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**Gender and industrialization: Developments and trends
in the context of developing countries**

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Abstract

This paper reviews the literature on the relationship between gender (in)equality and industrialization in the context of developing countries. It documents past developments, accounting for pre-industrial preconditions that might explain current differences in gender roles across societies. Moreover, it discusses the main drivers of the relationship between gender equality, economic development and structural change with a focus on the mechanisms driving this complex relationship. It provides novel empirical evidence of recent developments and the current state of gender equality in different spheres in developing countries at different stages of structural change. The study also identifies emerging trends, for instance, related to more recent technological advancements in Industry 4.0 and premature deindustrialization, and discusses their possible impacts on gender equality in developing countries. The ultimate aim of the paper is to identify knowledge gaps and to formulate relevant research questions that need to be addressed to design constructive policies aimed at promoting gender equality in developing countries.

Keywords: Gender, industrialization, developing economies

JEL classification: J16, O14, O33

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1. Introduction

The promotion of inclusive and sustainable industrial development is currently on the agenda of policymakers. One important aspect of inclusive and sustainable industrial development policies entails advocating gender equality in various domains, including, for instance, labour market participation of women and their financial inclusion, closing the gaps in educational attainment and educational outcomes, as well as in health. Indeed, achieving more gender equality and empowering women is one of the 17 Sustainable Development Goals outlined in the 2030 Agenda for Sustainable Development adopted by the United Nations, along with goals such as the reduction of poverty, fighting the impacts of climate change, and promoting strong institutions, among others.

Gender inequality is declining in virtually all major spheres around the globe, across diverse religious and cultural traditions (Dorius and Firebaugh, 2010; World Development Report, 2012; World Economic Forum, 2020). In some areas, however, progress towards gender equality has been limited. According to the recent Global Gender Gap report (World Economic Forum, 2020), the gender gap in educational attainment is relatively small around the world; the highest gender disparity remains in political empowerment. There are also strong cross-country differences in the pace of achieving gender equality, with the estimated time to closing the gender gap being longer in developing countries.¹ But can gender equality, economic development and structural change reinforce each other? Do industrial policies necessarily take account of gender issues? To what extent can the historical experience of developed countries contribute to the promotion of gender equality in less developed countries? What is the current state of gender equality in developing countries at different stages of industrialization? How will new developments, such as Industry 4.0 and premature deindustrialization, affect developing countries? One of the major insights of this study, which addresses the above-mentioned questions, is that a *glocal* approach to gender equality represents a promising approach for achieving more sustainable economic development. While gender equality in itself is valuable and, as such, is a global objective, the means and tools to achieving this aim are local, and therefore require a location-based approach. This suggests the need for a deeper understanding of region-specific economic, socio-demographic, institutional and cultural conditions that might influence gender equality, even within countries.

¹ For comparison, the estimated time to closing the gender gap is 54 years in Western Europe and 163 years in East Asia and the Pacific.

The main objectives of this paper are as follows. First, the paper provides a comprehensive overview of the existing literature on the relationship between industrialization and gender equality, taking into account the role of pre-industrial preconditions and different stages of the industrialization process. Furthermore, it identifies the main drivers behind this relationship to gain a better understanding of whether—and if so—under which circumstances industrialization positively contributes to gender equality. Second, the paper provides novel empirical evidence on recent developments and the current state of gender equality in different spheres in developing countries at different stages of structural change. Third, the paper describes recent trends, such as Industry 4.0 and premature deindustrialization, and discusses potential consequences of these trends for gender equality. Finally, based on the literature review and empirical evidence, research gaps are identified and clearly defined research questions for future research agenda are formulated.

The paper proceeds as follows. Section 2 examines various pre-industrial preconditions of gender inequality that continue to persist until this day. Section 3 reviews the literature on the relationship between economic development, structural change and gender equality, and discusses the main drivers of this relationship. Section 4 provides empirical evidence of the recent developments and current state of gender equality in different spheres in the context of developing countries at different stages of industrialization. Section 5 focuses on new and emerging trends, such as Industry 4.0 and premature deindustrialization, and their impact on gender equality. Finally, section 6 summarizes the main findings, identifies important research gaps and concludes.

2. Pre-industrial preconditions of contemporary gender inequalities

This section provides a historical perspective of gender equality by documenting the pre-industrial preconditions of gender inequality that continue to persist to the present day. One strand of the literature on gender inequality and industrialization argues that the origin of the current differences in gender roles lie in the form of agriculture traditionally practiced in the pre-industrial period. In her seminal work, Ester Boserup (1970), for instance, argues that the type of agricultural technology most commonly used in pre-industrial societies played a decisive role in determining the role of women in those societies. She differentiates between shifting and plough agriculture, which use different types of technology. Shifting agriculture relies on tools such as hoes and digging sticks, which are labour intensive, but allow more women to participate in agricultural activities. In turn, the use of ploughs in agriculture is more capital intensive and requires substantial physical strength, hence women's participation in this form of agricultural activities is limited. In societies characterized by plough agriculture, men specialized in agricultural activities while women primarily engaged in household chores, such as childcare. Boserup (1970)

asserts that the belief in the distinctions in the role between men and women in society persisted over time, even when the economy transitioned to a more advanced level of development.

More recently, Alesina, Giuliano, and Nunn (2013) empirically tested Boserup's hypothesis using data from the Ethnographic Atlas, a rich dataset containing pre-industrial ethnographic information for 1,265 ethnic groups worldwide, with the majority of ethnicities sampled from Africa, followed by North America and Asia. In the first step, the authors investigated the correlation between the prevailing type of agricultural technology and female participation in different agricultural tasks in pre-industrial societies. They found that plough use was associated with lower female participation in a variety of agricultural tasks, with the lowest participation rates in soil preparation, planting, crop tending and burden carrying.

It cannot necessarily be assumed, however, that these gender-specific roles are reflected in modern societies. To demonstrate the long-term persistence between the type of agricultural technology used and female participation in the labour force, Alesina et al. (2013) combine pre-industrial ethnographic data on whether societies traditionally practiced plough agriculture with contemporary data on female labour force participation and beliefs about the role of women in society. Their findings are striking and consistent with Boserup's hypothesis: there is a strong negative relationship between historical plough use and contemporary female labour force participation, female ownership (as measured by the share of firms with a woman among the principal owners), and female participation in politics (as measured by the proportion of parliamentary seats held by women in national parliaments).

In addition to measures of female labour force participation, firm ownership and participation in politics, Alesina et al. (2013) investigate differences in individual attitudes about the appropriate role of women in society. Using data from the World Values Survey, they find that traditional plough use among the ancestors of individuals living in the same district of a country is positively associated with attitudes reflecting gender inequality. Specifically, individuals currently residing in these districts are more likely to agree to statements, such as "When jobs are scarce, men should have more right to a job than women" and "On the whole, men make better political leaders than women do."

Alesina et al.'s (2013) finding of the persistence of the relationship between the prevailing agricultural technology used in pre-industrial societies and unequal gender roles—even within districts of countries—further emphasizes the important role local social norms and values play in this relationship. It also raises the question about the effectiveness of short-term policies aimed at promoting gender equality in those regions.

In a related study by Hansen, Jensen and Skovsgaard (2015), the authors empirically test the hypothesis that patriarchy has its origin in the Neolithic Revolution, when societies experienced technological advancement by transitioning from a hunter-gatherer to an agricultural society (Diamond, 1987; Iversen and Rosenbluth, 2010). This change in social norms occurred as a result of higher fertility and the diminishing role for women outside the home, which was primarily attributable to the fact that farming women did not have to transport their infants during a nomadic existence like their hunter-gatherer counterparts, and because demand for human labour increased during the agricultural period. The patriarchal values and beliefs intensified over time. These values and beliefs are therefore more persistent in countries with long traditions of agriculture. Hansen et al. (2015) provide empirical evidence of the relationship between the timing of the Neolithic Revolution and contemporary indicators of equality in gender roles. They document a robust negative relationship between the years a society was predominantly agrarian and contemporary female labour force participation and the number of female seats in national parliaments. These results hold for European, African and Asian countries.

Moreover, Giuliano (2018) highlights the important role of additional historical determinants for contemporary gender gaps across societies, which have persisted long after the historical conditions changed. Among the historical factors for the long-term persistence of gender roles are soil texture, various societal characteristics, such as matrilineality and matrilocality, religion, and language, for instance, grammatical gender marking, among others. The role of historical events is emphasized by Lagerlöf (2003), who argues that the spread of Christianity in Europe, which led to an improvement in gender equality, might have positively impacted the growth trajectory in the long run.

This long-term persistence of social norms relating to gender roles is striking. It implies that location-specific, historical contingencies are important determinants for contemporary gender inequalities, which policymakers need to consider when designing policies to foster gender equality in modern societies. Several questions remain unanswered, however. To decrease or even disrupt the long-term persistence of gender inequality, we need to better understand under what circumstances gender role differences persist over time. The following question is thus of particular significance: what factors may potentially affect the long-term persistence of gender roles? One of the few attempts to better understand the conditions under which cultural beliefs persist is provided in the paper of Giuliano and Nunn (2017). Motivated by the premise that societies living in a stable environment value tradition more strongly and are thus more reluctant to deviate from it compared to societies that live in less stable conditions, they show that the persistence in the relationship between the traditional participation of women in agriculture and

female labour force participation rates today is weaker in countries with higher historical climate variability.

Only few studies have investigated how historical shocks may have challenged traditional gender roles by altering the sex ratio in the population. Teso (2019), for instance, shows that women whose ancestors were more exposed to transatlantic slave trade in sub-Saharan Africa are more likely to be part of the labour force, have lower levels of fertility, and are more likely to participate in household decisions. Similar effects have been found in studies on violent conflicts, in which the share of the female population increased as a result of the high mortality among the male population (Goldin and Olivetti, 2013; Acemoglu, Autor and Lyle, 2004). Women have responded to such shock-like events by increasing their working hours, entering the labour force, altering their fertility patterns or by migrating and adapting the investments in children's health or education, thereby transforming traditional gender roles (Buvinic et al., 2012). More research is needed, however, to better understand how other factors, such as the institutional environment's characteristics and specific policies, influence this persistence.

In sum, the roots of contemporary gender inequalities in labour force participation and other gender roles can be found in the pre-industrial history of societies. This long-lasting persistence of gender-specific differences in economic behaviour as well as beliefs about the role of women in society is striking. It suggests that social norms and values that contribute to unequal gender roles tend to persist, even when the society reaches a more advanced level of development and undergoes structural change. The literature suggests that the transition of pre-industrial societies to a more advanced stage of technological development, such as the Neolithic Revolution, and the use of more advanced agricultural technology, such as the plough, fostered the emergence of gender-specific divisions of labour and unequal gender roles in pre-historical societies. This persistence appears to be less pronounced under certain environmental conditions. However, more research is needed to gain a better understanding of the role factors such as the institutional environment play in the long-term persistence of unequal gender roles.

The next section analyses the relationship between economic development, structural change and gender equality in more recent times.

3. Review of the literature on the relationship between gender equality, economic development and structural change

3.1 Economic development and women's participation in the economy

This section explores the relationship between economic development, structural change and women's participation in the economy. While there seems to be consensus in the literature that structural change is a major driver of economic development (see, for instance, Haraguchi et al., 2019), its relationship with gender equality is complex and less understood. Understanding this relationship, particularly in the context of developing countries, is crucial for designing constructive policies aimed at promoting gender equality. Several perspectives on the impact of economic development and structural change on female participation in the economy are identified in the literature and point to a relatively polarized debate. One strand of the literature emphasizes the positive effects of economic development on gender equality, such as the creation of employment opportunities for women, encouraging investments in human capital, and challenging traditional social norms about the role of women in society. Some scholars, on the other hand, argue that structural change undermines gender equality by pushing women into low-paying jobs (see, for instance, Momsen 2020, and Prieto-Carron, 2008, for a general overview of feminist literature on women workers and industrialization).

Several empirical studies highlight a more complex relationship between economic development and women's participation in the economy, giving rise to the so-called feminization U hypothesis. According to the feminization U theory, women's participation in the labour force drops during the initial phase of industrialization and rises once a certain level of development has been reached (Goldin, 1990, 1995). There are several reasons for this non-linear relationship. In the early stages of development, when agriculture dominates the economy, the majority of women participate in the labour force, e.g. by working on family farms. As the economy shifts from agriculture to industrial production, female labour force participation rates fall. Potential explanations for this decrease in female labour force participation rates at this stage of economic development include the low level of female education, the incompatibility of wage labour with childcare, and social norms preventing women from working outside the home, among others. Spurred by structural change, which leads to the emergence of more acceptable forms of employment for women as well as increases in education, declining fertility, and the introduction of supporting policy measures,² female economic activity increases again in later stages of development. This striking rise in female labour force participation has been observed in many developed economies.

² Such policy measures might include regulations on maternity leave, taxation policies and policies to promote universal education, among others. Recent evidence for OECD countries suggests, however, that the expansion of "family-

The feminization U hypothesis has important policy implications. If this theory holds, least developed countries on the path towards industrialization must pay particular attention to gender equality issues. Yet empirical evidence for this relationship is rather mixed. Early studies that corroborate the feminization U theory mainly involved currently developed countries (Goldin, 1990, 1995). The focus of those studies was usually on the relationship between female labour market participation rates and aggregated GDP per capita rather than more direct measures of structural change. They were, moreover, based on cross-sectional data and thus largely ignored the within-country developments over time.

The results of more recent empirical studies using panel data reveal that the U-shaped relationship is not necessarily universally valid, and the results of these studies are quite mixed. For instance, validity for the feminization U hypothesis was found in cross-country data for the pre-1990 period (Mammen and Paxson, 2000) and within countries over time (Luci, 2009; Tam, 2011; Hiller, 2014). By contrast, Gaddis and Klasen (2014) and Klasen (2019) do not find strong empirical support for the feminization U hypothesis. They challenge the previous evidence by demonstrating that the U-shaped relationship is highly sensitive to the choice of data source. Moreover, they stress the importance of country-specific patterns of structural change by illustrating that sector-specific growth in value added is associated with different dynamics of female labour force participation. For instance, they observe that higher value added growth in mining and utilities is strongly and negatively associated with female labour force participation, while there is a positive but not very robust relationship with the growth in manufacturing value added, and a positive relationship with the growth in all service subsectors. This observation points towards country-specific differences in the relationship between economic development and women's participation in the economy.³ In addition, and partly reflecting the failure to find robust empirical support for the feminization U hypothesis, Eastin and Prakash (2013) argue in favour of a feminization S hypothesis, which consists of three stages: gender equality increases during the initial stages of development, then decreases or decelerates, and finally increases again beyond a certain economic threshold. They find support for their hypothesis in the dataset covering 146 developing countries for the period 1980–2005. The policy implications for the S-shaped hypothesis differ from those for the U-shaped hypothesis, emphasizing the risks of the intermediate phase as opposed to the early stages of development in the case of the feminization

friendly” policies, including parental leave and part-time work entitlements, have contributed to a decrease in female labour force participation (Blau and Kahn, 2013).

³ Country studies provide very mixed evidence. For instance, in a study for South Africa, Roncolato (2016) reveals a U-shaped relationship between the share of non-agricultural employment and women's probability of participating in the labour force. In turn, little evidence for the U shape of female labour market participation is found in India (Lahoti and Swaminathan, 2016), in the Middle East and in the North Africa region (Verme, 2015).

U hypothesis, when policy measures to foster gender equality may be necessary. The feminization S hypothesis, however, faces the same limitations as the feminization U hypothesis, namely, it presumes that there is a universally valid trajectory of economic development. Another common limitation of the studies that empirically investigate the feminization U hypothesis is that they focus on patterns of female employment (e.g. female labour force participation rates) and disregard patterns of male employment.

In sum, while early studies, characterized by a simpler design and a focus on currently advanced economies, suggested that these economies may have transitioned through the U shape over the course of their economic development, more recent studies based on panel data, which account for within-country developments over time and include currently developing countries, do not necessarily substantiate the feminization U theory. Instead, they demonstrate that the relationship between economic development and gender equality is country-specific and that it depends on factors such as region-specific patterns of structural change. In terms of policy, the results suggest that local factors, such as the region's initial conditions, factor endowments, historical contingencies, prevailing norms and values, country-specific sectoral changes, domestic labour market policies and trends, as well as policies to directly promote female employment opportunities are likely to be more important drivers of female participation in the economy than certain general trends (Gaddis and Klasen, 2014; Klasen, 2019).

3.2 What drives the relationship between economic development and gender equality?

While the above discussion suggests a close relationship between gender equality and economic development, the question remains whether the existing evidence supports the premise that policies that reduce gender inequality foster growth. As emphasized by Bandiera and Natraj (2013), most cross-country studies do not identify the direction of causality. For example, lower gender gaps in education in more developed countries could be attributable to the fact that gender equality in educational attainment promotes economic development or vice versa. Thus, policies that foster gender equality in educational attainment do not necessarily contribute to economic development unless causality runs from equality to development. Duflo (2012) provides a comprehensive overview of the bidirectional relationship between women's empowerment and development. One of the important conclusions from Duflo's study is that the potential for women's empowerment and economic development to mutually reinforce each other should not be overestimated. Instead, continuous policy commitment to equality in and of itself may be necessary to achieve gender equality.

Bandiera and Natraj (2013) stress that existing cross-country studies are silent on the mechanisms that drive the relationship between gender equality and development. This is partly because most existing cross-country studies are conducted at the macro-level, while there is a lack of micro-level studies which are more suitable for uncovering the underlying mechanisms. Identifying these mechanisms, however, is crucial to design constructive policies. Policies aimed at spurring economic development by promoting gender equality focused primarily on achieving gender parity in educational attainment, because cross-country studies robustly support that a reduction of gender gaps in education leads to higher economic growth (Klasen, 2018; Minasyan et al., 2019) and human development (Ferrant, 2015). The rationale for such policies is that increased schooling of females raises their prospective earnings and thus serves as a strong incentive for labour market participation. Indeed, empirical evidence supports a positive relationship between increases in female education and higher female labour market participation (Heath and Jayachandran, 2018). Moreover, increased education changes women's attitudes towards traditional roles in the household, increases their age at first marriage, improves female bargaining power within households, decreases fertility and positively affects offspring's health and endowment in human capital (Diebolt and Perrin, 2013; Benavot, 1989). According to the World Development Report (2012), substantial progress has been made in closing the gender gaps in education at all levels, i.e. at the primary, secondary and tertiary levels, and most countries have reached gender parity in primary education enrolment.

In turn, economic development can promote gender equality in several ways. First, technological advances lead to the emergence of jobs, for instance, in services, that rely less on physical strength, or brawn, and are thus more appropriate for female labour. This decreases men's comparative advantage in tasks requiring brawn, increases female labour productivity, and leads to higher returns on women's education and labour market participation (Galor and Weil, 1996). A historical study of gender division of labour in silk manufacturing in 18th century Spain reveals that the introduction of a more advanced spindle type for silk reeling that required less brawn and could be handled by women changed the gender composition of employment in this particular activity. As the textile industry was very labour-intensive, this innovation allowed silk manufacturers to substantially reduce labour costs and governments to reallocate the male workforce to agriculture, public works and the army (Sarasúa, 2008). More recently, in a study of Brazil, Mexico, India and Thailand, Rendall (2013) highlights the importance of structural change in reducing gender disparity in both wages and labour force participation by decreasing the demand for physically demanding labour. Heath and Mobarak (2015) report that manufacturing growth in the Bangladeshi garment industry has led to higher educational attainment of women, employment outside of the garment industry, and the delay of marriage and childbirth. The

demand for education generated by manufacturing growth seems to have a much larger effect on female educational attainment than large-scale government cash transfer programmes to encourage female schooling in Bangladesh.

Second, more developed countries have more resources to invest in accessible education systems and better health care systems which decreases the health risk associated with childbearing. Third, women generally have primary responsibility for household chores, and technological progress makes these tasks more efficient and less labour-intensive, for instance, by means of technological innovations such as the refrigerator, vacuum cleaner and washing machine (Jayachandran, 2015; Greenwood et al., 2005). Fourth, the process of development may lead to the adoption of institutions that favour gender equality, such as strengthening women's property rights (Fernandez, 2014) and political rights, including extending voting rights to women (Bertocchi, 2011). Doepke and Tertilt (2009) and Doepke et al. (2012) argue that the ultimate cause for the expansion of women's rights is technological change, which increases the return to education. According to their theory, men prefer patriarchy, if technological change does not lead to higher returns to education, i.e. if human capital is irrelevant. By contrast, technological change that leads to high returns to education prompts men to take an interest in the education of their descendants, leading them to support women's rights.

Moreover, economic development may positively affect gender equality through international trade. Gender discrimination in social institutions, such as formal and informal laws, values and attitudes related to traditions and cultural practices, increases gender inequality in educational attainment and labour market participation in developing countries (Fontanella et al., 2020). In a globalized world, gender discrimination becomes economically inefficient, particularly if the country specializes in the export of goods and services that both men and women are equally well suited to perform (Do et al., 2011). In line with this argument, Black and Brainerd (2004) demonstrate that trade appears to benefit women by reducing firms' ability to discriminate. Furthermore, globalization and openness to international trade has increased access to information, primarily through wider exposure to television and the Internet, allowing countries to learn about more equal social norms in more developed countries and encouraging them to adopt these norms (World Development Report, 2012).

A comprehensive survey of literature on the complex relationship between trade and women's labour market outcomes is provided in the studies of Papyrakis et al. (2012) and Fontana (2009). The authors conclude that the evidence for developing countries points to an overall beneficial impact of trade expansion on female employment, both relative to male employment and in

absolute terms, although largely concentrated in unskilled manufacturing.⁴ Moreover, the evidence suggests a widening gender wage gap as a result of trade liberalization, although this evidence is more sparse than that on gender gaps in employment and is mixed. For instance, Seguino (2000) finds that gender wage discrimination in export-oriented, semi-industrialized countries may have contributed to economic growth during 1975–1995, because low wages for female workers in export industries may be conducive to fostering investments and exports, and consequently, economic growth in general. The results of a cross-country study by Busse and Spielmann (2006) partly support this claim by demonstrating that countries with higher gender wage gaps have higher exports of labour-intensive goods, although they do not prove that this can actually lead to economic growth. Schober and Winter-Ebmer (2011) replicate Seguino’s study (2000) using comparable wage discrimination data, and do not find any evidence that more discrimination might foster economic growth. On the contrary, their findings suggest that gender wage inequality has a negative impact on growth. In addition, Robertson et al. (2020) show that apparel exports benefitted women in Cambodia and Sri Lanka, evidenced by a positive wage premium and the decreasing male-female wage gap.

In sum, while women’s empowerment and economic development are closely related, the relationship moves in both directions. While development can advance women’s empowerment in several ways as outlined above, empowering women may actually benefit economic development as well. The latter provides an incentive to actively support policies that promote women, in addition to the rationale that equity in itself is valuable. One of the main insights gleaned from the literature is that the potential of women’s empowerment and economic development to mutually reinforce each other should not be overestimated (Duflo, 2012), owing to the existence of region-specific cultural factors that determine the prevailing gender roles in society (Jayachandran, 2015). These culture-specific social norms and values tend to be long-lasting (Alesina et al., 2013). Thus, continuous policy commitment and efforts, which account for the region-specific economic, cultural and historical conditions, may be necessary to achieve gender equality.

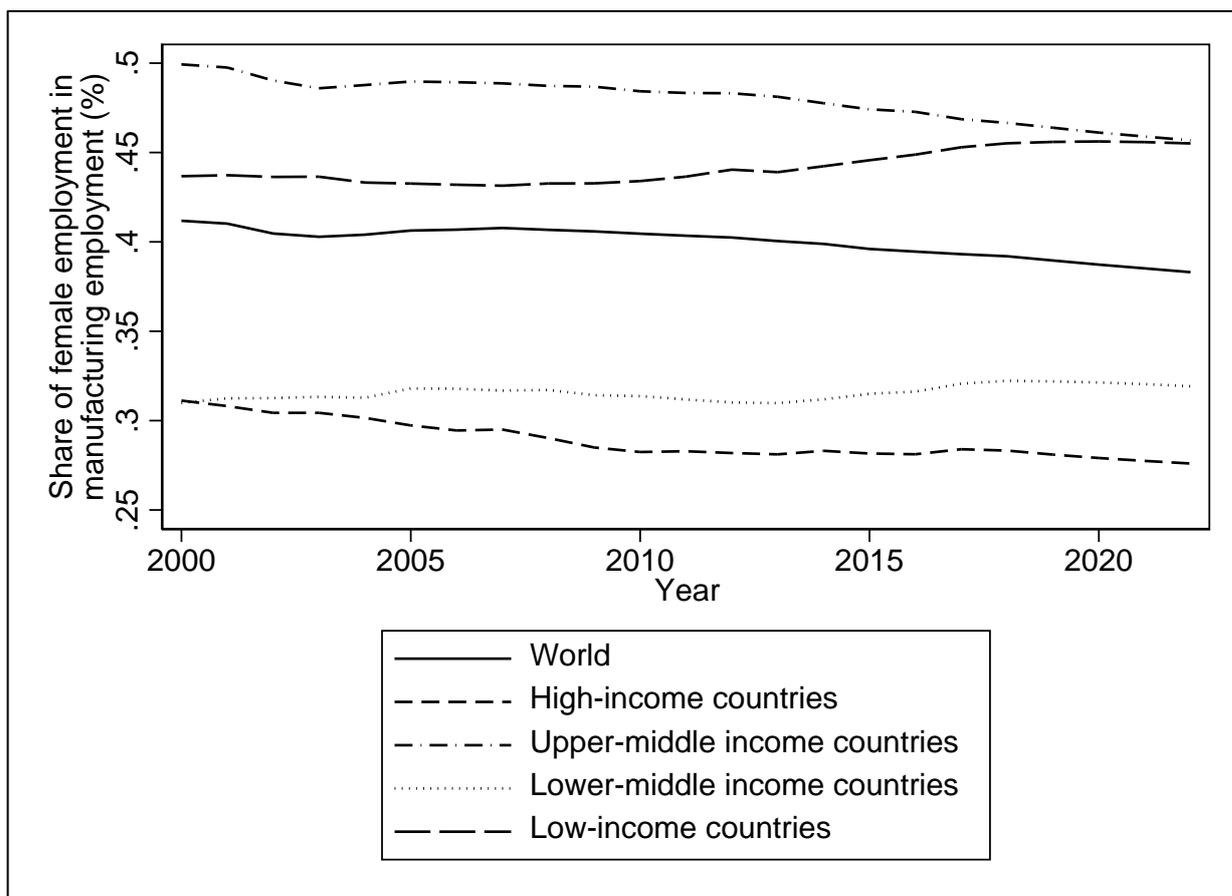
⁴ See also Jenkins and Sen (2006), who find that international trade is positively associated with the net creation of jobs in manufacturing in Bangladesh and Viet Nam, with female workers being the key beneficiaries. Moreover, Do et al. (2014) report that countries with a comparative advantage in female labour-intensive goods are characterized by lower fertility. It should be noted, however, that trade expansion with non-OECD countries resulted in a decline of manufacturing employment in OECD countries, which affected females more than males, and which is mostly attributable to employment changes in the textile, apparel, leather and leather goods industry (Kucera and Milberg, 2000).

3.3 Trends in female labour force participation in developing countries' manufacturing sector

In recent decades, many countries, both developed and developing, have witnessed dramatic feminization of labour, that is, an increase in female labour market participation rates. The literature that attempts to explain this trend, for instance, the feminization U theory discussed above, has mostly focused on female labour market participation rates in general, largely neglecting the developments of female labour market participation across sectors. A study by Kucera and Tejani (2014) addresses the impacts of structural change on female employment in manufacturing for 36 countries at different stages of development. They find that technological upgrading within labour-intensive industries contributed most to changes in the share of females in total manufacturing employment. Specifically, technological upgrading within labour-intensive industries such as textile and apparel has been the largest driver of defeminization in these industries. Although the causes of defeminization occurring alongside technological upgrading are not well understood, this might suggest that in the context of technological upgrading, employers' preference is for male workers as these industries become more capital-intensive.⁵ In a related study focusing on Southeast Asia and Latin America, Tejani and Milberg (2016) report a strong cross-country variation of the share of female employment in manufacturing, with feminization trends in some countries and defeminization in others. They further find that the capital intensity of production in these regions is associated with the defeminization of employment in manufacturing.

⁵ This is consistent with Caraway (2007), who argues that there is a strong relationship between export-oriented industrialization and feminization of labour, because export-oriented industrialization encourages employment growth in labour-intensive sectors. Technological upgrading in such sectors leads to the expansion of employment in capital-intensive sectors which, in turn, leads to defeminization of labour.

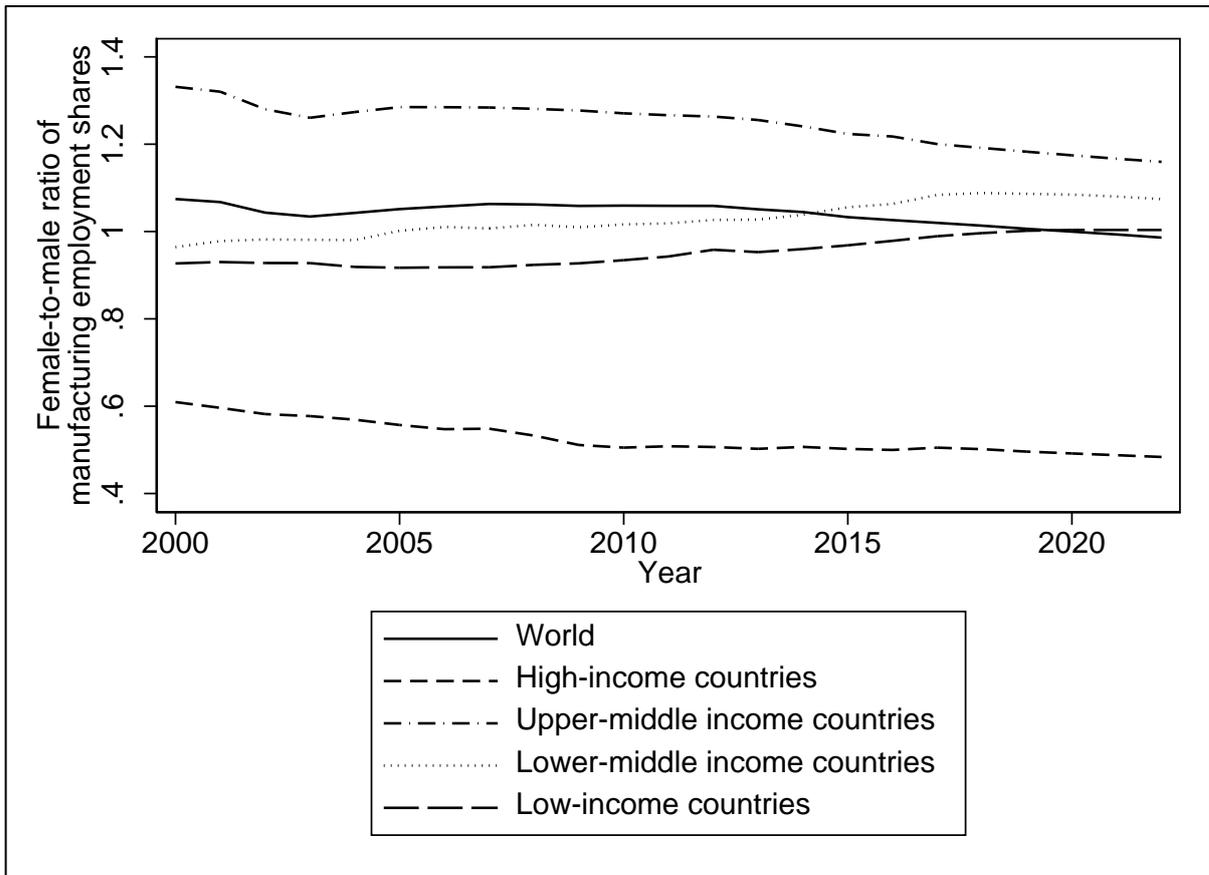
Figure 1: Share of female employment in total manufacturing employment, in %



Notes: The share of female employment in total manufacturing employment is calculated as the number of female workers in manufacturing, divided by the total number of workers in manufacturing (ILO modelled estimates until 2022).

Source: Author's own calculations based on ILOSTAT data.

Figure 2: Female-to-male ratio of employment shares in manufacturing



Notes: The female-to-male ratio is calculated as the share of manufacturing employment in total female employment, divided by the share of manufacturing employment in total male employment (ILO modelled estimates until 2022).

Source: Author's own calculations based on ILOSTAT data.

Figure 1 shows the development of the share of female employment in total manufacturing employment in countries at different income levels for the last two decades. High-income countries have the lowest share of females in manufacturing employment (about 30 per cent on average), indicating a declining trend over time. Low-income countries and upper middle-income countries have the highest shares of female workers in manufacturing (about 45 per cent on average for the end of the observation period). Low-income countries represent the only group for which an increase in the share of females in manufacturing is observed over time. Figure 2 presents the female-to-male ratio of employment shares in manufacturing, accounting for general employment dynamics in the respective groups of countries. This implies that the female-to-male ratio in manufacturing employment is increasing in low-income and in lower middle-income countries only, while all other country groups indicate a decreasing trend. These observations are consistent with the above presented evidence suggesting that countries at a lower stage of development rely more heavily on labour-intensive manufacturing industries, in which female

labour is in high demand. Capital-intensive industries gain more weight as the economy develops, which is associated with a decreasing share of female employment in manufacturing.

In sum, the global feminization of labour is not a general trend for all sectors of the economy. In addition to increasing shares of female employment in services, the evidence suggests that the feminization of labour in manufacturing is primarily related to labour-intensive industries. Technological upgrading within these industries leads to higher employment growth in capital-intensive industries, which is associated with the defeminization of labour. It is unclear, however, what the reasons are for the declining share of female employment in manufacturing at later stages of economic development. A potential explanation is that women do not possess the necessary skills that would allow them to compete with men in capital-intensive manufacturing industries (Sorgner, 2019). Other possible explanations include, for instance, increased opportunities for women to work in other sectors, such as services, and employers' preferences for male workers in capital-intensive manufacturing industries.

4. Recent developments and the current state of gender equality in industrializing and non-industrializing developing countries

This section describes recent developments of gender equality in different spheres, and its relationship with economic development and structural change. The focus of the data analysis is on currently developing countries for the period between 1991 and 2018. Most studies described in the previous sections focused on much earlier periods, and have rarely covered more recent years. The methodology used builds on the study by Haraguchi et al. (2019), who developed a technique to identify developing countries that exhibit a pattern of industrialization and can therefore be considered to be industrializers. This methodology is applied in the present analysis to shed more light on how industrialization is related to different types of gender inequality during the period of study.

4.1 Data sources and methods

4.1.1 Indicators of gender inequality

Several data sources provide indicators of gender inequality that are comparable across countries and that are available for a large number of developing countries. This paper uses a wide set of aggregated and domain-specific indicators of gender inequality. For instance, the Gender Inequality Index (GII) developed by the UN Development Programme (UNDP) measures gender inequalities in three areas, namely reproductive health, measured by the maternal mortality ratio and adolescent birth rates; empowerment, measured by the share of parliamentary seats occupied by females, as well as the proportion of adult females and males aged 25 years and older with at

least some secondary education; and finally, labour market participation, measured as the labour force participation rate of females and males aged 15 years and older. The GII is built on the same framework as the inequality-adjusted human development index (IHDI), which has also been developed by the UNDP. Since it measures the human development costs of gender inequality, higher GII values indicate higher disparities between females and males and therefore, higher losses to human development. The GII is available for the years 1995, 2000, 2005, and from 2010 until 2018.⁶

Moreover, the global indicator framework for Sustainable Development Goals (SDGs) proposes domain-specific indicators to measure the progress in each SDG (United Nations, 2020). The progress made in achieving gender equality and empowering all women and girls, which lies at the core of the fifth SDG, is measured by means of indicators that allow the monitoring of the achieved state of gender equality in terms of employment opportunities, opportunities for leadership at all levels of decision-making in political, economic and public life, reduction of vulnerable employment, promotion of health, ownership rights and technology use, among others. Thus, in addition to the aggregated measure of the GII, more specific gender inequality measures are used, which are related to gender differences in labour market participation, sectoral segregation, educational attainment, decision-making positions and earnings.

The labour force participation rate (LFPR) is one of the most important indicators of women's economic status. The World Bank provides gender disaggregated data on LFPR for the time period from 1991 until 2018, which are combined to a female-to-male ratio in LFPR to account for cross-country differences in overall labour force participation rates.

Moreover, there are substantial differences in the occupations held by women and men around the world. However, detailed data on the occupational distribution of men and women, which are comparable across many different countries, are largely missing, partly because different classification schemes are used in different countries. Thus, for the purposes of this analysis, the occupational classification is roughly approximated by the share of gender differences in sector-specific employment. Data for three main sectors, namely industry, services and agriculture, are available.

⁶ Other aggregated measures of gender inequality are, for instance, the Gender-Related Development Index (GDI) and the Gender Empowerment Measure (GEM) which has been developed by the UN Development Programme, the World Economic Forum's Global Gender Gap Index and the Social Institutions and Gender Index (SIGI) developed by Branisa et al. (2014). The GII measure was chosen for the purposes of the present analysis because it provides a more balanced indicator of gender inequality accounting for various areas including health, education and decision-making, and covers a longer time period compared to other available aggregated measures.

The quality of work also matters in addition to labour market inclusion. The World Bank provides gender-disaggregated data on vulnerable employment, which comprises contributing family workers, who are generally unpaid, and own-account workers (self-employed without hired employees) as a percentage of total employment. Contributing family workers and own-account workers are considered to be the most vulnerable social groups, since they are the least likely to have formal work arrangements and social protection, and are incapable of generating sufficient savings to offset economic shocks, and are therefore more likely to fall into poverty. The female-to-male ratio of vulnerable employment rates is calculated to measure gender disparity in vulnerable employment.

In addition, women's educational attainment is an important indicator of their economic status, because it influences their occupations and earnings. Gender differences in educational attainment are measured by the Gender Parity Index (GPI) in school enrolment at the primary, secondary and tertiary level. The GPI in school enrolment is constructed as the ratio of women to men enrolled at the primary, secondary or tertiary level in public and private schools. The literacy rate is another indicator for evaluating educational attainment. A high literacy rate suggests the capacity of an education system to provide a large population with opportunities to acquire literacy skills. The World Bank provides gender-disaggregated data on the adult literacy rate, which is calculated as the percentage of people aged 15 and above who can both read and write a short simple statement about their everyday life.

Moreover, the World Bank provides data on gender parity in decision-making positions. Data are available, for instance, on the percentage of parliamentary seats held by women in a single or lower chamber; the percentage of firms with a female top manager; and the percentage of firms with female participation in ownership.

Last but not least, gender wage gaps in monthly earnings were calculated based on data from ILOSTAT as the female-to-male ratio of average monthly earnings from paid employment.

4.1.2 Identification of industrializers

Since the focus of this study is on developing countries, the sample is limited to countries classified as low- or middle-income countries by the World Bank at the end of the observation period. Countries with an average population value of less than 1 million for the entire observation period are excluded from the analysis.

The main data source for indicators of economic development and structural change is the UN National Accounts Statistics. To account for cross-country differences in the level of economic development, data on real GDP per capita at constant 2015 prices (US dollars) and its annual rate of growth (in %) are used. To measure the level of industrialization, which is a major driver of economic development, data on annual manufacturing value added (MVA) at constant 2015 prices (US dollars) and its annual rate of growth (in %) are used.

To identify industrializing countries within the sample of developing countries, the methodology described in Haraguchi et al. (2019) is applied. The identification strategy proposed by the authors involves the following steps:

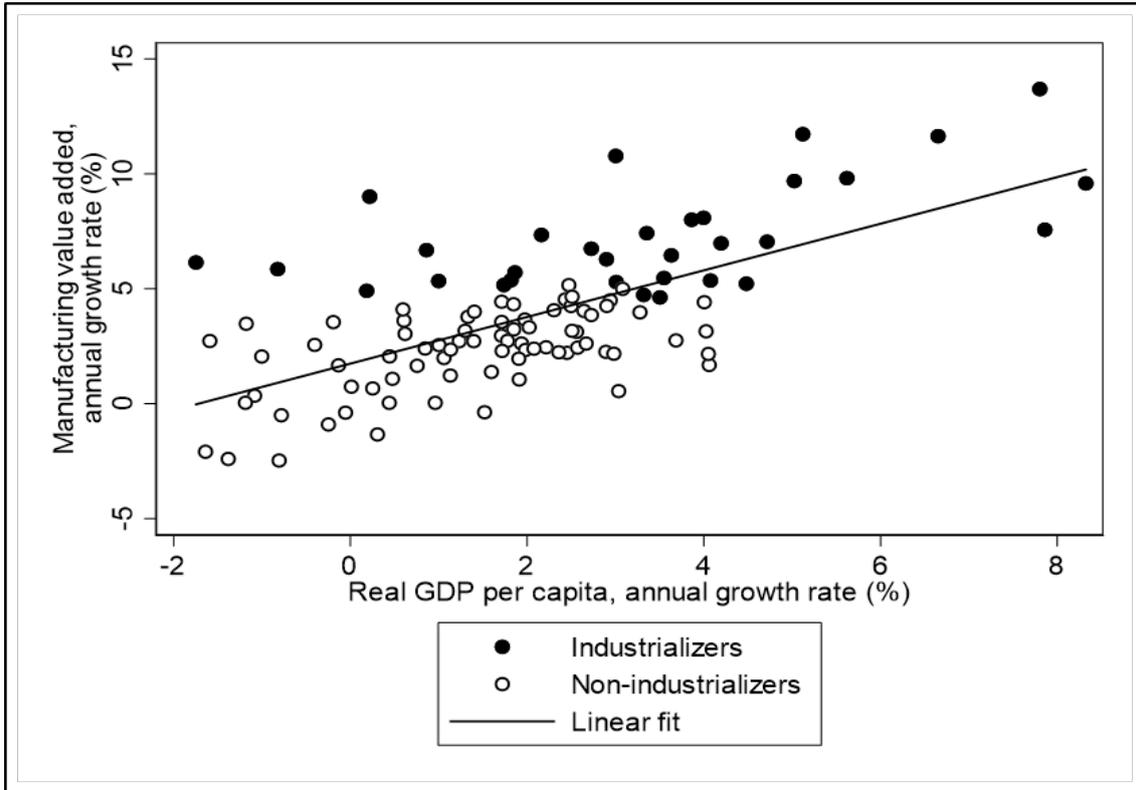
1. For each country, the average MVA growth rate during the period of analysis (1991–2018) must be higher than the average MVA growth rate for the entire sample;
2. For each country, an “episode” of industrialization is defined as any year in which the annual MVA growth rate is higher than the average annual MVA growth rate for the entire sample;
3. A country is classified as an “industrializer” if it experienced a higher number of industrialization episodes than the average number of such episodes for the entire sample.

The list of industrializing countries identified based on this methodology is presented in Table A 1 in the Appendix. About 26 per cent of all countries in the sample of developing countries were classified as industrializers.

Figure 3 supports the notion that economic growth is positively correlated with the level of industrialization, measured as the annual MVA growth rate. It also reveals that countries classified as industrializers according to the methodology described above are generally characterized by higher levels of real GDP per capita growth rates.⁷ Table 1 presents descriptive statistics for indicators of economic development and structural change separately for industrializing and non-industrializing developing countries. The results further support the view that industrializing countries experience economic development at a higher pace than non-industrializers. Moreover, there is a negative correlation between annual MVA growth rates and GDP per capita ($r=-0.145$), which suggests that industrializing countries are generally those at earlier stages of economic development.

⁷ This becomes even more pronounced when the data are disaggregated by region (see Figure A 1). A deviating pattern is only observed for the Middle East and North Africa region, where the relationship between average annual MVA and GDP per capita growth is negative, and industrializers have lower levels of GDP per capita growth rates.

Figure 3: MVA and GDP per capita, annual growth rates (%), average for 1991–2018



Notes: Only low- and middle-income countries according to the World Bank classification. Industrializing countries are identified following the methodology described in Haraguchi et al. (2019).

Source: Author's own calculations based on UN National Accounts Statistics.

Table 1: Economic development and structural change in industrializing and non-industrializing developing countries

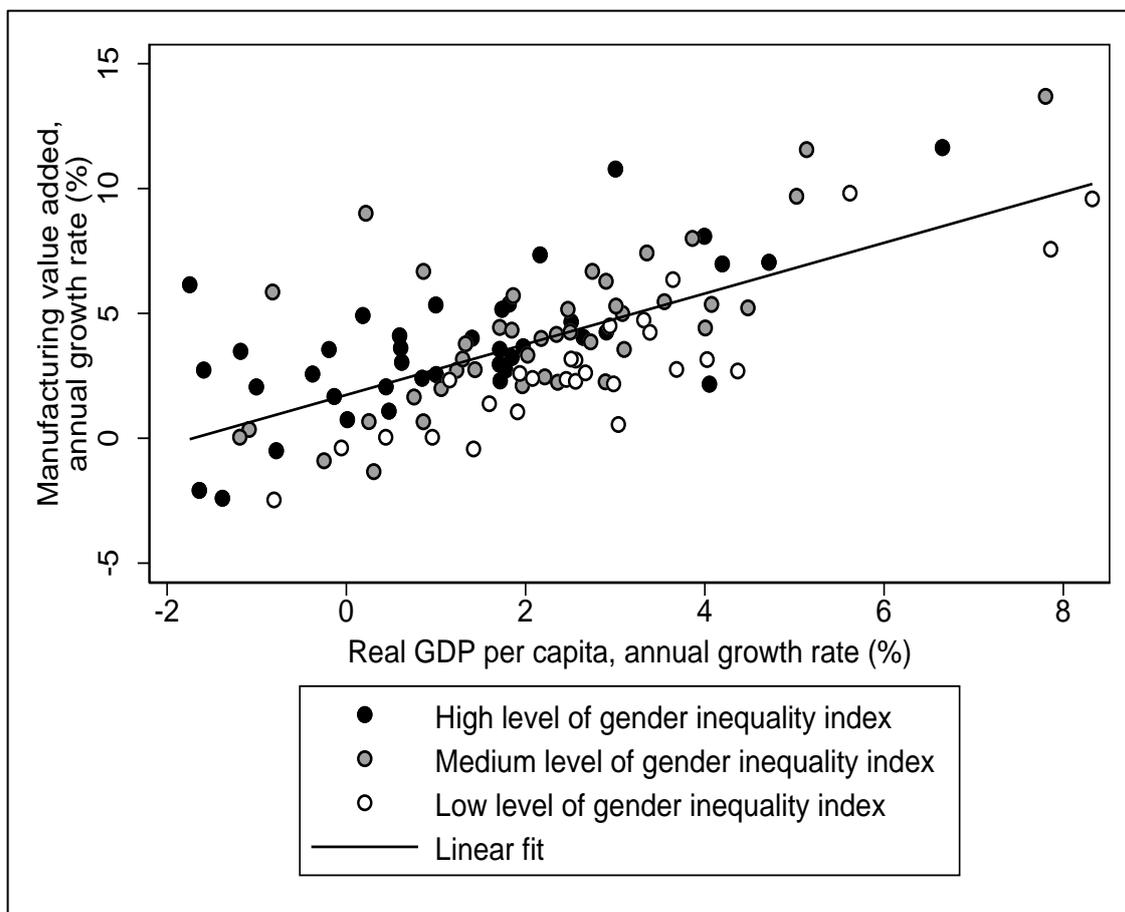
	Non-industrializers		Industrializers		Full sample	
	Real annual growth rate (%)	GDP annual growth rate (%)	Real GDP annual growth rate (%)	MVA annual growth rate (%)	Real GDP annual growth rate (%)	MVA annual growth rate (%)
Mean	1.44	2.31	3.36	9.86	2.01	4.58
Standard deviation	1.43	1.74	2.35	14.83	1.96	8.87
25th percentile	0.48	1.65	1.86	5.37	0.76	2.18
50th percentile	1.71	2.55	3.35	6.75	1.92	3.41
75th percentile	2.50	3.56	4.48	9.01	3.00	5.29

Source: Author's own calculations.

4.2 Results

Figure 4 sheds light on the general state of gender equality in developing countries at different stages of industrialization and economic development. It shows each country's annual MVA growth rate, GDP per capita and the state of gender inequality (high, medium or low) defined as a country's position in the distribution of the Gender Inequality Index (GII) for the entire sample (greater than the 75th percentile, between the 25th and 75th percentiles, and below the 25th percentile). Countries with relatively high levels of gender inequality (darker circles in the figure) are more likely to have a high annual MVA growth rate, which might suggest a negative relationship between industrialization and gender equality.

Figure 4: Gender inequality and annual growth rates of MVA and of GDP (in %), average for 1991–2018

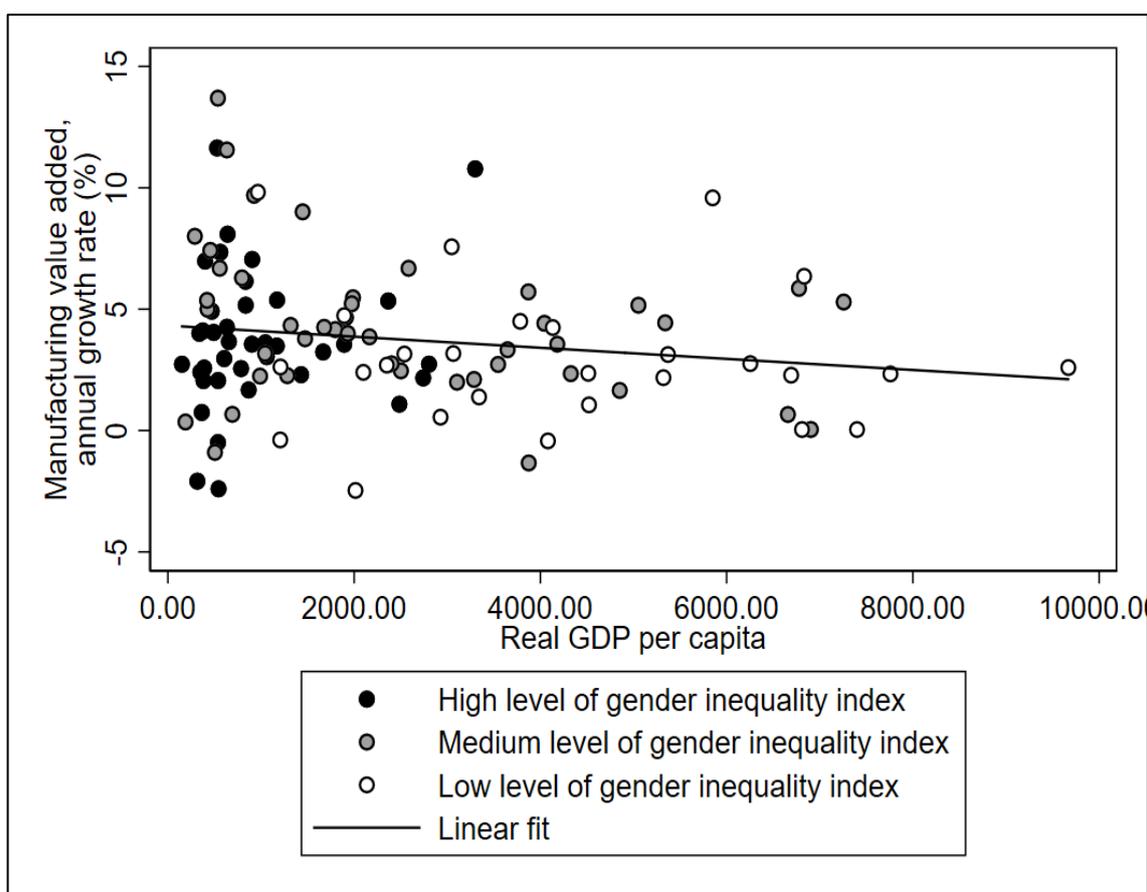


Notes: Data on the annual growth rates of MVA and GDP are from UN National Accounts Statistics. Data on the Gender Inequality Index (GII) are from the UN Development Programme. Only low- and middle-income countries according to the World Bank classification are considered. A high level of GII corresponds to values that are higher than the 75th percentile of the entire sample distribution; a medium GII level corresponds to values between the 25th and 75th percentile of the entire sample distribution; a low GII level corresponds to values below the 25th percentile of the entire sample distribution.

Source: Author's own calculations.

To further explore this relationship, Figure 5 illustrates that richer countries with a relatively high real GDP per capita level tend to have a lower annual MVA growth rate and are characterized by lower GII levels compared to poorer countries. This observation suggests that industrializing countries that are generally at lower stages of economic development are more likely to have higher levels of gender inequality. However, Figure 6 reveals that this finding is strongly region-specific. It shows that the relationship between the GII and annual MVA growth rates is strongly positive in the Middle East and North Africa region, while it is negative in “East Asia and Pacific” and “Europe and Central Asia”, and there is no pronounced relationship in other regions. A potential explanation for this finding is that the countries in these regions might be at different levels of economic development and structural change, or the sectoral structure of their economy may be different.

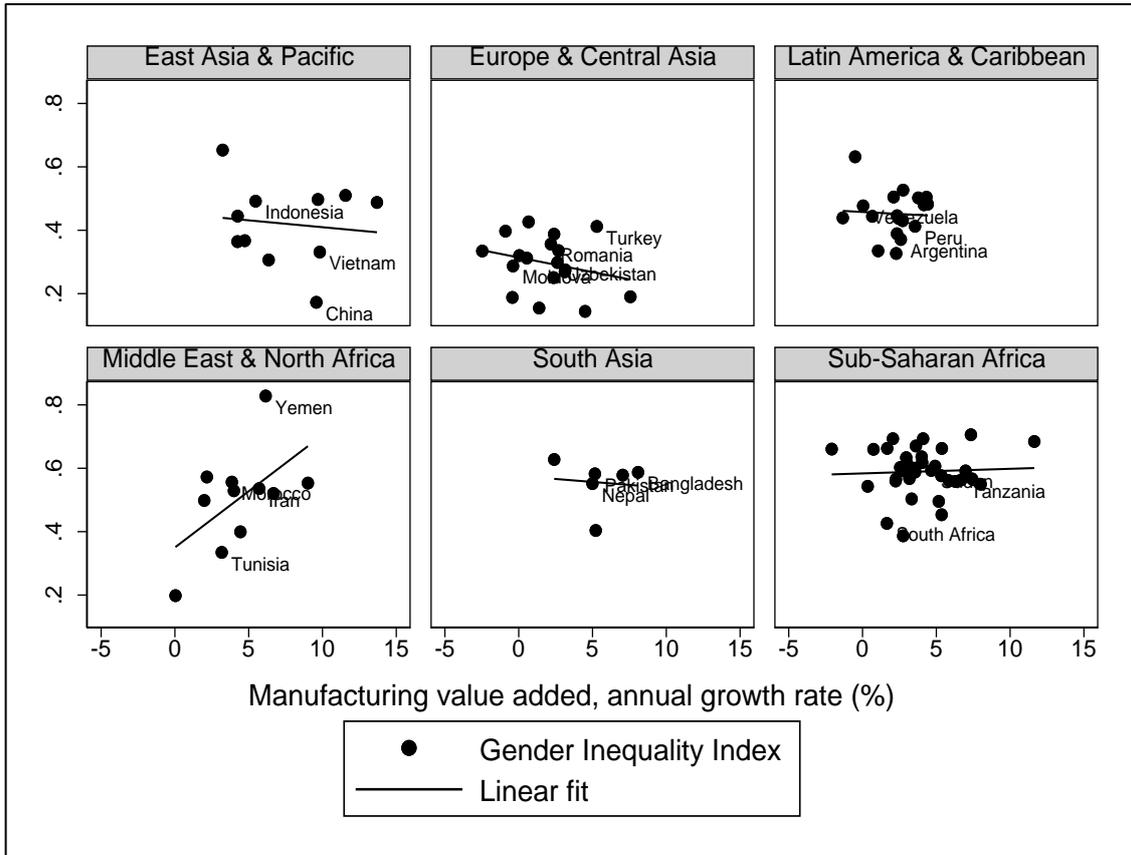
Figure 5: Gender inequality, annual MVA growth rate (in %), and real GDP per capita at constant 2015 prices (US dollars), average for 1991–2018



Notes: Data on annual MVA growth rate and real GDP per capita are from UN National Accounts Statistics. Data on the Gender Inequality Index (GII) are from the UN Development Programme. Only low- and middle-income countries according to the World Bank classification are considered. A high GII level corresponds to values that are higher than the 75th percentile of the entire sample distribution; a medium GII level corresponds to values between the 25th and 75th percentile of the entire sample distribution; a low GII level corresponds to values below the 25th percentile of the entire sample distribution.

Source: Author's own calculations.

Figure 6: Relationship between the GII and annual MVA growth rate, by region



Notes: Data on annual MVA growth rate are from UN National Accounts Statistics. Data on the Gender Inequality Index (GII) are from the UN Development Programme. Only low- and middle-income countries according to the World Bank classification are considered.

Source: Author's own calculations.

Table 2 presents the average values of different domain-specific indicators of gender equality in industrializing and non-industrializing countries. The table's results indicate that industrializing countries, on average, have a higher GII level than non-industrializing countries. As regards indicators of gender equality in labour force participation, industrializers compared with non-industrializers show a lower female-to-male ratio of labour force participation rates and a lower female-to-male ratio of employment shares in services, but a higher female-to-male ratio of employment shares in industry and in agriculture. Taken together, this indicates that industrializing countries are, on average, at earlier stages of structural change. As regards indicators of gender equality in educational attainment, the results suggest that the gender parity in primary school enrolment has been achieved in developing countries that are at different levels of development. Industrializing countries, however, show less gender parity in school enrolment at the secondary and tertiary levels and in adult literacy rates than non-industrializing countries. Moreover, industrializers show less gender equality in decision-making positions, as indicated by a lower share of parliamentary seats held by women and a lower share of firms with female top

managers or owners. Last but not least, the gender wage gap is wider among industrializers than among non-industrializers.

Table 2: Average values of gender equality indicators in industrializing and non-industrializing developing countries

	Non-industrializers	Industrializers	Full sample
<i>Aggregated indicator of gender equality</i>			
Gender Inequality Index (GII)	0.468	0.514	0.483
<i>Labour force participation</i>			
Female LFPR (in %)	51.52	51.55	51.53
Female-to-male ratio of LFPR	0.689	0.661	0.680
Female-to-male ratio of employment shares in industry	0.597	0.662	0.617
Female-to-male ratio of employment shares in services	1.234	0.999	1.163
Female-to-male ratio of employment shares in agriculture	0.911	1.170	0.990
Female-to-male ratio of vulnerable employment rates	1.134	1.153	1.139
<i>Educational attainment</i>			
Gender Parity Index (GPI) in school enrolment at primary level	0.924	0.923	0.924
Gender Parity Index (GPI) in school enrolment at secondary level	0.903	0.858	0.889
Gender Parity Index (GPI) in school enrolment at tertiary level	0.932	0.766	0.879
Female-to-male ratio of adult literacy rates	.853	.796	.838

Decision-making positions

Share of parliamentary seats held by women (in %)	16.440	16.011	16.326
Share of firms with female top managers (in %)	17.621	17.287	17.530
Share of firms with female participation in ownership (in %)	32.791	29.159	31.839

Earnings differentials

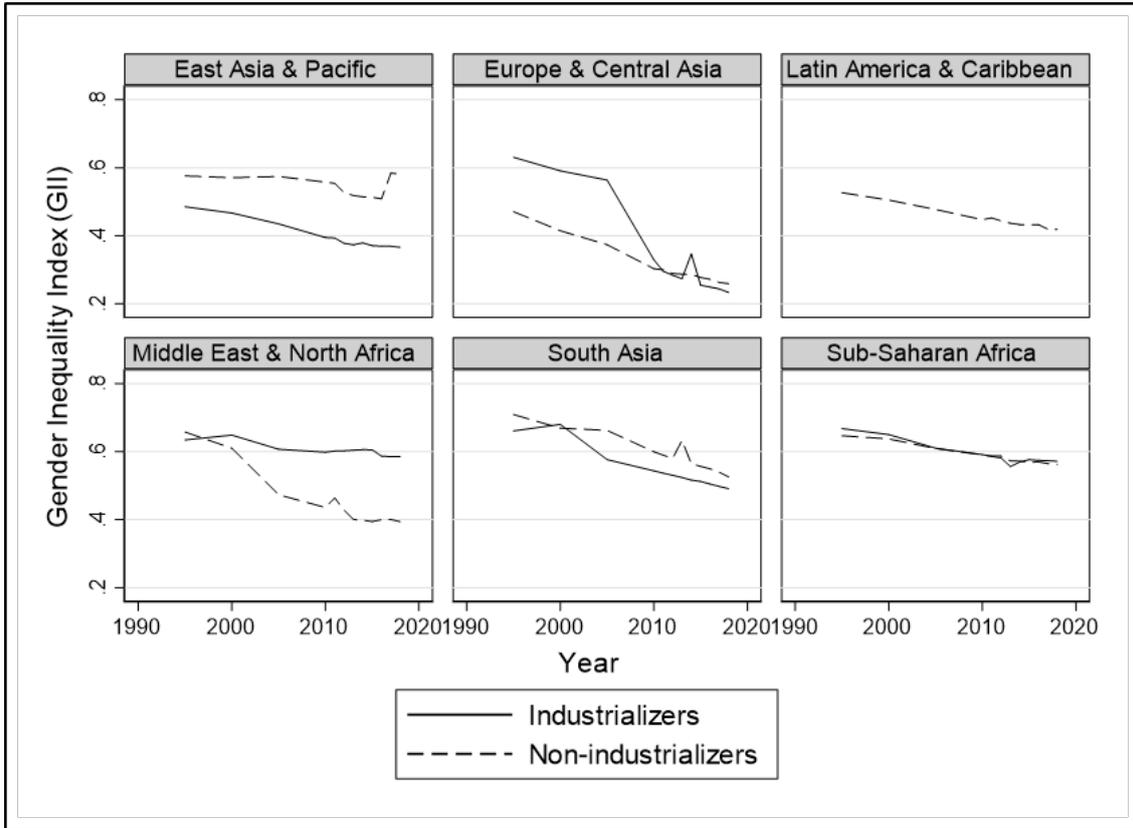
Female-to-male ratio of monthly earnings	0.841	0.825	0.837
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Source: Author's own calculations.

There seem to be strong regional differences in the relationship between gender equality indicators and industrialization (see Table A 2 in the Appendix). For instance, industrializing countries in East Asia and South Asia have lower GII values than non-industrializing countries, thus indicating higher levels of gender equality. As regards gender equality in labour force participation, industrializing countries across regions seem to have lower female-to-male ratios of labour force participation rates, but higher female-to-male ratios of employment shares in industry in comparison to non-industrializers. The only exception is sub-Saharan Africa, where the opposite seems to be the case. As regards gender parity in educational attainment, the case of South Asia appears to be specific, because industrializers in this region are close to achieving gender parity in these indicators, including tertiary level enrolment, but non-industrializers show strong gaps in this respect. As to gender equality in decision-making positions, industrializers in the Middle East and North Africa and in the South Asia regions have a lower proportion of parliamentary seats held by women than non-industrializers, which differs from other regions. However, the share of firms with female top managers or female participation in the ownership is lower among industrializers than among non-industrializers in nearly all regions. Finally, the gender wage gaps are much wider in industrializing than in non-industrializing countries in East Asia, which seems to be specific to this particular region.

While the descriptive results presented so far suggest that industrializing developing countries are generally less gender equal than non-industrializing developing countries, it is important to analyse the development of gender equality in these countries over time. This will shed some light on whether the process of industrialization increased or decreased gender equality over time.

Figure 7: Development of the Gender Inequality Index by region, over time (1995–2018)



Notes: Data on the Gender Inequality Index (GII) are from the UN Development Programme. Only low- and middle-income countries according to the World Bank classification. Industrializing countries are identified following the methodology described in Haraguchi et al. (2019).

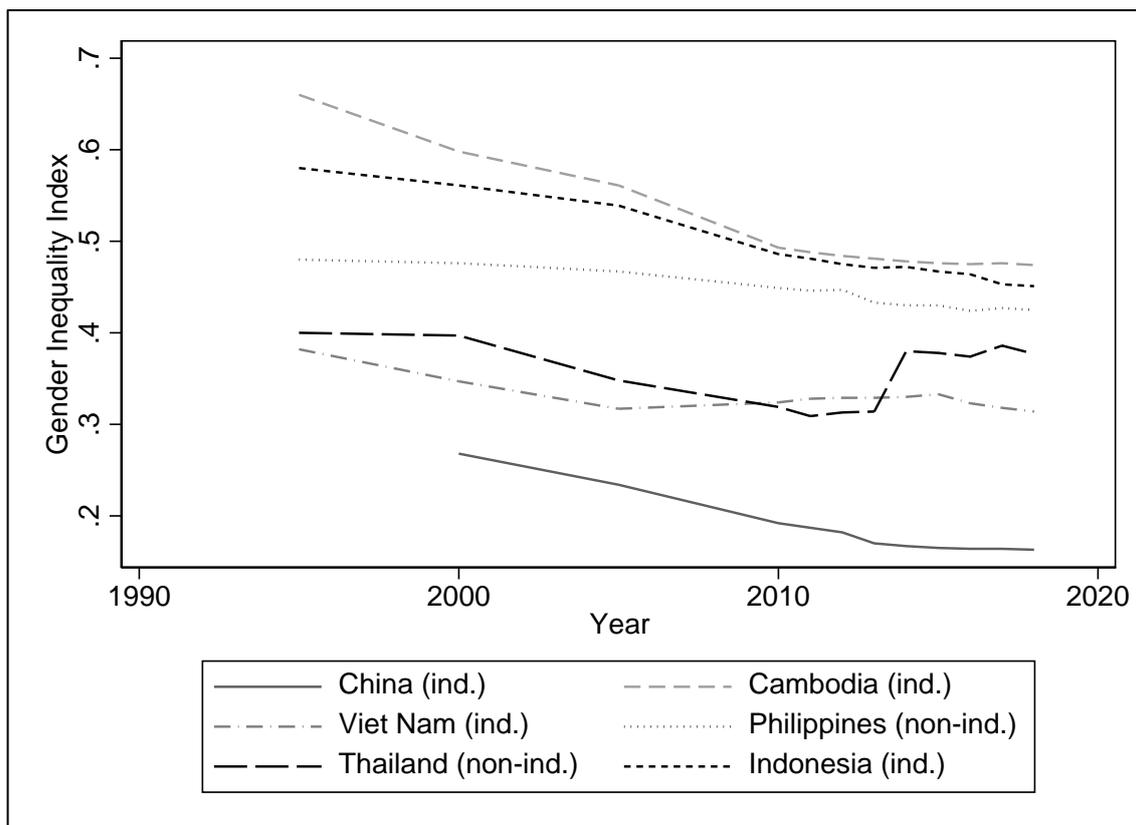
Source: Author’s own calculations.

There was a continuous decline in the level of the Gender Inequality Index (GII) in all regions over the past three decades, as shown in Figure 7. This suggests that the general state of gender equality has improved substantially over the last 30 years in both industrializing and in non-industrializing developing countries. The GII level of the entire sample decreased from 0.61 in 1995 to 0.45 in 2018. There are, however, several differences across regions that are noteworthy. In the East Asia and Pacific region, the decline in the Gender Inequality Index was much more pronounced in industrializing than in non-industrializing countries. In non-industrializing Eastern Asian countries, the GII has actually increased over the last years, which is not the case for any other region. This development differed considerably in the Middle East and North Africa, where industrializers have a very high GII level without any substantial change over time, while the decrease was very pronounced in non-industrializing countries. These differences suggest that the relationship between industrialization and gender equality is strongly region- or even country-specific. Furthermore, industrializers in South Asia are slightly more gender equal compared to non-industrializers. Industrializers in Europe and Central Asia have been substantially less gender

equal than non-industrializers until 2010, when both types of economies reached approximately the same GII level. The GII is at about the same level among industrializers and non-industrializers in sub-Saharan Africa. No industrializing countries could be identified for Latin America based on the methodology described above.

Since the East Asia, Middle East and North Africa regions represent a particular case as regards the relationship between industrialization and gender equality, Figure 8 and Figure 9 illustrate the development of the GII over time in selected industrializing and non-industrializing countries in these regions. China recorded the lowest GII level among East Asian countries. In the two non-industrializing countries of this region, Thailand and the Philippines, the GII level did not change substantially over time. Moreover, the Middle East and North Africa region represent another unique case, because the GII levels remained nearly unchanged over time in these regions' industrializing countries. Figure 9 shows that this was mainly attributable to Yemen, which is the only country in the region where the GII slightly increased over time.

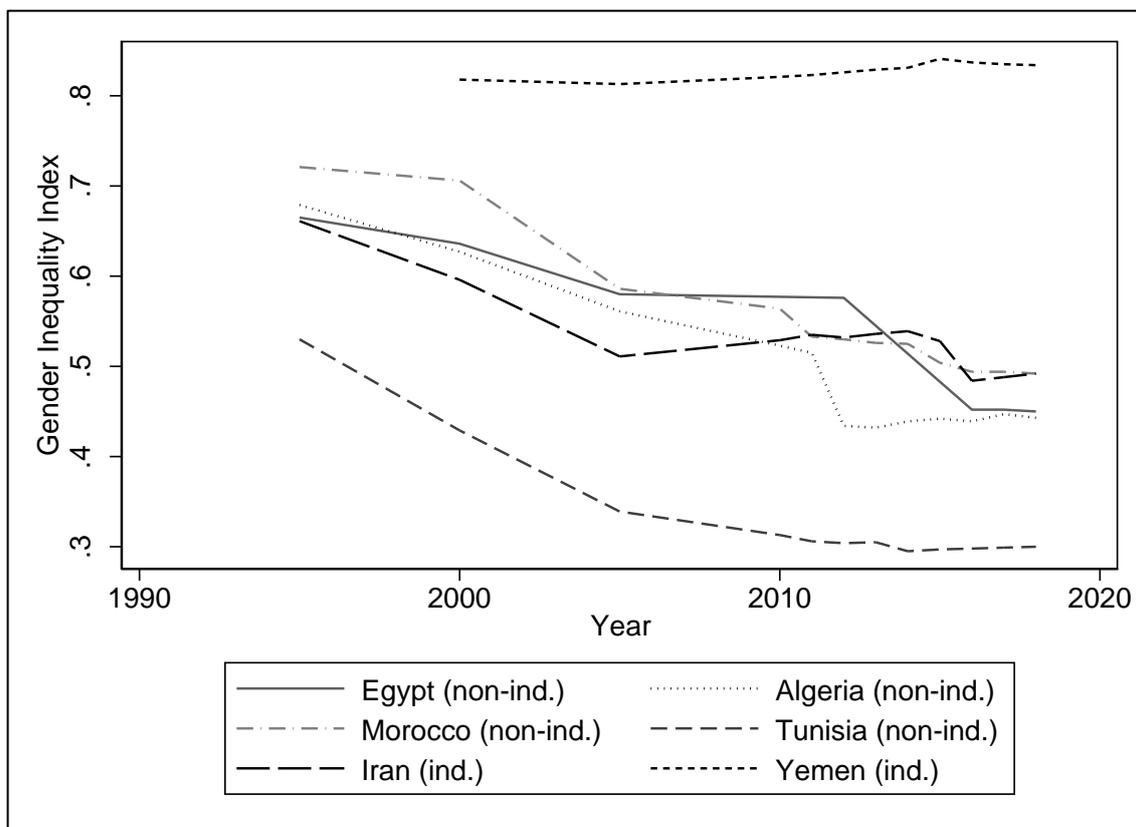
Figure 8: Development of the Gender Inequality Index in selected industrializing and non-industrializing countries in the East Asia and Pacific region over time (1995–2018)



Notes: Data on the Gender Inequality Index (GII) are from the UN Development Programme. Only low- and middle-income countries according to the World Bank classification. Industrializing countries are identified following the methodology described in Haraguchi et al. (2019).

Source: Author's own calculations.

Figure 9: Development of the Gender Inequality Index for selected industrializing and non-industrializing countries in the East Asia and Pacific region over time (1995–2018)



Notes: Data on the Gender Inequality Index (GII) are from the UN Development Programme. Only low- and middle-income countries according to the World Bank classification. Industrializing countries are identified following the methodology described in Haraguchi et al. (2019).

Source: Author's own calculations.

Figures A2-A6 in the Appendix present the development of various domain-specific indicators of gender equality over time separately for industrializing and non-industrializing countries in different regions. They reveal strong heterogeneity in the development of gender equality in different spheres within and across regions, and between industrializing and non-industrializing countries. In general, the female-to-male ratio in labour force participation rates has increased only slightly across regions over the last three decades, with industrializing countries in the Middle East and North Africa region showing a negative trend. Gender differences in the quality of employment, measured as a female-to-male ratio in vulnerable employment rates, are generally higher in industrializing countries than in non-industrializing countries, with an exception of the Middle East and North Africa region, suggesting that female workers in industrializing countries more frequently participate in vulnerable employment. Moreover, there are indications of defeminization of the industrial sector across regions, which is more pronounced in industrializing countries in the East Asia region. Industrializing countries in the Middle East and North Africa

region represent a specific case, however, in that feminization of the industrial sector is evident. This might indicate a catch-up effect owed to a relatively low level of female labour force participation in these countries. Finally, nearly all regions have shown positive developments in gender equality in educational attainment, with some regions demonstrating gender differences in favour of women.

In sum, the results presented in this section suggest that significant progress has been made in achieving more gender equality in different spheres across regions. Industrializing countries, which are generally at lower stages of economic development, show lower levels of gender equality than non-industrializing countries. This result, however, is highly heterogeneous across regions and across countries within regions. This might suggest that region-specific factors are at play, which could explain this heterogeneity. More research is needed, however, to better understand which local factors—socio-economic, cultural and historical—are particularly important moderators of the relationship between industrialization and gender equality.

5. New and emerging trends

This chapter discusses two recent trends, namely the emergence of Industry 4.0 and premature deindustrialization, and their consequences for gender equality in developing countries.

5.1 Gender and Industry 4.0

This section examines how Fourth Industrial Revolution (4IR) technologies alter the demand for skills in developing economies and how this development is likely to affect gender equality in those countries. The evidence presented in previous sections suggests that technological upgrading is associated with the defeminization of labour in manufacturing industries. Do the developments in new digital automation technologies represent a particular threat to female workers?

Only few studies have analysed the susceptibility of the female workforce to labour-replacing digital technologies. The focus of these studies is usually on gender-differences in skill endowments that could protect workers from losing their jobs to automation. This is based on the contention that certain tasks that require skills, such as manual dexterity, socio-emotional intelligence and creativity, represent bottlenecks to automation (Frey and Osborne, 2017; Autor et al., 2003). Workers who possess such skills are better shielded against the negative impacts of digitalization and automation on their jobs. Sorgner et al. (2017) study the effects of digitalization on gender equality in labour market participation in selected G20 countries. Following the methodology of Frey and Osborne (2017), who estimate occupation-specific computerization risks, Sorgner et al. show that this risk is not evenly distributed among women's and men's jobs.

They find that the computerization risk decreases with a rising level of formal education for both genders, but low-skilled women face lower risk of computerization, on average, than low-skilled men. This result is likely attributable to the fact that many jobs typically held by low-skilled women consist of high non-routine manual skills that still represent bottlenecks to automation, while low-skilled men are more likely to perform routine-intensive tasks that can easily be automated. Moreover, Brussevich et al. (2018) use the same measure of susceptibility of workers to digitalization and combine it with PIAAC data, which mostly cover developed OECD countries. Despite the strong variation of results between countries, they find that women are generally more likely than men to be substituted by machines. They further show that less educated and older female workers, as well as female workers in clerical, service and sales positions, are even more susceptible to automation in these countries.

Empirical evidence on the impacts of digitalization on gender equality in developing countries is scarce. Sorgner (2019) empirically analyses gender-specific differences in skill endowments based on the large representative STEP Skill Measurement Surveys of individuals residing in urban areas of selected developing and transition countries. The results indicate that women in developing and transition economies are significantly less likely than men to possess skills that protect them from labour-displacing digital technologies, such as analytical, non-routine manual, interpersonal, advanced ICT and socio-emotional skills. This result is robust across sectors, but gender differences are more pronounced in manufacturing than in services. Moreover, based on the methodology described in Fossen and Sorgner (2019), who distinguish between labour-displacing and labour-reinforcing digital technologies, Sorgner's study demonstrates that, in developing countries, women's jobs are more susceptible to labour-displacing digitalization than men's, and women have less opportunities for labour-reinforcing digitalization.

In the digital age, it is claimed that investments in soft skills, such as socio-emotional intelligence, are important to increase employment prospects. Thus, soft skills training programmes have become an increasingly common form of youth employment policy in developing countries, but to date, there is little evidence of their impact (Groh et al., 2016).⁸ Indeed, empirical evidence suggests that labour markets increasingly reward social skills, but primarily when these are combined with cognitive skills (Deming, 2017). It is widely believed that women have an advantage in soft skills, at least partly because of their care responsibilities in the household and

⁸ The reasons for this are not clear. It might be due to the relatively low quality of such training programmes. It might also be because investments in soft skills alone are insufficient, and should ideally be complemented by investments in hard skills, such as analytical skills. Another possible explanation is that soft skills acquired during actual work experience, for instance, in decision-making positions, might be more relevant than soft skills acquired during relatively short training programmes.

their work experience in jobs that generally require social skills. However, it is unlikely that the advantage in soft skills alone, if there is such an advantage, will substantially reduce gender inequality. It appears to be more important, particularly in the context of developing countries, to close the digital gender divide, which involves gender differences in the access to and use of digital technologies, as well as gender gaps in digital skills, and increasing women's participation in STEM (Science, Technology, Engineering, Mathematics) occupations (Mariscal et al., 2019).

In sum, empirical studies on the impacts of 4IR technologies on gender equality are still scarce, particularly for developing countries. The existing evidence suggests that female workers seem to be particularly vulnerable to the destructive digitalization of occupations because they lack skills that can be considered bottlenecks to computerization, such as analytical skills (e.g. numeracy skills), abstract skills (e.g. learning new things at work) and interpersonal skills (e.g. supervisory skills). New digital technologies will also require workers to have advanced ICT skills. The digital gender divide is, however, particularly large in developing countries: women in many developing countries currently only possess relatively low levels of ICT skills, and many of them lack access to digital technologies.

5.2 Premature deindustrialization and gender equality

Deindustrialization, or the decline in manufacturing employment, has been one of the most dramatic social changes in developed countries since the mid of the last century (Brady and Denniston, 2006). Deindustrialization is principally caused by rising productivity as measured by an inverted U-shaped relationship between GDP per capita and manufacturing employment (Rowthorn and Ramaswamy, 1997; Bluestone and Harrison, 2000). As a country's economy develops, agricultural employment is replaced by industrial employment. This occurs until a country reaches a point of industrial maturity, after which service jobs replace manufacturing jobs and service sector growth outpaces that of the industrial sector.

In turn, premature deindustrialization refers to a trend among late industrializers that are deindustrializing at earlier stages of development than their predecessors, which might have detrimental effects on economic growth in developing countries (Rodrik, 2016). Premature deindustrialization entails both lower levels of industrial employment at all stages of income and peaks in industrial employment at lower levels of GDP per capita. Rodrik (2016) documents that, with some exceptions that mostly involve Asian countries, developing countries have experienced falling manufacturing shares since the 1980s in both employment and real value added. This trend was particularly pronounced in Latin American countries. The driving forces behind developing economies' deindustrialization patterns seem to differ from those of advanced economies. While

technological progress was primarily responsible for deindustrialization in advanced economies, the main drivers of deindustrialization in currently developing countries seem to have been trade and globalization. Countries without a strong comparative advantage in manufacturing have become importers of manufacturing, while Asian countries that had a comparative advantage in manufacturing have remained largely unaffected by deindustrialization trends.

This change in deindustrialization patterns has occurred alongside changing patterns of women's share in employment in industry. While industrial upgrading has been defeminizing, there is a global tendency towards the feminization of employment. An emerging literature tries to link the trends of premature deindustrialization and of defeminization of manufacturing and industrial employment. For instance, Greenstein and Anderson (2017) empirically analyse this relationship for 62 countries spanning from 1990 to 2013. They identify premature deindustrializers based on a country's competitive position. Less competitive countries, the premature deindustrializers, experienced a later peak of manufacturing employment compared to more competitive countries. Greenstein and Anderson (2017) show that more competitive countries have higher relative rates of female employment in industry than premature deindustrializers, thus, supporting the hypothesis that premature deindustrialization is likely to amplify the male bias of industrial upgrading. Their analysis, however, included countries at different stages of development. Since trade and globalization appear to be more important drivers of deindustrialization in developing countries than technological progress and labour productivity growth, the results might differ considerably for different country groups.

Moreover, while the transition to a post-industrial society has reduced some gender inequalities, it is associated with its own characteristic inequalities, which are related, for instance, to the hollowing-out of the middle class, more flexible labour markets with a high share of insecure jobs, and the skewed spatial distribution of industries (Crouch, 2019; Goos et al., 2014). Assuming that these developments have a gender bias, the process of premature deindustrialization might involve the emergence of new types of gender inequality in developing countries.

In sum, the emerging literature on the impacts of premature deindustrialization on gender equality suggests that early deindustrialization might amplify the defeminization of manufacturing and industrial sectors in developing countries. Moreover, new types of gender inequality associated with the post-industrial stage of development may emerge.

6. Conclusions

This final section summarizes the main findings of this study and discusses their relevance for policymakers (section 0). Moreover, it identifies knowledge gaps and formulates research questions for future research (section 0).

6.1 Summary of findings and policy implications

As societies transition to more advanced stages of technological and economic development, an important question arises about how these processes affect gender equality in these societies. This paper aimed to provide a comprehensive literature review on the relationship between gender and industrialization in the context of developing countries. It started with a discussion on the literature focused on historical pre-industrial preconditions of contemporary gender inequality, for instance, in labour market participation. Studies in this strand of literature argue and provide empirical evidence that differences in many outcomes, such as female labour market participation, female participation in politics, and other gender roles, have their roots in local pre-industrial conditions. The transitioning of pre-industrial societies to a more advanced stage of technological development, such as the Neolithic Revolution and the use of more advanced technologies in agriculture, for example the plough, have likely contributed to the emergence and strengthening of gender-specific roles. One of the most striking results is that these roles tended to persist over time, even when societies transitioned to a more advanced stage of development. Policymakers can glean at least two important lessons from this finding. First, the determinants of gender equality are at least partly defined at a rather narrow level of regions defined within countries rather than at a broad level of nations. The existing initiatives to promote gender equality often disregard regional variations in the determinants of gender equality. However, regional differences in gender equality within a country are likely to be substantial, which is due to sectoral structure of regional economies, region-specific social norms and values regarding appropriate gender roles in a society, and local historical contingencies, among others. This implies that initiatives to promote gender equality should entail a location-based approach. The glocalization of efforts to promote gender equality seems to be a promising way to achieve this aim: while the promotion of gender equality is a global objective, it can best be achieved by considering local factors that might impact gender equality. Second, given the strong persistence of regional gender-specific roles over time, policymakers need to make a long-term commitment to fighting gender inequality. It is fairly unlikely that short-term measures, particularly if they do not account for local conditions, will be successful in promoting gender equality. In addition, comparable gender-disaggregated data should be made available at the level of regions defined within countries rather

than at the level of countries. This will allow for a better understanding of the regional differences in gender equality, their determinants and the developments over time.

The relationship between economic development, structural change and gender equality is quite complex. The evidence suggests that it is non-linear, bidirectional and country-specific. The non-linear relationship implies that policymakers, who aim to achieve sustainable economic development and simultaneously promote gender equality, may have to undertake different efforts depending on their country's level of economic development. The feminization U hypothesis states that gender inequality, indicated, for instance by a lower female labour market participation rate, increases in the earlier stages of economic development, when societies transition from agriculture-based economies to industrial economies, and decreases at a later stage of economic development. This implies that economic development in least developed countries coincides with increased gender inequality. The empirical evidence for the feminization U hypothesis in the context of currently developing countries is mixed, however, and points towards strong cross-country differences. A novel empirical analysis presented in this paper suggests that developing countries that industrialize at a high pace are generally less gender equal compared to developing countries with a lower speed of industrialization. This result varies significantly across regions and across countries within regions. This variation could be explained, for instance, by differences in the sectoral structure of developing countries' economies, which determine the availability of opportunities for female labour. Women in some developing countries, for example, had high labour market participation rates in certain manufacturing industries, such as textile and apparel, while a high share of mining and quarrying industries in the economy was associated with low female labour force participation rates.

Policymakers must be aware of the mechanisms through which economic development and structural change could promote gender equality to be able to design appropriate policies. These mechanisms—in addition to the creation of job opportunities that are more appropriate for female labour—include higher investments in more accessible education and health care systems, the strengthening of women's rights and openness to international trade, among others. Another important insight from the literature is that while the relationship between economic development and gender equality is bidirectional, the potential for women's empowerment and economic development to mutually reinforce each other should not be overestimated. Thus, continuous policy commitment to and efforts that account for region-specific economic, cultural and historical conditions may be necessary to achieve gender equality.

Moreover, the global feminization of labour is not a general trend in all sectors of an economy. The evidence suggests that the feminization of labour in manufacturing was primarily related to labour-intensive sectors. However, technological upgrading within these sectors in the course of economic development leads to higher employment growth in capital-intensive sectors, which, in turn, is associated with the defeminization of labour. This trend is particularly important in the context of Industry 4.0. One example is the textile industry, which experienced a strong decline in the share of female workers, even though this share is still high. This industry is characterized by strong transformations due to the introduction of so called Fourth Industrial Revolution (4IR) technologies. Given that these technologies have the potential to improve the quality of work by decreasing health risks (e.g. in occupations that are very physically demanding), jobs in the manufacturing sector may become more attractive for the female workforce in the future. It is therefore puzzling that the manufacturing sector is currently experiencing a strong decline in the share of female workers. One potential explanation for the defeminization of labour in manufacturing is that women do not possess the necessary skills that would allow them to compete with men in capital-intensive manufacturing industries. Other possible explanations include, for instance, a rise in opportunities for women to work in other sectors, such as services, and employers' preferences for male workers in capital-intensive manufacturing industries.

Given that new 4IR technologies are likely to have labour-displacing effects on workers with specific types of skills, existing research has investigated gender-specific differences in skill endowments. It appears that women in developing countries are less likely than men to possess skills that shield them from the labour-displacing effects of new digital technologies, such as analytical, non-routine manual, interpersonal, advanced ICT and socio-emotional skills. This result is robust across sectors, but gender differences are more pronounced in manufacturing than in services. Although considerable progress has been achieved in promoting gender equality in educational attainment, gender-specific differences in skill endowment are substantial. For instance, the lack of supervisory skills is likely due to a relatively low share of women in managerial positions. Moreover, developments in Industry 4.0 will result in a higher demand for workers with advanced ICT skills. However, the digital gender divide, that is, gender differences in the level of ICT skills and access to digital technologies, is particularly large in developing countries. Thus, education programmes specifically designed for women are needed to reduce the digital gender divide. Moreover, further action should be taken to improve opportunities for women to participate in managerial posts and other decision-making positions.

Finally, premature deindustrialization is a relatively new trend in developing countries and signifies a decreasing share of manufacturing employment among late industrializers at a lower level of economic development compared to early industrializers. Nascent literature emphasizes that this trend is likely to amplify the defeminization of the manufacturing labour. Furthermore, premature deindustrialization and the transition to post-industrial societies may result in new types of social inequalities, for instance, related to the hollowing-out of the middle class. Thus, these developments must be closely monitored in developing countries to identify the emergence of potentially new gender inequalities in a timely manner.

6.2 Open research questions

Based on the literature review conducted for this paper, several relevant research questions can be identified, which are worth investigating in the future.

For instance, a strong persistence of social norms and values across cultures on the role of men and women in a society has important implications for policymakers by suggesting that policies aimed at fostering gender equality should be continuous and should account for local historical conditions. However, research suggests that there is a pronounced heterogeneity in persistence patterns, which is not yet well understood. Hence, a promising research area would be the identification of factors that contribute to the long-term persistence of social norms and values that promote unequal gender roles, and under which conditions the persistence is weak or even absent. Among the possible factors that could be investigated are, for instance, environmental conditions, natural resources, the formal institutional framework, different patterns of structural change, as well as other characteristics of the socio-economic environment.

The relationship between economic development, structural change and gender equality remains rather ambiguous. Several recent studies, which employ more sophisticated empirical strategies compared to earlier studies, failed to confirm the feminization U hypothesis for currently developing economies. This might suggest that currently developing countries are more heterogeneous and that certain mechanisms are more relevant for some countries than for others. These mechanisms, which may possibly be related to local historical conditions, social norms and values on gender roles that have resulted from these conditions, the sector-specific structure of the economy and openness to international trade, among others, need to be explored in more detail in empirical studies. One possible direction for this research is to use micro-level panel data, which allows to distinguish between different mechanisms through which economic development and structural change can affect gender equality. It should be noted that the evidence on the relationship between industrialization and gender equality is generally more scarce and more

ambiguous for gender differences in earnings than for gender differences in labour market participation, which is likely due to the lack of high-quality comparable data on wages for developing countries. However, our understanding of how industrialization is related to gender equality cannot be complete without sound evidence from different spheres of gender equality.

Moreover, the methodology of Haraguchi et al. (2019) used in this paper to differentiate between developing countries with different rates of industrialization is promising for the analysis of gender equality in the context of developing countries. These authors make a further distinction by identifying successful industrializers, which can be used in the analysis of gender equality to gain a more nuanced picture. Such an analysis was not possible in the present study. Thus, future research could use this approach to shed more light on how industrialization is related to gender equality in developing countries.

Another relevant research question entails the drivers of the defeminization of labour in manufacturing, which is currently being observed in many developing countries. This trend is striking, because technological upgrading in the manufacturing sector allegedly creates jobs in this sector that are more appropriate for female labour by reducing health risks. There are several potential mechanisms that can explain this phenomenon, such as the availability of job opportunities that are more appropriate for female labour in other sectors, such as services; lack of skill endowments that allow women to compete with men when technological upgrading transforms manufacturing industries into more capital-intensive ones; and preferences of employers for male workers. Micro-level studies are needed to provide sound empirical evidence on which of these mechanisms can be considered to be more important drivers of defeminization of manufacturing industries in developing countries. The research in this field seems to be particularly relevant in the context of Industry 4.0, which will likely increase demand for workers with high levels of ICT skills. Given that gender digital divides represent a new type of gender inequality, which is particularly pronounced in developing countries, more research is needed on how this type of gender inequality is related to women's socio-economic outcomes and the performance of economies.

Finally, as developing countries prematurely transition to a post-industrial stage, a relevant research question arises whether this change is associated with the emergence of new types of gender inequalities characteristic of more developed societies at this stage of development.

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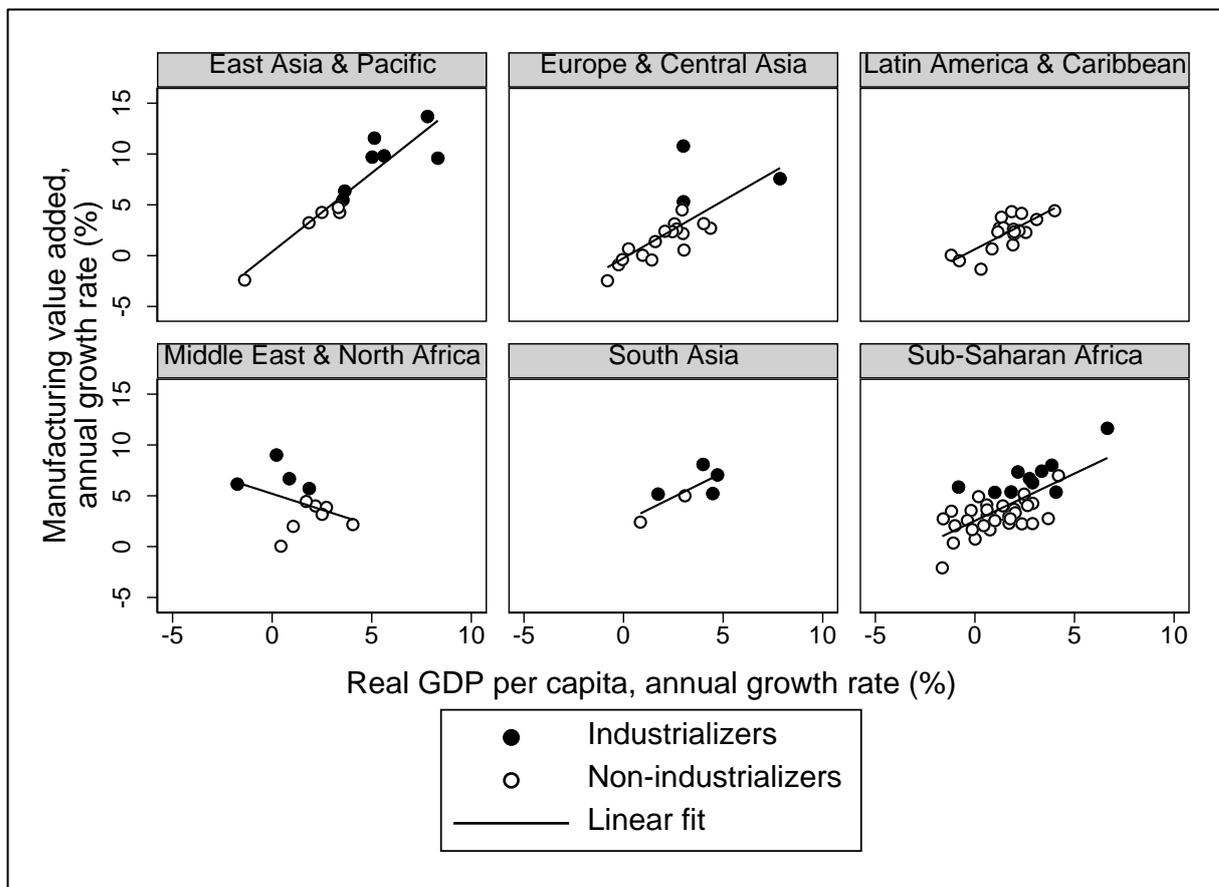
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Appendix

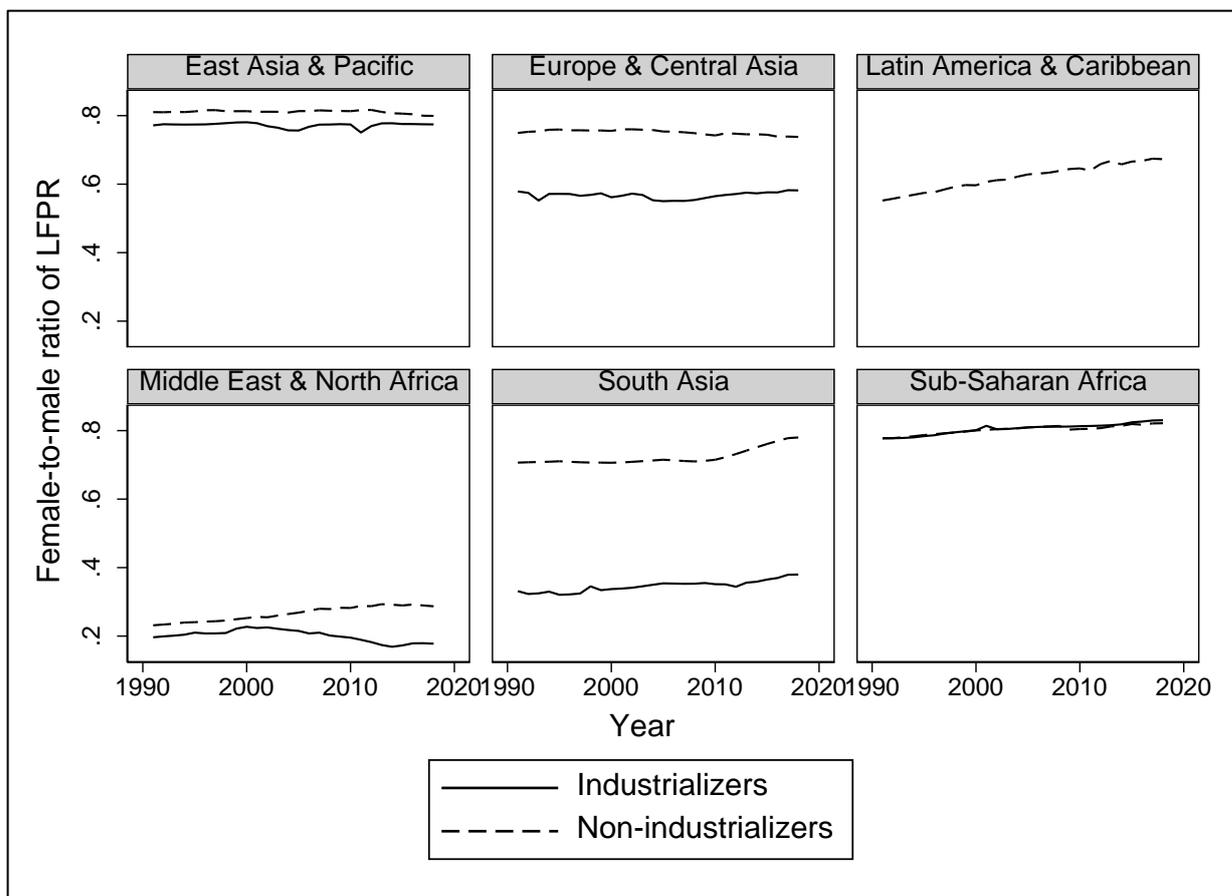
Figure A 1: MVA and GDP, annual growth rates (%) by region, average for 1991–2018



Notes: Only low- and middle-income countries according to the World Bank classification. Industrializing countries are identified following the methodology described in Haraguchi et al. (2019).

Source: Author's own calculations based on the UN National Accounts Statistics.

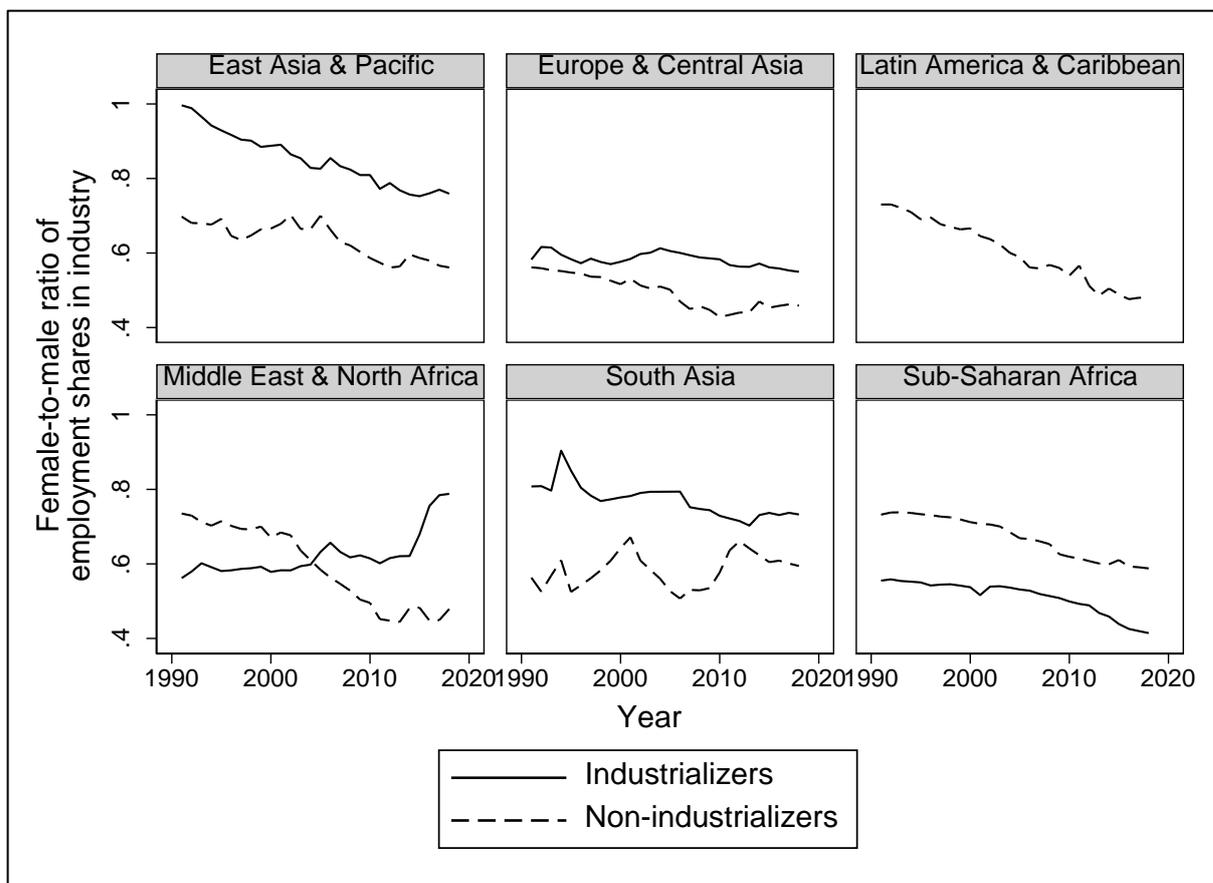
Figure A 2: Development of female-to-male ratio of labour force participation rate by region, over time (1990–2018)



Notes: Only low- and middle-income countries according to the World Bank classification. Industrializing countries are identified following the methodology described in Haraguchi et al. (2019).

Source: Author's own calculations.

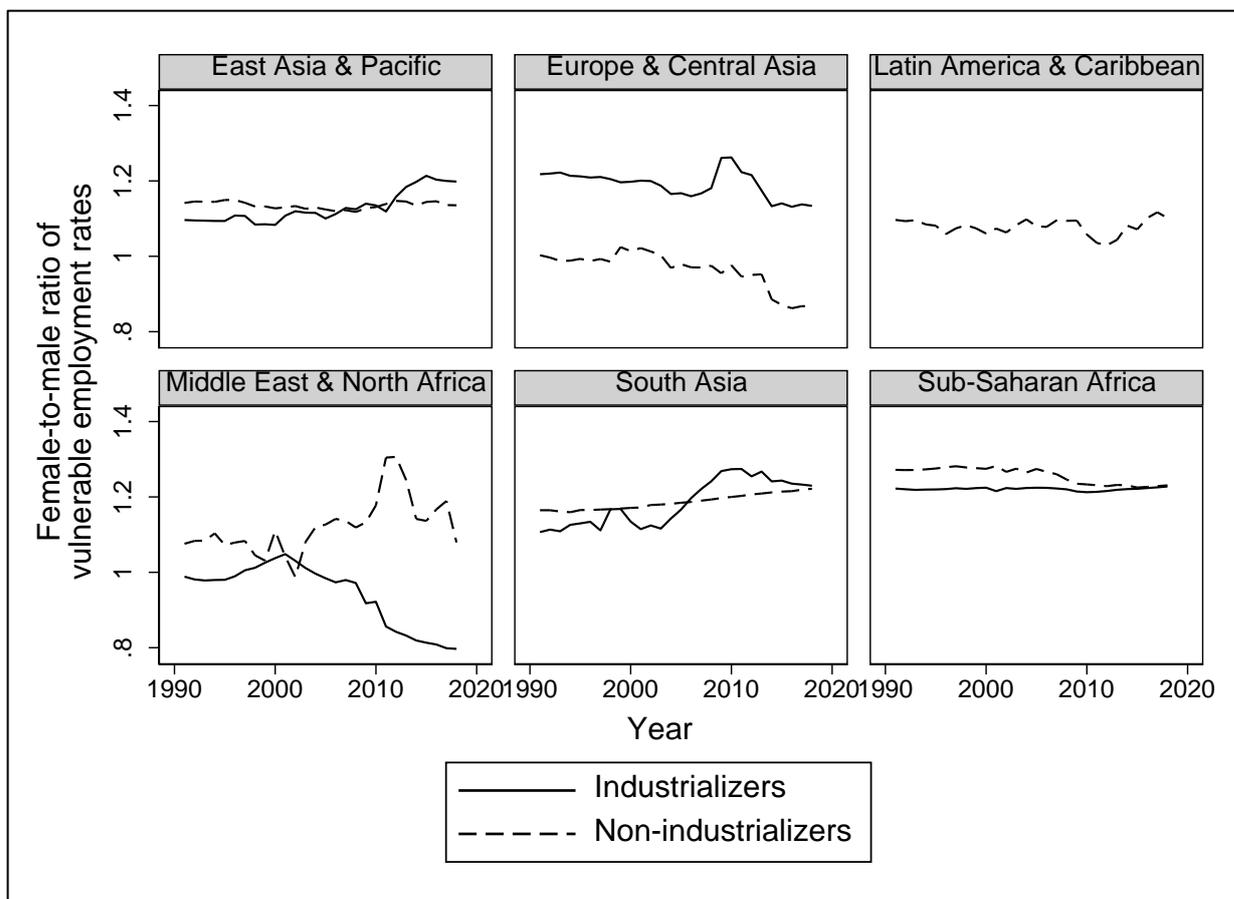
Figure A 3: Development of female-to-male ratio of employment shares in industry by region, over time (1990–2018)



Notes: The industrial sector consists of mining and quarrying, manufacturing, construction and public utilities (electricity, gas and water), in accordance with categories B-F (ISIC 4). Only low- and middle-income countries according to the World Bank classification. Industrializing countries are identified following the methodology described in Haraguchi et al. (2019).

Source: Author's own calculations.

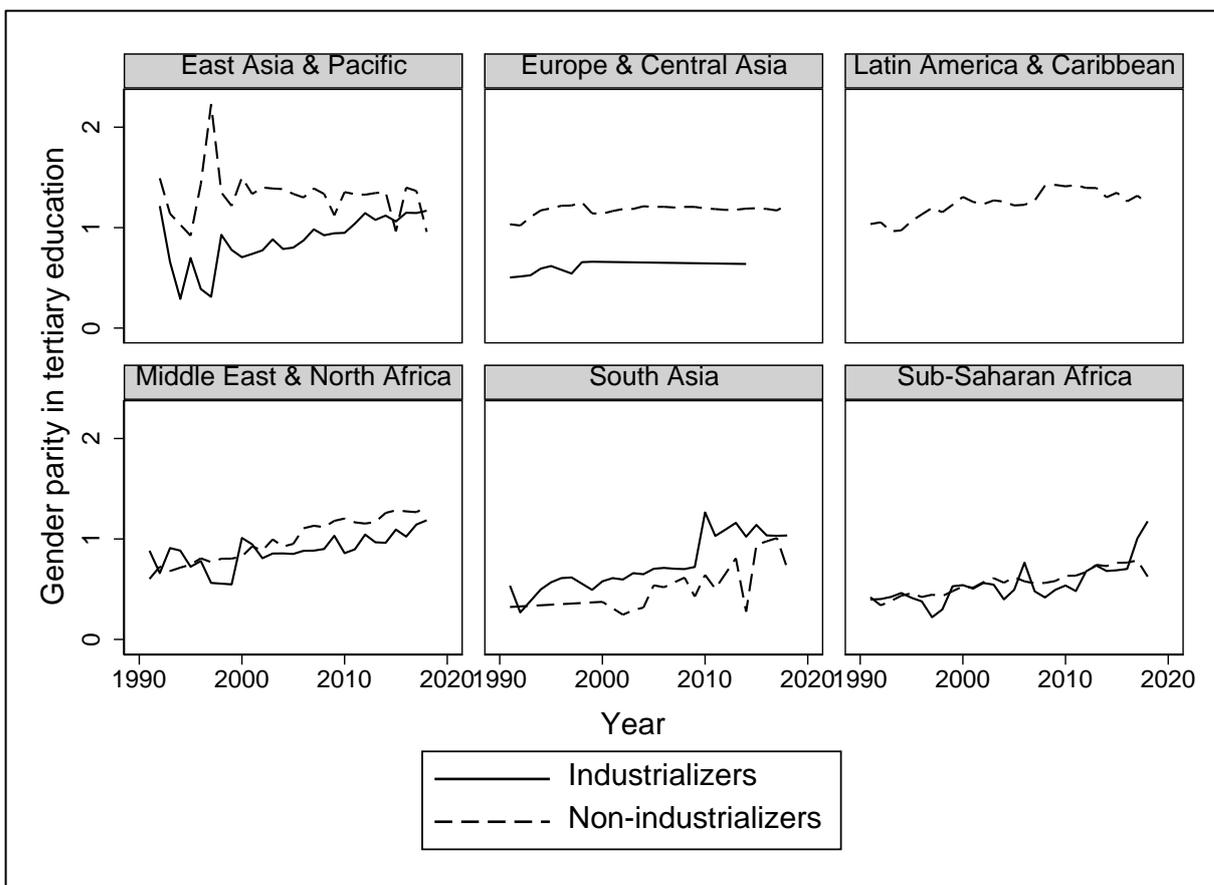
Figure A 4: Development of the female-to-male ratio of vulnerable employment rates by region, over time (1990–2018)



Notes: Only low- and middle-income countries according to the World Bank classification. Industrializing countries are identified following the methodology described in Haraguchi et al. (2019).

Source: Author's own calculations.

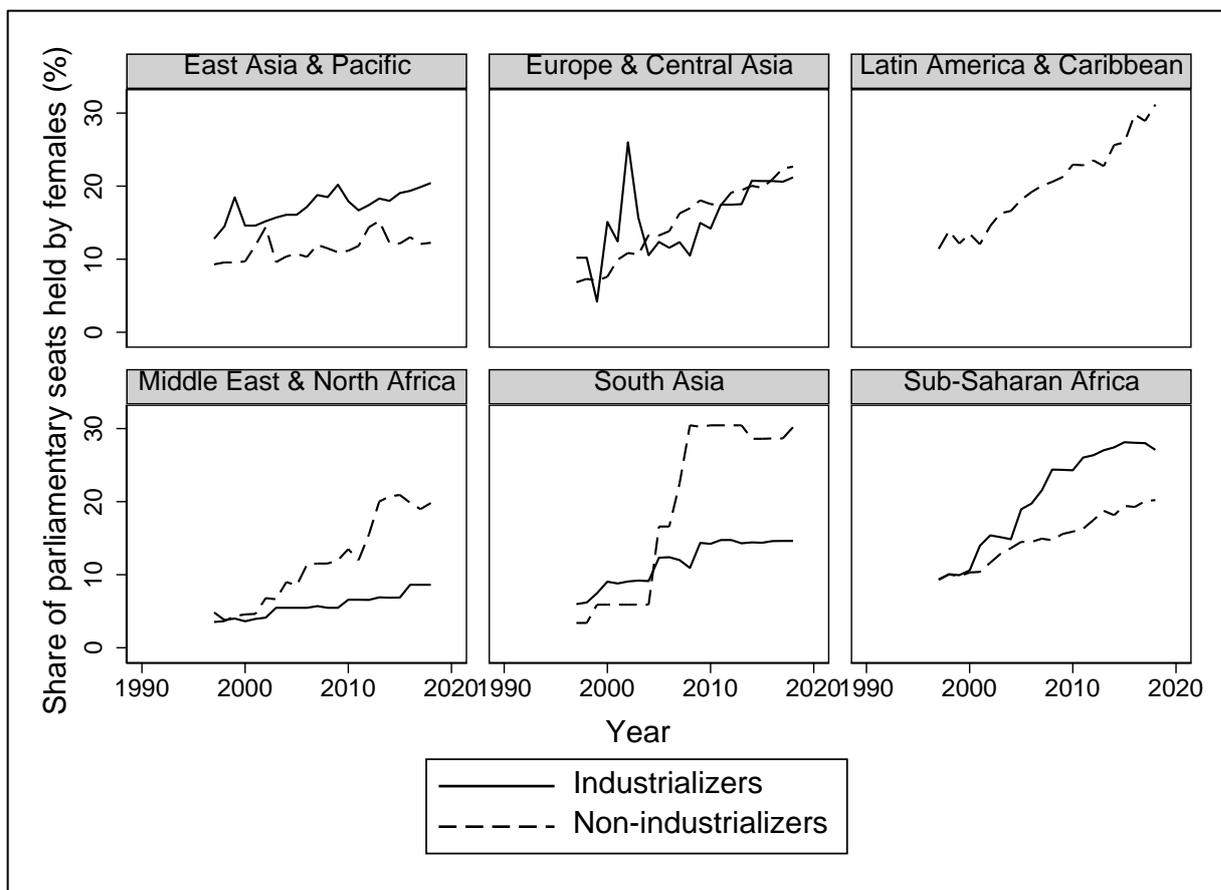
Figure A 5: Development of gender parity in tertiary level enrolment by region, over time (1990–2018)



Notes: Only low- and middle-income countries according to the World Bank classification. Industrializing countries are identified following the methodology described in Haraguchi et al. (2019).

Source: Author's own calculations.

Figure A 6: Development of the share of parliamentary seats held by females (in %) by region, over time (1997–2018)



Notes: Only low- and middle-income countries according to the World Bank classification. Industrializing countries are identified following the methodology described in Haraguchi et al. (2019).

Source: Author's own calculations.

Table A 1: Industrializing developing countries by region

Region	Industrializing countries
East Asia and Pacific	Malaysia, Indonesia, Lao PDR, Myanmar, Cambodia, Viet Nam, China
Europe and Central Asia	Bosnia and Herzegovina, Turkey, Turkmenistan
Middle East and North Africa	Yemen, Syrian Arab Republic, Iran, Jordan
South Asia	Sri Lanka, Pakistan, Bangladesh, India
Sub-Saharan Africa	Liberia, Lesotho, Angola, Mauritania, Uganda, Gabon, Tanzania, Rwanda, Chad, Ethiopia, Mali

Notes: Industrializing countries were identified based on the methodology proposed by Haraguchi et al. (2019). No industrializing countries were identified in the Latin America region based on this methodology.

Table A 2: Gender equality indicators in industrializing and non-industrializing developing countries, by region

	East Asia and Pacific		Europe and Central Asia		Middle East and North Africa		South Asia		Sub-Saharan Africa		Latin America and Caribbean
	Non-industrializers	Industrializers	Non-industrializers	Industrializers	Non-industrializers	Industrializers	Non-industrializers	Industrializers	Non-industrializers	Industrializers	Non-industrializers
<i>Aggregated indicator of gender equality</i>											
Gender Inequality Index (GII)	0.457	0.399	0.296	0.301	0.441	0.609	0.590	0.538	0.590	0.595	0.452
<i>Labour force participation</i>											
Female LFPR (in %)	60.052	63.326	50.513	39.431	19.398	14.532	62.325	27.903	60.789	62.604	49.108
Female-to-male ratio of LFPR	0.811	0.777	0.752	0.567	0.265	0.201	0.723	0.346	0.796	0.805	0.619
Female-to-male ratio of employment shares in industry	0.627	0.860	0.497	0.583	0.596	0.623	0.583	0.772	0.652	0.512	0.605
Female-to-male ratio of employment shares in services	1.189	1.059	1.245	1.129	1.078	0.960	0.469	0.553	1.046	1.096	1.669
Female-to-male ratio of employment shares in agriculture	0.927	0.944	1.041	1.417	1.218	1.286	1.429	1.496	1.043	1.156	0.395
Female-to-male ratio of vulnerable employment rates	1.137	1.134	0.962	1.191	1.101	0.942	1.186	1.184	1.253	1.221	1.081

Educational attainment

Gender Parity Index (GPI) in school enrolment at primary level	0.967	0.959	0.996	0.966	0.921	0.913	0.709	0.950	0.862	0.892	0.978
Gender Parity Index (GPI) in school enrolment at secondary level	1.007	0.911	0.992	0.882	0.923	0.855	0.614	0.932	0.754	0.797	1.065
Gender Parity Index (GPI) in school enrolment at tertiary level	1.052	0.956	1.169	0.608	0.995	0.827	0.460	0.916	0.588	0.542	1.294
Female-to-male ratio of adult literacy rates	0.964	0.892	0.991	0.943	0.793	0.756	0.525	0.779	0.723	0.716	0.975

Decision-making positions

Share of parliamentary seats held by women (in %)	11.682	17.027	15.991	15.976	12.358	5.816	23.384	12.076	15.451	20.511	20.737
Share of firms with female top managers (in %)	36.475	31.264	19.146	13.850	7.570	8.683	9.000	6.688	15.257	15.218	20.603
Share of firms with female participation in ownership (in %)	56.275	41.236	30.500	24.413	25.408	11.767	13.525	14.913	29.183	32.261	42.743

Earnings differentials

Female-to-male ratio of monthly earnings	0.951	0.847	0.734	0.936	0.855	0.885	0.647	0.790	0.764	0.763	1.029
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Notes: No industrializing countries were identified in the Latin America region based on the methodology of Haraguchi et al. (2019).

Source: Author's own calculations.



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