the term 'technological unemployment', estimate that 47 per cent of current employment in the United States is likely to be replaced by computers over the next twenty years.

Technologies that are contributing to the 'hollowing out' of the labour market in manufacturing include mobile technology, cloud computing, social networks (which cover already more than 26 per cent of the global population), and robotics (Stokes, 2014). There were an estimated 1.1 million robots employed globally in 2012, and particularly so in manufacturing: already 80 per cent of the world's automobile manufacturing is performed by robots (Culey, 2012). As discussed by Culey (2012), the US firm *Rethink Robotics* has produced a robot named Baxter to eventually replace all human labour in the manufacturing process. The company aims to make Baxter more professional than humans in all routine tasks such as 'material handling, line loading and unloading, product inspection, light assembly, sorting and packaging'. Industrialisation will increasingly take place without creating large numbers of new jobs, and consequently increase wage inequality [see Box 3].

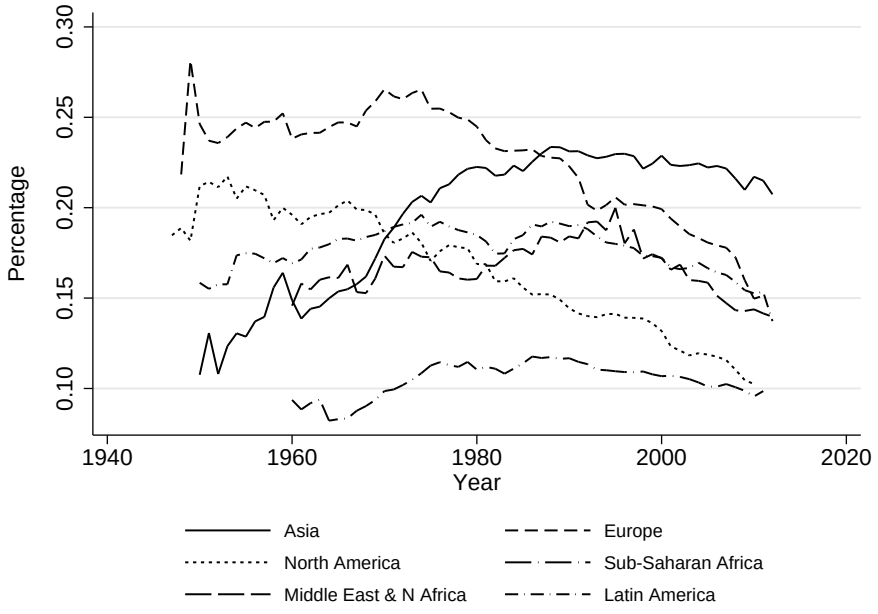
Box 3: Meet Dexter Bot, Baxter, LBR iiwa, UR5 UR10, Sawyer

In 2011 an estimated 1.1 million robots were already in use throughout the world, with around 180,000 new robots sold each year. Demand is rising fast with the average prices of robots having declined by 2005 to only one-fifth of 1990 prices (Graetz and Michaels, 2015). Manufacturing sectors where robots are increasingly placed are food processing, electronics and electrical machinery, automotive, chemicals, and rubbers and plastics, according to the International Federation of Robotics (IFR).
Dexter, Baxter, Sawyer and others are the names of some of the new generation of robots that are being introduced into industry. They are known as collaborative robots as they differ from previous industrial robots, such as those used in the automotive industry that were immobile single-task robots. The new robots work in closer proximity to human workers, are lighter, more flexible, can be re-assigned tasks, and can even learn and move around the factory floor.
Apart from taking over hazardous and routine work, and increasing the productivity of their firms significantly, collaborative robots '[...] do not answer back, they do not get sick and they can toil away 24 hours a day, seven days a week, with no holiday or bathroom breaks' (Powley, 2014). Moreover, as Siegel and Gibbons (2013, p.4) estimate, the hourly cost (wage) of a robot such as Baxter amounts to USD 4.32 an hour (and continues to decline) compared to the average hourly wage in US manufacturing of USD 23.32 per hour.

Sources: Siegel and Gibbons (2013); Powley (2014); Graetz and Michaels (2015).

Figures 6 and 7 depict the percentage of the labour force employed in manufacturing across different regions from 1947 onward, as well as the employment in manufacturing by technological intensity. The first figure shows that the share of labour in manufacturing has declined consistently in the technologically advanced countries in Europe and North America. Only in Asia, reflecting China's successful industrialisation, has the share increased.

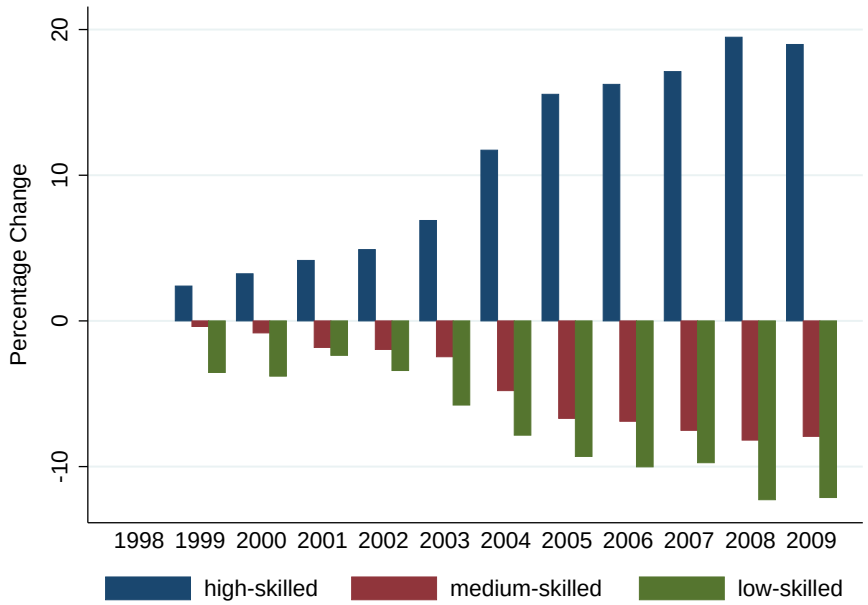
Figure 6: Percentage of Labour Force Employed in Manufacturing, 1947 to 2012



Note(s): Authors' calculation based on the GGDC 10-Sector Database.

The second figure shows that after 1998 employment in the OECD grew only in high-skilled jobs, at the expense of medium- and low-skilled jobs.

Figure 7: Changes in Employment by Skill Level, 1998 to 2009



Note(s): Authors' calculation based on the GGDC 10-Sector Database. Percentage change relative to 1998.

The implications of automation do not only affect manufacturing jobs in advanced economies, but also jobs in developing countries. Recent empirical evidence from countries such as Brazil, South Africa and Mexico documents evidence of labour market polarisation [see also Box 4], and are derived from two different reasons.

First, developing countries closer to the world technological frontier are themselves adopting leading technologies including automation, and hence starting to reduce the share of labour in manufacturing at levels of GDP per capita that are still lower than that of advanced economies. As countries close the technological gap, the result may be reduced between-country inequality, but at the expense of rising within-country inequality.

Second, replacing a large part of labour with machines in the advanced economies' manufacturing sector can lead to a re-shoring of manufacturing (reverse off-shoring) to the detriment of low-wage labour in these countries. The question has been posed by Culey (2012): 'how important is low-cost labour when you don't actually need labour?'.

To revert back to the initial question 'how can the technological innovation driving industrialisation be responsible for rising income inequality?', we summarise our answer as follows: manufacturing has become technologically sophisticated, driving up productivity and reducing employment. This process contributes to a higher skills premium for the high-skilled workers and increases the relative wage gaps. This trend is relevant for both advanced and developing countries and is accelerated by globalisation.[20]

[20] A feature of the rise in income inequality over the past years that is difficult to explain by technological change is the significant increase in income inequality at the top 1 per cent (and even top 0.1 per cent) of the income distribution. In the United States, for example, the top 0.1 per cent share of income grew by 324 per cent between 1979 and 2006 (Mishel et al., 2009).

A concern is that industrialisation through manufacturing growth may not necessarily contribute to socially inclusive development. In the past, process innovations such as the introduction of steam energy and power looms during the 19th century (analogous to automation and robots today), replaced jobs and changed the relative demand for different types of labour. However, in contrast to process innovations, product innovations aim to create new consumer markets and have led to many new job opportunities (e.g. in the manufacturing of automobiles that replaced horse-drawn carts). In this respect, new technological innovations in manufacturing also bring about new opportunities through which new jobs can be created, and socially inclusive development supported.

Box 4: Rise of the Robots in Emerging Economies

While robots are intensively used in manufacturing in advanced economies, such as the United States, Japan, South Korea and Germany, the use of robots in countries such as Brazil, India, Russia and Indonesia is less but continuously increasing. These countries are emerging as new manufacturing hubs for robots. As detailed by Siegel and Gibbons (2013, p.3) 'China is expected to lead demand for industrial robots in the next five years [...]. Rising wages and demand for faster production are convincing Chinese manufacturers to invest more in robots to maintain their competitive advantage as global manufacturing exporters'. According to the International Federation of Robotics (IFR) there will be more robots in China than in the United States or Europe by 2017. Foxconn, the firm manufacturing Apple's IPhones and IPods, has reportedly ordered around one million robots to replace around 500,000 lower-skilled routine tasks in manufacturing (Culey, 2012). And Brazil has seen a 40 per cent increase in the number of robots per 10,000 workers used in manufacturing between 2008 and 2011, according to the IFR.

Source: Siegel and Gibbons (2013).

Peter Marsh and Chris Anderson have argued that the world is currently at the start of a 'New Industrial Revolution'. This new industrial revolution is driven by the combination of social media, the internet, and new production technologies such as additive manufacturing, with the result of scale economies becoming less important. The creation of niche-market products to fit closer to individual consumer preferences are gaining in importance. For example in the Netherlands architects are 'printing' a designer house using a 3-D printer that can manufacture 6-by-9 meter panels. Astronauts expect to 'print' food from a diverse menu when on space missions in the future. In New York, the company MakerBot has been building 3-D printers at ever-decreasing costs.

This new industrial revolution results in human skills becoming even more important in manufacturing. For the countries and regions that can successfully provide the appropriate human skills, including entrepreneurship skills and manufacturing, opportunities will expand. Brynjolfsson and McAfee (2012a) argue that new technologies can make manufacturing more inclusive by opening up opportunities to the many small businesses that characterise developing economies, pointing out that 'Heartland Robotics plans to provide cheap robots-in-a-box that make it possible for small business owners to quickly set up their own highly automated factory, dramatically reducing the costs and increasing the flexibility of manufacturing'.

The policy challenge is to develop local capabilities and skills that will benefit from the new industrial revolution, and simultaneously cushion the short- and medium-term disruptive effects that technological innovation bring along. For instance, through

unemployment insurance for displaced workers, or through financial markets that can assist entrepreneurs to benefit from the new markets. In the recent past, and despite the overall rise in within-country inequalities, some countries and regions did succeed in fostering more inclusive industrialisation and development. This illustrates that technological change and structural change do not need to inevitably result in higher inequality. This was particularly the case in various Latin American countries over the past three decades.

3.4 Can We Learn Anything From Latin America?

Achieving socially inclusive industrialisation has been made more complex by the nature of technological innovation, although this achievement is certainly not ruled out. Countervailing policies are required to ensure that structural change and technological innovation do not result in social disruption and exclusion. Although income inequality has risen in a large number of countries over the recent years, there were also countries and regions where structural change and technological innovation were simultaneously accompanied by growth, poverty reduction and declining income inequality.

As documented by the World Bank (2013), extreme poverty in Latin America and the Caribbean (LAC) declined from 26.3 per cent in 1995 to 13.3 per cent by 2011. Simultaneously income growth for the bottom 40 per cent of the income distribution was faster than that of the total population. LAC has been the only region in the world where income inequality declined since 2000: income inequality fell from 0.58 in 1996 to 0.52 in 2011 (World Bank, 2013; Tsounta and Osueke, 2014). Hence, the overall experience of Latin America is consistent with the type of growth that includes declining unemployment, rising incomes and declining income inequality, and is associated with socially inclusive development.

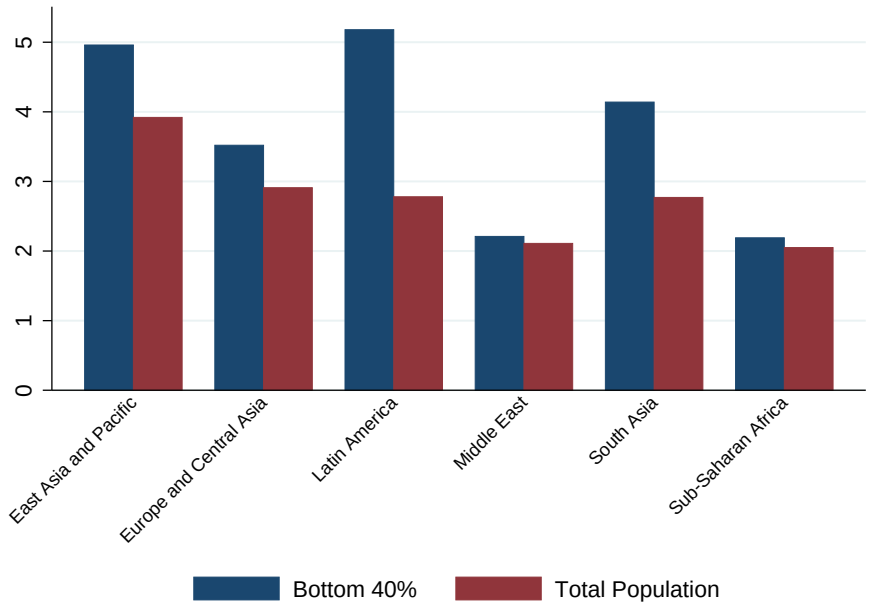
Figure 8 illustrates the extent of pro-poor growth that Latin America has experienced over the period 2006 to 2011. The average growth rate in income of the poorest 40 per cent of the population was around 5 per cent, significantly higher than the growth rate in income of the total population amounting to almost 3 per cent. The figure also shows that economic growth was less inclusive in sub-Saharan Africa and the Middle East over the same period.

And Table 3 shows, in three of the largest economies in Latin America, that the more inclusive growth has resulted in the decline of extreme poverty and inequality, as well as in reduced unemployment. Concurrently the share of employment in industry remained constant in Argentina and Brazil, but increased in Peru.

The Economist (2012) took up and analysed this topic by asking 'How did a continent that had been egregiously unequal since the conquistadores' land grab suddenly change course?'. The answer reads as follows,

> First, the premium for skilled workers has been declining: a surge in secondary education has increased the supply of literate, reasonably well-schooled

Figure 8: Shared Growth: Income or Consumption Growth of the Bottom 40% and Total Population, 2006 to 2011



Note(s): Authors' compilation based on the World Bank's Global Database of Shared Prosperity.

Table 3: Poverty, Inequality, Unemployment, and Employment in Industry in Argentina, Brazil and Peru, 2006 to 2011

Year	**Argentina**		**Brazil**		**Peru**	
	Extreme Poverty	Inequality (Gini)	Extreme Poverty	Inequality (Gini)	Extreme Poverty	Inequality (Gini)
2006	10.3	0.478	19.6	0.567	23.0	0.491
2007	8.8	0.474	18.1	0.559	21.8	0.497
2008	8.2	0.463	15.6	0.55	18.0	0.471
2009	8.0	0.452	14.9	0.545	15.4	0.463
2010	6.1	0.445			13.4	0.451
2011	4.6	0.436	12.6	0.536	12.7	0.457
	Unemployment	Emp. in Industry	Unemployment	Emp. in Industry	Unemployment	Emp. in Industry
2006	10.1	23.6	8.4	21.4	4.6	15.3
2007	8.5	24.2	8.1	22.0	4.5	16.8
2008	7.8	23.9	7.1	22.6	4.5	17.2
2009	8.6	23.1	8.3	22.1	4.4	16.9
2010	7.7	23.2	7.9		4.0	17.7
2011	7.2	23.8	6.7	21.9	3.9	17.4

Note(s): Extreme poverty, unemployment, and employment in industry: shares (in %).

workers, and years of steady growth have raised relative demand for the less skilled in the formal workforce, whether as construction workers or cleaners.

Second, governments around Latin America have contributed to the narrowing of wage gaps through social spending on the lowest income groups. These include better pensions and conditional cash transfer schemes.

According to Lopez-Calva and Lustig (2010); Azevedo et al. (2013); Tsounta and Osueke (2014) the decline in income inequality in Latin America can be explained by better higher education that drove down the skills premium. In the calculations by Tsounta and Osueke (2014), this was responsible for 25 per cent of the decline in income inequality.

Box 5: The Experience of Brazil

Brazil has nearly eliminated extreme poverty, which declined from 10 to 4 per cent over the period 2001 to 2013. Approximately 25 million Brazilians escaped extreme or moderate poverty. Income growth of the bottom 40 averaged 6.1 per cent annually (2002 to 2012), compared to mean income growth of 3.5 per cent. Consequently income inequality has declined. The Gini-coefficient was reduced from 0.59 to 0.52 (2001 to 2013). How can this success be explained? Four main reasons have been identified:

- First, high and sustained economic growth after 2001. This explains two-thirds of the reduction in poverty between 2001 and 2012.
- Second, a concentrated policy focus on poverty, including redistributive policies. Large-scale non-contributory conditional and unconditional cash transfer programmes targeted at low-income families were established.
- Third, a dynamic labour market. Job creation has been accompanied by improved job quality. In 2012, nearly 60 per cent of all jobs were in the formal sector. Additionally, real wages rose due to higher minimum wages.
- Fourth, a reduction in the skills premium. This was due to a combination of lower demand for skilled labour and better access to education that raised the supply of skilled workers (Gasparini et al., 2011).

Furthermore, Brazil promoted inclusive development by improving access to ICT such as digital TV. Reduced costs of digital TV, and subsidies for low-income households, led to improved access to information, which in turn facilitated social inclusion.

In contrast to Brazil, China has experienced faster reduction in poverty, but with less inclusive development. For instance, over the past decades the income growth of the bottom 40 per cent has been relatively slower compared to overall income growth, leading to rapidly rising inequality. Between 1981 and 2005 the number of people living in extreme poverty in China declined by over 500 million, while the Gini-coefficient increased from 0.29 to 0.47. Income disparities are not only evident in interpersonal income distribution, but also in disparities between urban and rural areas, and Eastern and Western provinces. With the average income in China rising, the growth-equity trade-off in the country has become more important.

Table 4 summarises labour productivity, poverty rates and income inequality in China and Brazil for the years 1990, 1999 and 2010/2011. While both countries have experienced an increase in labour productivity and a decline in the poverty rate, only Brazil has also experienced a decline in inequality, while income inequality increased in China.

Since around the year 2000 the Chinese government has been concerned that growing inequality will reduce social cohesion. As a consequence, it has adopted the policy

Table 4: Socially Inclusive Growth - Brazil and China Compared, 1990 to 2011

	Labour Prod. in USD	Poverty Rate	Income Inequality
China			
1990	2.562	60.7	32.4
1999	4.318	36.0	39.2
2010	13.162	9.2	42.0
Brazil			
1990	10.441	16.2	60.4
1999	11.953	9.9	58.5
2011	13.430	4.5	49.5

Note(s): Authors' compilation based on data from World Bank's PovCal Database and The Conference Board's Total Economy Database.

objective of promoting a harmonious society as part of its 11th five-year plan. In this plan a strong emphasis has been put on improving the social protection system, consequently avoiding economic growth to by-pass the poorest and most vulnerable part of the population. A discussion of the evolving social protection system in China is contained in Xiaoyun and Banik (2013).

Latin American countries have seen improvements in socially inclusive development in recent decades. Economic policies, such as the promotion of higher education and provision of better social protection, contributed to this achievement. However, inequalities remain high. High inequality can equally be observed in sub-Saharan Africa. In both continents significant inequalities remain in the access to opportunities, particularly in access to education and basic needs provision (Okojie and Shimeles, 2006; Tsounta and Osueke, 2014). This means that significant growth benefits could be harnessed from further reductions in income inequality of these two heavily populated regions, with their fast-growing young populations. The social and security benefits of greater social inclusiveness, and hence social cohesion in two ethnically diverse continents, are also likely to be substantial.

4 The Context of Globalisation

4.1 Globalisation and Technology Transfer

Two important trends that have influenced social inclusive industrialisation are rapid technological innovation and the globalisation of the world economy. Both trends accelerated over the past thirty years, and created both opportunities and threats for economic development. In this section we focus on globalisation, in particular on how globalisation and technological innovation can interact to have a positive impact on the inclusiveness of industrialisation.

Globalisation is the growing integration of communities throughout the world in terms of economic, social and political dimensions. In economic terms globalisation has resulted in growing integration and interdependence across countries and regions, as reflected by the increased movement of people, goods, finance and knowledge. Multinational enterprises (MNEs) have promoted economic globalisation through trading and investments across borders, and by expanding global value chains (GVCs).

GVCs provide new opportunities for developing countries to promote manufacturing-led structural change and to obtain access to foreign technology. Baldwin (2011) argues that developing countries could start manufacturing by joining an existing supply chain, without having to build an entire one themselves. For Milberg et al. (2014) this may enable developing countries to develop manufacturing capabilities in certain areas, without or before building up these broader manufacturing capabilities, so that they can learn by starting on a small scale. Over time, the benefits of GVCs could be extended if countries 'upgrade' the position of their manufacturing firms within the GVCs, therefore shifting their production from lower to higher value-added parts of the GVCs (Jiang and Milberg, 2012).

However, globalisation and the role of MNEs through GVCs have been subject to criticism. As Nixson (2015) points out, it is very difficult for developing countries to achieve upgrading in a value chain without active governmental industrial policy. Moreover, participation in GVCs reduces what Wade (2003) refers to as policy or development space, that is the freedom or autonomy the host country exercises to determine or influence the industrialisation process.

Empirical evidence suggests that technology transfers from advanced to developing countries through GVCs do not happen easily, nor often. GVCs have not fundamentally changed the way in which developing countries can benefit from knowledge transfer for development. Learning and innovation remain difficult for firms in developing countries. GVCs play a leading role in facilitating such learning only in a minority of cases. Generally developing countries' firms that take part in GVCs are weak innovators, and in the cases where they do innovate, they often use learning mechanisms and knowledge sources from outside the value chain. Baldwin (2011) has claimed that MNEs are not essential in the business of technology, but rather technology lending and 'leave little technology behind them if they relocate to another country' (Nixson, 2015).

Globalisation and participation in GVCs have also been blamed for increases in within-country income inequality in recent years, and in perpetuating inequalities between countries.

4.2 Global Value Chains and FDI

Standard (neoclassical) trade theory predicts that the greater trade openness that characterises globalisation would, *ceteris paribus*, lead to more income inequality in skill-abundant countries (advanced economies) and improve income equality in skill-scarce countries (developing countries). According to the theory countries specialise in

production and trade of their relatively more abundant factor under free trade, which increases the relative demand (and consequently the relative wage) for that production factor. Lower trade barriers facilitate the unbundling of production processes across countries, causing the off-shoring of low-skilled jobs from advanced economies (Blinder, 2009; Baldwin and Venables, 2013). Once the jobs of low-skilled workers in advanced economies are off-shored to low-skilled workers in developing countries, wages of low-skilled workers in advanced economies decline, leading to higher income inequality. As a result, globalisation has been a cause of de-industrialisation in the West and in the middle-income countries of Latin America and sub-Saharan Africa, where import penetration of manufacturers from relatively low-cost producers such as China, have contributed to de-industrialisation.

While income inequality has risen in many advanced economies since the 1980s, when an increasing number of countries enacted policies of trade liberalisation consistent with theoretical predictions, within-country inequality also increased in many developing countries, in contrary to theoretical predictions.

One reason for this phenomenon, at least for countries close to the world technological frontier, is that SBTC can be transmitted through GVCs. In trade models with endogenous technological innovation, globalisation can lead to a rise in the skills premium in both advanced and developing countries, and more substantially in countries that are closer to the world technological frontier and that attract more FDI (Gancia, 2012).

This is relevant for manufacturing in developing countries. Where manufacturing development has been driven by FDI, as in Asia for example, the impact on inequality is stronger than where manufacturing development has taken place behind protective barriers such as in Latin America (Jaumotte et al., 2008). More productive firms are more likely to export, to produce better quality goods, and to pay higher wages (Verhoogen, 2007). Countries more distant from the world technological frontier are better insulated against SBTC, since knowledge intensive industries are subject to increasing returns to scale, and therefore benefit from increases in the market size for their products.

There is a further reason why globalisation does not necessarily imply inclusive industrialisation. The GVCs and networks that characterise trade and FDI are not operating under perfectly competitive market conditions. Rents and monopolies are widespread. This means that trade and labour market policies can face a trade-off between restrictions on FDI (protecting domestic industries) on the one hand, and gaining international knowledge on the other hand. Competition among countries to attract FDI-led technological industrialisation can lead to a 'race to the bottom' with regard to labour safety regulations, environmental rules or taxation, and could end up worsening inequalities and reducing social inclusion [see also Box 6].

Box 6: FDI-led Technological Industrialisation: A Race to the Bottom or Using FDI for Good?

During the 1980s and 1990s labour standards across the world declined as countries competed for FDI. According to the Labour-Rights Index of Davies and Vadlamannati (2013) covering 135 countries over a period of almost two decades, the evidence for competition for FDI is reflected in the fact that the labour standards of a country declined, if the labour standards of neighbouring countries had previously declined. Consistent with this finding, they also discovered that membership of the World Trade Organisation is associated with a declining country's position on the Labour Rights Index.

This 'race to the bottom' of labour standards often occurs in a subtle manner: instead of scrapping protective measures for labour, countries often seem to rather compete by enforcing labour laws less vigorously, as reflected in increases in labour law violations.

However, FDI-led industrialisation does not inevitably have to lead to deteriorating labour standards. As The Economist (2012) points out, FDI can lead to better labour regulations in two ways. First, the productivity increase with which it is associated provides a basis for better working conditions. For instance, many industrial MNEs offer new income and job opportunities to the rural population outside of agriculture, where working conditions are generally unregulated. Second, Western MNEs in developing countries can use their bargaining power to apply pressure to their subsidiaries and suppliers to implement better working conditions.

Empirical evidence on whether globalisation has been able to 'transmit' SBTC to developing countries is mixed: the skills premium declined in many developing countries over the past decade, especially in Latin America.

Los et al. (2014) use the World Input-Output Database (WIOD) to measure the rate of skill-biased technological change in global supply chains. They establish that the demand for high-skilled labour increased in most countries between 1995 and 2008, while the demand for low-skilled workers declined (with the exceptions of India and Indonesia). They find the net effect on total employment to be negative. In advanced economies the higher demand for high-skilled jobs can be primarily found in business services. This finding is consistent with the evidence of replacement of labour in OECD manufacturing. Over this period the labour demand in manufacturing only increased in China and India. In many other countries the proportion of jobs in manufacturing declined sharply over recent decades. Latin America is an exception, where the share of employment in manufacturing has been fairly constant since the early 1990s, following a period of de-industrialisation in the 1970s and 1980s.

4.3 Technology Lending

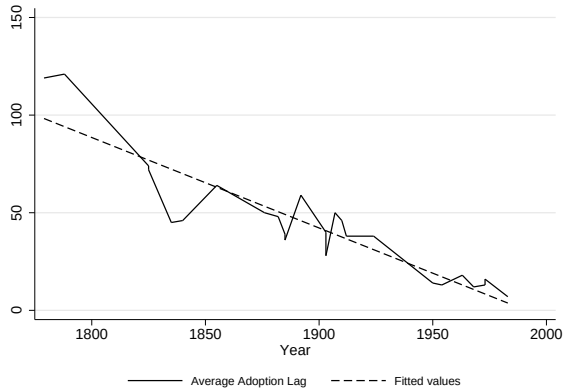
While 'technology has arrived everywhere', between-country inequality persists, since not all developing countries adopt new technologies at the same intensity. There is concern that participation in GVCs does not lead to technology transfer, but rather involves technology lending. Hence, although advanced technologies may be available in developing countries, they are not intensively adopted, causing the technology gap between advanced and developing countries to persist.

Empirical evidence exists on the difference in the adoption of advanced technologies between developed and developing economies. Figure 9a shows how lags in adoption of

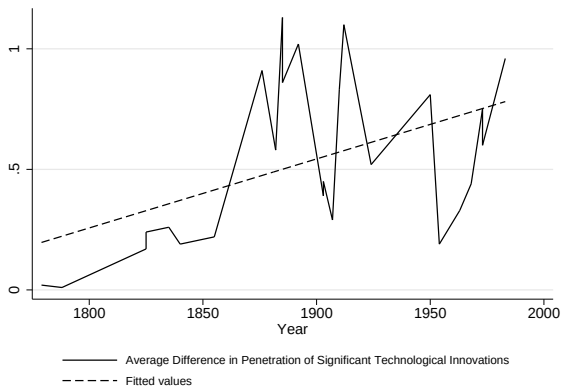
twenty-five leading technologies have become shorter over time. In contrast, Figure 9b shows that the gap in the difference of technology penetration between countries has increased over time. This indicates that the gap in the number of workers or capital units benefiting from the technology (the intensive margin of technology adoption) has increased over time, and can explain up to 80 per cent of between-country inequality (Comin and Mestieri, 2013).

Figure 9: Adoption and Penetration Rates of Technological Innovations, 1779 to 1983

(a) Average Adoption Lag



(b) Average Difference in Penetration



Note(s): Authors' construction based on data from Comin and Mestieri (2013, p.14). For year and type of invention see Table 5 in Appendix A.

Research and policy advice have been concerned with the challenge to increase adoption of foreign technologies by firms in developing countries. Since domestic capabilities are required to absorb technology, many countries have invested in domestic R&D capabilities. The main obstacle in this regard, however, is not so much a lack of skills, but a lack of market size. As far back as Adam Smith, economists have stressed that technological innovations depend on market size. Innovations are subject to fixed costs and hence economies of scale required for increased specialisation. Many developing countries do not have access to large markets, or cannot generate economies of scale that are large enough to incentivise technological innovations appropriate or suitable to the skills and cost level of their labour force. Although all countries have access to and knowledge of new technologies, the penetration to local capital and labour remains limited due to market size (Szirmai et al., 2013).

A country's development level also limits the penetration of technologies and national R&D efforts through the abundance of low-wage and low-skilled labour. With low wages, it is not always profitable to adopt and apply new technology, whether through own R&D efforts or imported machinery (Allen, 2012). Allen (2012, p.9) has pointed out that 'the easiest technology for poor countries to adopt is that of the nineteenth century, which was invented when wages were much lower relative to the price of capital'. Contrariwise, higher wages are an incentive for technological innovation in rich countries, which in turn raise productivity and wages, and set in motion a virtuous cycle for further invention and dissemination of technology, further entrenching between-country inequality. The industrial revolution occurred and spread first in countries where average wages were high for that time: England, the Netherlands and the United States (Allen, 2012, p.12).

The penetration of technologies into a country's industrial structure also depends on international systems of intellectual property right (IPR) protection. This may be significant for whether and how globalisation affects income distribution through technological innovation. If IPR protection was only enforced in advanced economies, innovation would be aimed at technologies that complement high-skilled labour in these countries, replacing expensive low-skilled labour, and presents the predominant mode of technological innovation in manufacturing over the past three decades. SBTC would then be transmitted through the activities of MNEs and GVCs to developing economies, starting with those closest to the world production frontier. The result would be higher overall income inequality, both within- and between-countries (see Gancia, 2012). However, if IPR covers all countries, a global market for new technologies will emerge, making it profitable for MNEs to innovate and develop technologies used by 'less skilled workers who are more predominant in developing countries'. Spence and Hlatshwayo (2011) argue that this may already be happening, and a reason for the decline in innovation efforts of advanced economies. MNEs have been shifting their technological innovation away from advanced to emerging economies, particularly to China, in order to invest more in off-shoring of R&D to raise productivity of workers in these countries. Better incentives to offshore R&D may be one reason for the decline in the skills premium across the developing world, although further research is warranted. It suggests that global innovation policies can contribute to improved income distribution.

5 Conditions for Socially Inclusive Industrial Development

Socially inclusive industrial develop requires a coherent set of policies that support technological innovation and its uptake to close technological gaps, and that facilitate labour market adjustments, provide protection against the disruptive effects technological innovation can cause, and promote the potential of new technologies to ensure sustainability and inclusion. In the remainder of this paper we discuss in more detail these conditions for socially inclusive industrial development, focusing on innovation and technology policies, human capital, redistributive fiscal policies and social protection, and labour market policies.

5.1 Innovation and Technology Policies

Given the existence of technology gaps within and between countries, and the role they play in explaining disparities in income and wealth, a major policy recommendation for promoting development over the past decades has been the stimulation of technological innovation, demonstration and dissemination. A huge literature has dealt with why and how developing countries could develop domestic capabilities in innovation and technology, including strengthening domestic capabilities to absorb foreign technology, creating national innovation systems, attracting foreign direct investment and incentivising research and development (R&D).

Education, skills formation and local fostering of innovative abilities (e.g. to conduct R&D) have been advocated in the literature as necessary complements to attract foreign technology (Hidalgo et al., 2010), as well as to generate sufficient capacity for technology penetration. In theory and practice this has led to a recommendation to develop national systems of production and innovation that consist of learning, development of absorptive capacities, and an environment that facilitates the commercialisation of innovations (Nelson, 1993; Cimoli et al., 2006; Fagerberg et al., 2007). A discussion of this literature and its recommendations falls outside the scope of this paper. For present purposes we highlight three areas of attention for innovation and technology policies.

First, despite the rapid pace of technological innovation in recent years, especially in ICT, there are increasingly concerns that innovation and technology policies are failing to generate adequate innovations to close technological gaps. The concerns have been raised for both advanced and developing countries: in the case of advanced economies (e.g. the EU) the question arises, why average labour productivity has been declining since the 1970s, if technological innovations were so rapid. According to Artus (2013, p.1) it can be explained by the 'low extent to which new technologies and technological progress have spread in the economy'. Investments in ICT have been declining in the recent past in the Eurozone countries. As Robert Solow famously remarked, 'you can see the computer age everywhere, but in the productivity statistics' (The Economist, 2013). Supporting empirical evidence comes from Jones (2009) who reports that innovation is getting more difficult, because successive generations of innovators must overcome an increasing educational burden that contributes to a decline in long-run growth. Youn et al. (2014, p.8) find, using USPTO data, that not all technological innovations were equally novel over the period 1970 to 2010. They conclude that there has been a slow-down in novel inventions since the 1970s, stating that 'the process of invention is driven almost entirely by combining existing technologies'. Lazonick (2014b) argues that the slow-down can be explained by an innovation crisis in the United States, blaming inappropriate incentives for large firms to invest in innovation. He presents data showing that large US companies have been using most of their earnings to buy back their own stock since the 1980s, instead of investing in innovation. He documents that the 449 largest public companies in the United States used 54 per cent of their earnings to buy back their own stock between 2003 and 2012. The reason for doing so, instead of investing the earnings in technological innovations, is because stock buy-backs (legalised in 1982) raise the price of their companies' stock and hence CEO's remuneration, which is generally tied to the performance of their companies' stock prices.

Second, not all technological innovations are equal from a social inclusiveness point of view. Most technological innovations in manufacturing tend to replace human labour, which requires regulations and the creation of incentives to steer technology in a certain direction. For instance, Brynjolfsson and McAfee (2012a) suggest that more effort should be made in steering the direction of technological innovation to complement human labour, instead of replacing it. They argue that 'we can do more to invent technologies and business models that augment and amplify the unique capabilities of humans to create new sources of value, instead of automating the ones that already exist'. They furthermore argue that the availability of many medium-skilled workers and ever-cheaper technology offers unique opportunities for entrepreneurs. As entrepreneurs played a vital role in incorporating new technology-organisations during the Industrial Revolution, many

expect that entrepreneurs will again play a decisive role in driving future technological innovations. Cowen (2014) shares a similar view, calling for more directed or regulated technological innovations that have the potential to raise the productivity and wages of low-skilled labour. He argues that job creation can be facilitated if access to and use of ICT become easier, for instance if robots and machines are easier to operate. Given that the gap in worldwide per capita income still largely reflects widening gaps in the penetration of technology, such innovations would be consistent with reduced global income disparities (see Comin and Mestieri, 2013).

Third, it may also be necessary to support innovations on the organisational level. This could include flatter hierarchies, decentralisation of management responsibilities, and off-shoring of management. Brynjolfsson and McAfee (2012a) consider many of the most recent ICT innovations as promising opportunities to complement certain human skills that are more valuable than ever. The utilisation of these opportunities, however, requires new forms of 'organisational innovations that have the potential to complement new technologies with human skills to deliver new products and services in innovative ways and create new jobs we can't yet imagine'. Marsh (2012, p.241) states that the Industrial Revolution started out 'centred on new technology plus new methods of organisation originating in a small group of countries'.

5.2 Human Capital

5.2.1 Aligning Curricula with Labour Market Needs

Due to the fact that technological progress is skill-biased, a skills mismatch can further contribute to inequality. Hence, expanding education and training programmes, especially in ICT and related areas, is an important recommendation to combat rising income inequality and to promote social inclusion. Education policies are crucial to ensure that the quality and type of education is aligned with labour market needs.

To foster inclusive industrialisation in Africa the Economic Commission for Africa (ECA, 2013) concludes that non-inclusive, jobless growth has characterised Africa's recent economic performance and is due to a mismatch between the contents of education programmes with labour market requirements. This is not only the case in Africa. Many advanced economies equally struggle to match their curricula with labour market needs, as the alignment of curricula and labour market requirements remains challenging. The race between technology and education results in current jobs becoming obsolete, while future jobs cannot yet be predicted [see Box 7].

Box 7: Education for Jobs that Do not yet Exist

Generally, 'as a rule of thumb, 60 per cent of the jobs ten years from now have not been invented yet' (Frey, 2011). It is predicted, however, that the demand for jobs will grow for tasks where computerisation is less likely, such as jobs requiring social and creative intelligence, including top management functions, leadership, as well as occupations in art and entertainment (Brynjolfsson and McAfee, 2012a,b; Autor and Dorn, 2013). Other scholars have predicted that whereas robots and machines were made to augment human labour in the past, human labour will increasingly exist to complement robots and machines in the future. Hence, Cowen (2014) calls for education and support of technologies that will make robots and machines easier to operate.

This means that education systems need to adapt faster to these needs. However, making correct predictions are difficult, 'especially of the future'.[21] Technological innovations are so rapid,[22] that education systems face the challenge to respond fast enough to provide labour with the type of skills that complement and benefit from capitalisation (Canidio, 2013). Therefore not only is education losing the race against technology, but also labour is losing the race against the machine (Brynjolfsson and McAfee, 2011).

Since education is costly and subject to fixed costs, improvements in the efficiency of financial markets and access to finance may be important to give workers access to the education they need in order to access and utilise new technologies. In low-income countries underdeveloped financial markets and the lack of credit in poor rural areas prevent people to access opportunities in education or entrepreneurship. Credit market imperfections can constrain the occupational choices and labour market mobility of unskilled workers, entrenching higher income inequality. Inequalities can even increase under moderate rates of technological innovation, if workers with low skills are prevented from accessing costly education (Canidio, 2013).

The experiences of many advanced economies have taught that on the job training and stable career ladders are vital, but under-appreciated conditions for innovation-led industrial development (Lazonick et al., 2014). The authors discuss how collective and cumulative learning matters for technological innovation, and underline that the process is embedded within organisations. Within advanced countries the rising incidence of self-employment coupled with more job uncertainty reduces own innovation efforts, while many developing countries are putting more effort into their own R&D capacities to facilitate inflow, adoption and penetration of foreign technologies. Therefore, in both advanced and developing countries, policies that can establish a more conducive framework for career and organisational development, are critical for a capacity development that sustains and facilitates the penetration of relevant new technologies.

5.2.2 Industrial Policy for Entrepreneurship

The availability of a large number of medium-skilled workers combined with cheaper technology offers opportunities for entrepreneurs. The support of entrepreneurial

[21] To quote physicist Niels Bohr.

[22] The fast pace of change in ICT has become too fast for the re-absorption of workers who lost their routine medium-skills jobs (Brynjolfsson and McAfee, 2012b).

ecosystems is therefore a valid policy objective. Brynjolfsson and McAfee (2012a, p.6) call for policies that support entrepreneurship, claiming that 'there has never been a worse time to be competing with machines, but there has never been a better time to be a talented entrepreneur' [see Box 8].

Box 8: Can Techno-Entrepreneurs Drive Africa's Industrialisation?

As advanced economies and countries such as China, the world's manufacturing centres, increasingly replace low- and medium-skilled routine tasks in manufacturing, the prospects for countries abundant in low-skill labour to industrialise through assembly-type manufacturing is becoming a less viable option. However, the same technologies that are replacing routine-tasks may open up new opportunities for entrepreneurs to engage in new forms of manufacturing, including network production and additive manufacturing, and to enter world markets for mass customised articles.
In South Africa, the world's second-largest supplier of titanium ore, entrepreneurs, in collaboration with government and research institutions, have been developing 3D-printing systems to accelerate the additive manufacturing of titanium metal parts, including titanium hip joints. Production times are up to eight times faster compared to older technologies (Wild, 2014).
To make use of these opportunities the entire entrepreneurial ecosystem in low-income countries becomes more important, including the quality and access to infrastructure, transport and logistical services, ICT and public infrastructure.

Entrepreneurial activities can help a country to 'discover' its comparative advantage (Hausmann and Rodrik, 2003). Àcs and Naudè (2011) argue that entrepreneurial support policies should consider the extent of industrialisation of a country and its stage of development. It might even be the case that a complete overhaul of existing institutions is needed to remove obstacles to innovation. In this respect entrepreneurs play a useful role in changing the policy environment. Athreye (2011) argues, based on the experience of India, that entrepreneurs can be successful in innovating even when facing an adverse environment characterised by over-regulation, high costs of doing business, weak enforcement of property rights, poor capital markets, and underdeveloped markets. The author outlines how Indian software firms found a way to overcome such obstacles, showing that adversity promoted creativity. The 'spectacular growth of industry in the 1990s was also marked by an improvement in the institutional infrastructure surrounding the software outsourcing industry, which generally served to ease constraints on the industry's further growth. These included capital and labour market reforms, better access to finance, improved IP right protection and contract enforcement' (Athreye, 2011). Institutional entrepreneurship may hence be very useful in establishing the conditions for industrialisation to take place in poor countries.

5.3 Redistributive Fiscal Policies and Social Protection

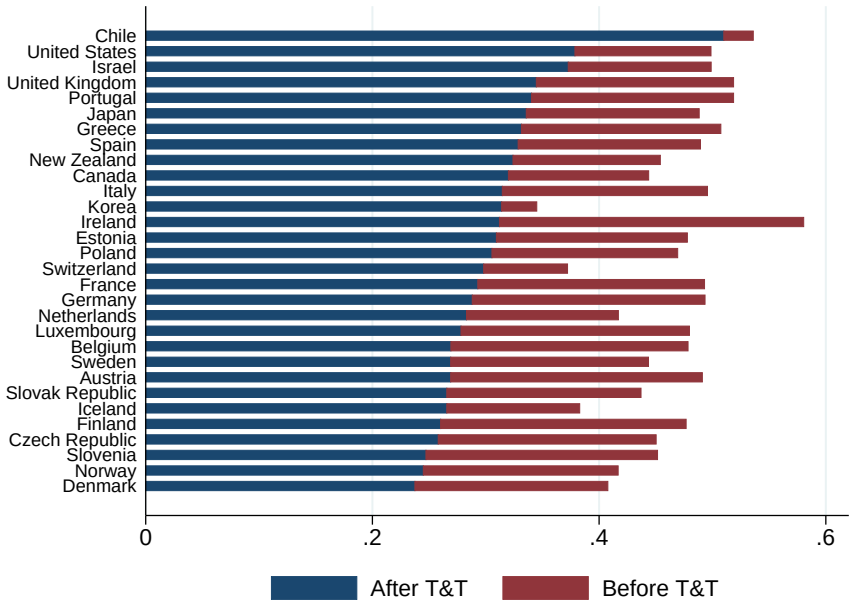
Social protection can support inclusive structural transformation by supporting the reallocation of labour from less to more productive sectors or firms. As Atkinson (2010, p.3) outlines, social protection is vital for 'facilitating economic change while promoting social inclusion'. He argues that social protection systems had their origins in establishing appropriate labour markets to support industrialisation in Europe in the late 19th and

20th centuries.[23] Social protection furthermore provides a measure to assist in the stabilisation of aggregate demand during economic downturns.

Through redistributive tax policies income and wealth inequalities can be reduced. These policies include, for example, higher marginal tax rates and higher inheritance taxes.[24] Piketty et al. (2011) and others (e.g. Mishel et al., 2009; Fernholz and Fernholz, 2012; Stiglitz, 2012; Mishel et al., 2014) propose higher taxation, inheritance taxes and a global wealth tax, to shift the balance in favour of labour. Based on simulations using US data, Piketty et al. (2011) suggest that the highest marginal tax rate in the US could be raised to 83 per cent without creating disincentives. Baker (2012) argues for a tax on financial speculation, claiming that the financialisation of the US economy has been one of the most important determinants of income and wealth inequalities.

The OECD (2011) shows empirical evidence that lower taxes and reduced social protection contributed to rising inequality, at least in advanced economies. The potential of higher marginal taxation to reduce income inequalities is clear when income inequality is compared before and after taxes. Figure 10 shows that taxes and transfers (T&T) can reduce the inequality by a considerable amount: to levels between 0.2 and 0.3 points of the Gini-coefficient (or 20 to 30 depending on the scale). Ireland reports higher before T&T inequality than Chile, but lowers its Gini coefficient to a Gini-coefficient of almost 0.3 through high taxes and transfers, while Chile is the most unequal country in this sample due to the minor role of taxes and transfers.

Figure 10: Gini-Coefficient Before and After Taxes & Transfers, in 2009



Note(s): Authors' calculation based on OECD Stats.

[23] One of the motives for the introduction of the Bismarkian system of social insurance was to underwrite the modern industrial employment relationship (Atkinson, 2010, p.2).

[24] Atkinson (2010) makes a case for higher inheritance taxes in Europe to reduce the rise in household wealth and income ratio, and for reforms to product- and capital markets to address a concentration of market power, as well as the bargaining power of capital.

Distributive tax policies are not easy to implement, particularly in developing countries. Tanzi (2014) stresses that taxing the richer part of the population is a challenging task, as they generally oppose these types of policy changes, providing resistance through political, administrative and legal means. In developing countries this challenge can be even more substantial given the power of local elites, and the ease of moving capital offshore. There is a growing interest in identifying the determinants of the preferences for redistribution, due to the heterogeneity of the size of T&T a specific country adopts. While preferences for redistribution have structural, cultural and historical causes, they also show temporary and fleeting causes, meaning that such preferences are not stable over time (Alesina and Giuliano, 2009; Guillaud, 2013). This finding also complicates the implementation of redistributive tax policies.

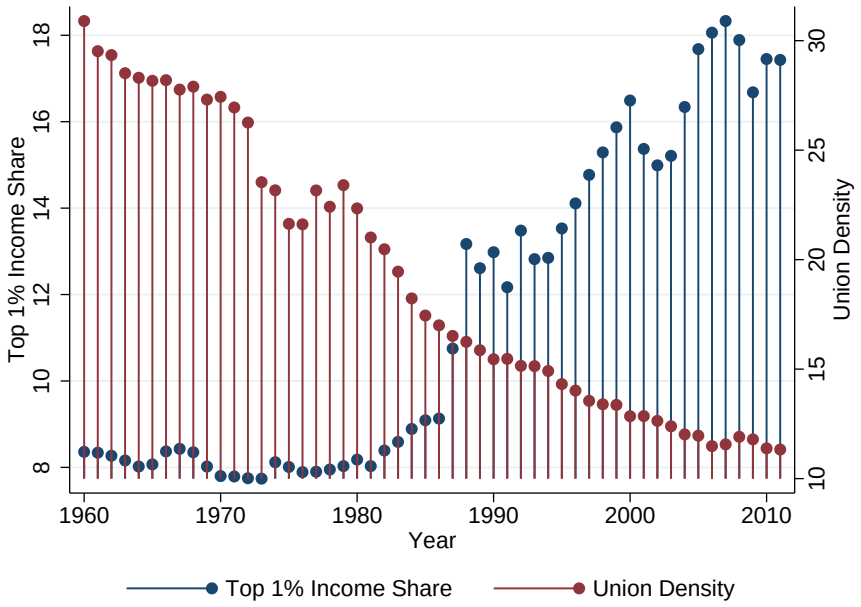
5.4 Labour Market Policies

Piketty (2013) ascribes rising inequality as the outcome of a struggle between capital and labour, in which labour receives a smaller proportionate share, since most countries experience a systemic weakening of their bargaining power over time (see also Mishel, 2011; Stiglitz, 2012; Bivens and Mishel, 2013; Lazonick, 2014a; Mishel et al., 2014). The erosion of the bargaining power of workers can be explained by a reduction in unionisation, trade policies and higher unemployment, due to lack of sufficient demand and economic growth. Some disputed evidence exists that declining minimum wages and labour union membership contributed to the rise in wage inequality in some Western countries since the 1980s (Card and DiNardo, 2002; Teulings, 2003; Card et al., 2004; Bénabou, 2005).

Figures 11 and 12 depict the associations between income inequality and union bargaining power measures in the United States, as well as in a selected sample of developing and emerging countries for which comparable data is available. The figures show an inverse association between changes in unionisation, as measured by the number of union members, and union density, as measured by the net union membership as a percentage of total employed wage and salary earners.

As previously stated, the decline of the welfare state in the West may be related to SBTC. Acemoglu (2003, p.3) argues that SBTC created a vested interest, so that 'higher skilled individuals opt out of labour unions and stop supporting the welfare state'. With more and better education that make technological innovation in cognition-demanding investments more profitable, the demand for higher-skilled workers raises their relative wage. This, in turn, creates a constituency that leads to changes in labour market institutions, including a reduced preference for redistribution. In other words 'technology interacts with the overall organisation of the labour market' (Acemoglu, 2002, p.13). Consistently, Card et al. (2004) find evidence from the US, Canada and the UK that union membership is concentrated in the middle of the skills distribution and not at the top level.

Figure 11: Income Inequality and Union Density in the United States, 1960 to 2011



Note(s): Authors' construction based on data from the World Top Incomes Database and the ICTWSS Database.

5.5 Improved Industrial Policy-Making

Most policy recommendations for promoting socially inclusive industrial development are aimed at the level of the sovereign nation-state. This may not be optimal given the impact of technology and globalisation on supra-national governance. Moreover, governance structures based on the nation-state may increasingly become out-dated to deal with the nature and pace of technological innovation.

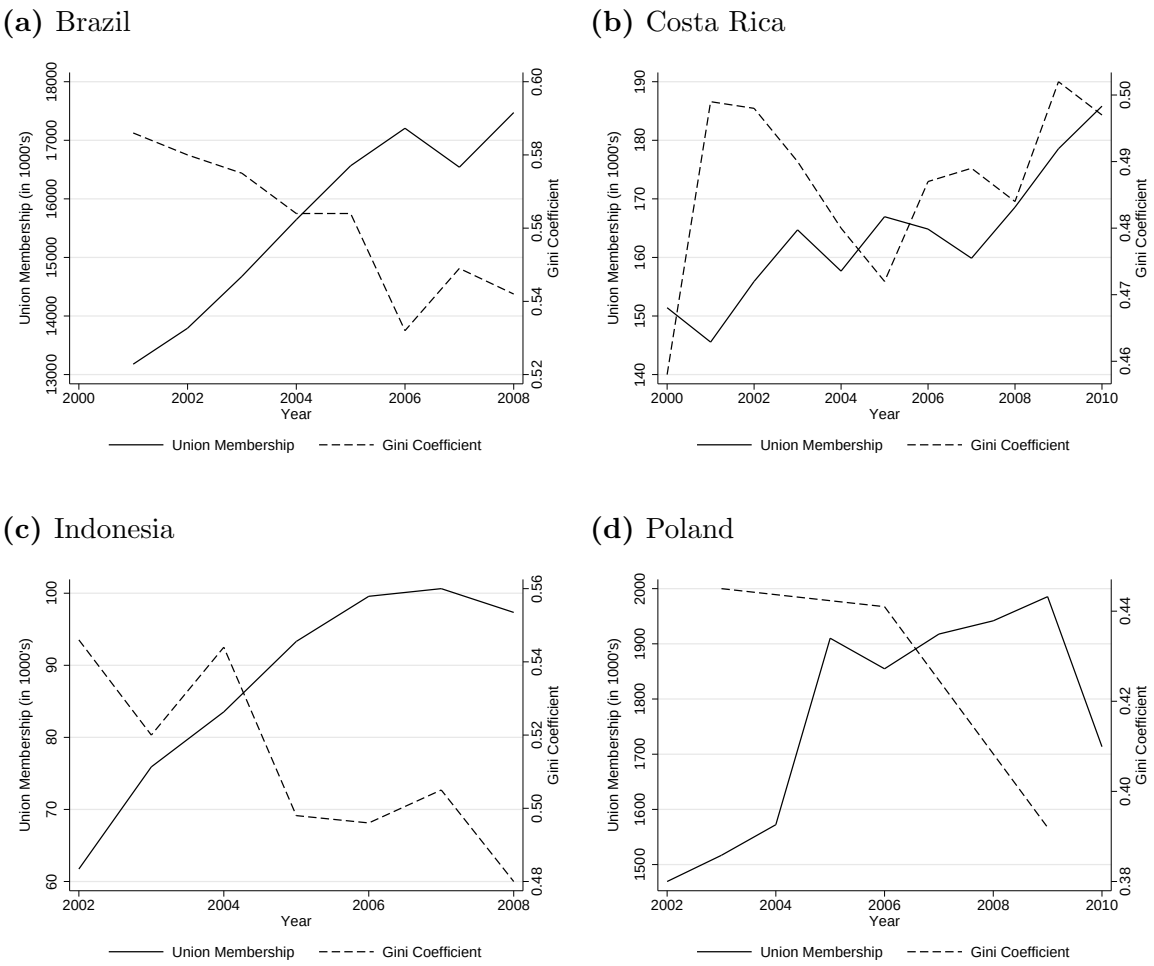
If labour and education are losing the race against technology, how can national government bureaucracies or global governance institutions, based on a 19th century model with a notion of sovereignty going back to the Peace of Westphalia in the 17th century, hope to effectively design and implement policies for inclusive industrialisation in the 21st century? After all, as Pastreich (2014) remarks, 'Facebook in its primitive current form is still years ahead of the United Nations, the World Bank, the OECD or any of the international organisations supposedly engaged in global governance'.

The answer is that it would require innovations in governance itself. Over the next fifty years technological innovations in ICT, the Internet and virtual government are likely to make this inevitable, and induce significant changes to the nation-state. These technological innovations can result in more inclusive societies, as well as more inclusive industrialisation and industrial policies, by making governments more effective and customer-focused.

Crowd-sourcing, open government, big data, virtual-citizen schemes (such as Estonia's e-residency)[25] and virtual currencies such as Bitcoin are eroding the traditional nation state,

[25] The government of Estonia introduced an e-residency scheme in 2014, which can be described as 'a

Figure 12: Unionisation and Income Inequality in Selected Developing Countries, 2000 to 2010



Source: Authors' compilation based on ILO data and Milanovic (2014).

leading to government-types and hybrid non-state structures that offer public services and are 'attracting customers, and deriving revenues without regard to physical territory [...], allowing states to turn public goods into virtual business ventures' (Schnurer, 2014, 2015). According to Khanna (2013) 'though most of us might not realise it, the non-state world describes much of how global society already operates [...]. Where growth and innovation have been most successful, a hybrid public-private, domestic-foreign nexus lies beneath the miracle'.

state-issued secure digital identity for non-residents that allows digital authentication and the digital signing of documents' (see https://e-estonia.com/e-residents/about/).

Box 9: New Technologies for Inclusive Industrial Policies

Not only the nature of manufacturing is changing due to new technologies, such as additive manufacturing, mass customisation, nano-technology and networked production. Also the tools through which governments can support inclusive structural change and productivity growth are becoming smarter. According to estimates by McKinsey (2011), governments in the EU could save EUR 100 billion annually in operational efficiency through the application of big data.
More important, having access to large amounts of digital data will allow governments to assess and track economic changes and competitiveness more accurately and timely, and measure in more detail the participation of firms in the global economy. Peres (2014) cites a number of examples where developing countries in Latin America began to harness big data to improve economic sustainability in agriculture and processing, water use, traffic planning and surveys.
In January 2014 engineers from the Kinshasa Higher Institute of Applied Technique installed robotic 'traffic cops' at a busy crossing in central Kinshasa, Democratic Republic of Congo. These robots helped to regulate the traffic: through a set of sensors, they send information on traffic flows to a control center, help to reduce congestion, improve road safety and ultimately reduce transport costs for commuters and businesses.

Sources: McKinsey (2011); Peres (2014); Taylor (2014).

Without significant changes in the nature of governance and considering how global migration flows are governed, the current nation-state may even be a stumbling block to socially inclusive industrialisation and global equality. As Bentham (2014) argues 'the concept of the nation pushes authorities to privilege some as citizens, while rejecting others and denying their rights. The sole reason there have been citizens in any place or time has been so that non-citizens can be isolated and their rights denied. No one will ever promote equality by reserving access to the world's political centres and advanced technologies for the privileged few'.

5.6 (Re)-establishing the Social Contract

The ability of countries to enact policies to strengthen the relative bargaining power of labour, to regulate innovation that favour capital and to impose redistributive taxation, depends on social unity and social cohesion, and the capacity to underpin these with a social contract. Posen (2014) argues that appropriate social contracts have kept inequality low in Nordic countries, even if their industrial sectors operate on the world technological frontier, and are thus exposed to the SBTC and labour market polarisation effects of technological innovation. As the author describes,

> The international differences between post-tax inequality in the US or UK versus the Nordic countries, for example, are quite sharp. This reflects the power of policies and institutions that mitigate inequality, and shows an ability to offset the seeming inevitability of ever-rising inequality. However, these cross-national differences also reveal the importance of social unity, which gives rise to those institutions that raise the poor where they exist.

The term social contract goes at least back to the ideas of Jean-Jacques Rousseau who argued for such an understanding or 'pact' between members of a society that would

recognise and acknowledge their inherent equality, stating that 'the social pact establishes equality among citizens in that they all pledge themselves under the same conditions and all enjoy the same rights' (Rousseau, 1754 as quoted in Stewart, 2014, p.46).

Inspired by Rousseau, Durkheim, Marx and other scholars were concerned with social exclusion and inequality that accompanied industrialisation in Europe in the 19th century. Concerns about social exclusion and inequality, in the French context defined as the rupture of social bonds or the social contract (resonances of Jean Jacques Rousseau) re-emerged in the 20th century with the rise of unemployment and the decline of the post-War European model of full employment. This model was based on different state-led forms of social inclusion, described as welfare capitalism (Esping-Andersen, 1990). Although it was not uniform, the European state-led form of social inclusion shared commonly accepted norms around the relationship between the economy and social inclusiveness, including norms of income distribution and taxation. In the 20th century, the US upward social mobility became a central element of the social contract and a cohesive force. It tolerated moderate inequality based on the assumption that anyone could make use of the individual initiative and effort to participate in the 'American Dream'. Today, however, there are growing concerns that social mobility has declined and that the United States is no longer the land of opportunity (Chetty et al., 2014).[26]

A social contract that promotes social justice would require societies that support equal access to opportunities (e.g. through education) and ease social mobility (e.g. through entrepreneurship and inclusive finance), while making compensating benefits for the poorest available (e.g. social protection and labour market policies) (Brunori et al., 2013; Ferreira et al., 2014; Stewart, 2014).

6 Concluding Remarks

More than seventy years ago Rosenstein-Rodan (1943, p.202) was confident that 'industrialisation is the way of achieving a more equal distribution of income between different areas of the world'. Today, it seems that he may have been wrong. Industrialisation, while accepted as necessary for development, appears to also be associated with rising and persistent disparities in incomes and wealth, and does not automatically foster inclusive development.

In this paper we explore whether industrialisation driven by technological innovation is contributing to high and rising inequality. These inequalities reduce productivity and limit economic growth. Moreover, inequality contributes to social exclusion, lower levels of trust, high potential for conflict, and consequently retard further industrialisation.

We start by detecting a note of techno-pessimism in this debate, with rapid technological innovations blamed for causing inequality to rise, the scapegoat since the First Industrial Revolution. By exploring the literature and empirical trends, we conclude that

[26] The negative association between inequality and inter-generational social mobility has been termed the 'Great Gatsby Curve' by Krueger (2012).

technological innovation is not neutral, but directed towards capital and high-skilled labour. Furthermore technological change does not always complement labour, but often replaces it.

However, this conclusion does not mean that we subscribe to techno-pessimism. Inclusive industrialisation is possible if appropriate policies support entrepreneurial innovation, and provide greater social security and fairness. Rising inequality may occur at earlier stages of industrialisation, because not all labour can be reallocated instantly or without frictions to the sectors where more capital and technology are at their disposal, such as manufacturing. However, persistent inequality implies that institutional weaknesses exist, and that they affect the incentives entrepreneurs face.

As key agents that take the risk of reallocating production factors from and among sectors, entrepreneurs often encounter incentives to introduce technologies that are skill-biased or replace labour. They might also face incentives not to introduce technology at all, which can largely explain persisting between-country inequality. In developing countries it is often not profitable for entrepreneurs to use technologies at the world technological frontier, because of cheaper wage labour, or because they cannot find enough high-skilled labour given imperfections in education and credit markets, or because of small domestic markets. In advanced economies, a combination of weaker bargaining power of workers in middle-income employment, failed corporate governance and government capture by entrepreneurs have contributed to inappropriately directed innovation, as well as an erosion of safety nets, which are indispensable in cushioning the short-term adverse impacts of creative destruction within a globalising world economy.

We present and discuss a number of policies that have the potential to better promote equality without discouraging entrepreneurial innovation. Socially inclusive industrialisation is only possible if both within- and between-country inequalities are reduced. This is a complex challenge: on the one hand because of possible trade-offs between equity and efficiency in within-country inequality, on the other hand because of trade-offs between reducing between-country inequality and increasing within-country inequality. We therefore argue for a (re)-establishment of a social contract as a necessary basis for inclusive industrialisation. The idea of a social contract goes back at least to the ideas of Jean-Jacques Rousseau who argued that industrialisation brings unequal wealth, and may destroy social cohesion.

Finally, and crucially, our policy recommendations assume that policy-making for inclusive industrialisation lies in the initiative of sovereign nation-states. However, this might be a wrong assumption: governance structures based on the nation-state may be outdated to deal with the nature and pace of technological innovation that drives modern industrialisation.[27] If labour and education are 'losing races' against technology, how can national government bureaucracies or global governance institutions, based on a 19th century model, hope to effectively design and implement policies for inclusive

[27] Additionally, Boudreaux (2014) points out: 'People identify a problem in reality and then demonstrate how that problem can be solved by government. But far too many such demonstrations feature a 'then a miracle occurs' step. This step is the assumption that politicians and other government agents are superhuman - that when they are elected or appointed to political office, they are miraculously transformed'.

industrialisation in the 21st century?

The answer is that they are probably not able to do so, unless government itself innovates and evolves. Over the next fifty years technological innovations are likely to make this step inevitable and induce significant changes to the nation-state. These technological innovations can result in more inclusive societies and more inclusive industrialisation, by making governments more effective and more customer-focused. Without significant changes in the nature of government and in the way global migration flows are governed, the current nation-state may even be a stumbling block to inclusive industrialisation and global equality.

While this paper rejects the antagonism of techno-pessimist or modern-day Luddites, it also does not subscribe to techno-utopian visions on the other end of the spectrum. Technological innovation will bring changes to governments and governance models, and can improve efficiencies and transparency, as well as the promotion of a more inclusive government. However, this is not a foregone conclusion. There are moreover risks that technological innovation in governance can spur greater social exclusion and hence hinder policies for more inclusive industrialisation. In the non-polar world of today there is a strong trend towards decentralisation, devolution and fragmentation of the government (see Haass, 2008). This trend could foster social exclusion and a return to nationalism.

In conclusion, for some romanticists who lived through the First Industrialisation, such as Jean-Jacques Rousseau, John Keats, Charles Dickens and others, technological innovation was a threat to human society. In this paper we argue that theory and practice do not only prove this to be false, but that it is equally wrong to 'blame the robots', an accusation that became salient in industrial production to explain inequality, unemployment and exclusion. However, neither should it be expected that technology innovation solves on its own the human tendency to establish stratified societies. Nor that with a push of the 'right button' technological-driven industrialisation solves rising inequality and social exclusion. Countervailing policies, including social protection and labour market policies, that are coordinated on a global level and based on universal good governance, are ultimately required for socially inclusive industrialisation.

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A Appendix

Table 5: Year and Type of Inventions

Year	Invention
1779	Spindles
1788	Steam and Motor Ships
1825	Railways Freight
1825	Railways Passengers
1835	Telegraph
1840	Mail
1855	Steel
1876	Telephone
1882	Electricity
1885	Cars
1885	Trucks
1892	Tractor
1903	Aviation Freight
1903	Aviation Passengers
1907	Electric Arc Furnace
1910	Fertiliser
1912	Harvester
1924	Synthetic Fiber
1950	Blast Oxygen Furnace
1954	Kidney Transplant
1963	Liver Transplant
1968	Heart Surgery
1973	Cellphones
1973	PCs
1983	Internet

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