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Essays in Globalization Technology and the Labor Market

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Dedicated to my mother and my wife

Essays in Technology, International Trade and the Labor Market

Abstract

This thesis attempts to investigates and analysis the link among the technological advancement, international trade and the labor market. It comprises three independent chapters of which the first two are empirical work and the third one is the theoretical work. The first chapter of the thesis introduces the general overview of the thesis and the main motivations. The second chapter "Job polarization in Developing countries; Evidence from Developing Countries" attempts to investigate and present the evidence of job polarization in the case of the developing countries, using the Ethiopian labor force survey data. Job polarization, which the growth of the employment of both high skilled and low skilled workers at the expense of the middle skilled once, is a widely discussed phenomenon in the case of advanced countries like US (see Autor et al. (2003) and others), UK (see Goos and Manning (2007) and Salvatori (2015)), EU (Goos et al. (2009)) ad others. However, there hardly exists the evidence in the case of developing countries, apart form some reports by the World Bank. The starting point for the present chapter is Blanchard and Willmann (2016) trade model which shows the hollowing out of the middle class workers in developed countries and the opposite in the developing countries. Using the labor force survey data from Ethiopian CSA, however, this study finds clear evidence of job polarization in developing country; Ethiopia. The third chapter, "The impact of Firms' global market engagement on the local labor market", analyses the effect of firms' participation global market via trade or ownership (FDI) on the labor market outcome and inequality using the Ethiopian manufacturing firms survey data. The results from the regression analysis show the firm's global market engagement through export contributes positively towards the employment and wage growth. However, the wage gap between the skilled and unskilled workers stays posi-

tive. Further analysis also show as the effect is positive, significant for the high and low skilled workers, and negative, significant for middle skilled workers, which is a confirmation for the evidence of job polarization discussed in chapter two. The fourth chapter "International trade and Equilibrium unemployment with heterogeneous firms and workers" attempts bridge two strands of economic literatures; International trade with heterogeneous firms (Melitz (2003)) and the frictional labor market (Pissarides (2000)). Thus, the model shows the interaction between the labor market and trade variables. We showed that the productivity cutoffs are directly affected by trade liberalization and further depends on the labor market tightness. The model also shows as the wage inequality between workers in the exporting and non-exporting sector increases due to trade liberalization.

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Chapter 1

Introduction

This thesis examines the interaction between technological advancement, globalization, and the labor market focusing on the case of the low-income country of Ethiopia. Recently there has been growing public concern and pessimistic views regarding the pros and cons of fast growing technological advancement and globalization. Technology in its nature is believed to favor highly skilled workers, therefore changing the labor demand structure in favor of high skilled workers. While globalization effect is through, facilitating the movement of new technologies and tasks (offshoring) from places where they are relatively expensive to areas where they are relatively cheap. The market adjusts itself to these phenomena mainly through the reduction of wages and employment of low-skilled workers[1]. Thus, questions like; who benefited who is affected by technological advancement and globalization, and the distribution of the benefits and effects of these phenomena, are always at the center of the debate in many fields of study.

This document is a compilation of three self-contained chapters which all explore the issues related to globalization (international trade), technology advancement, and the labor market, both empirically, focusing in the case of a low-income country, and theoretically. Focusing on the growing inequalities especially in developing countries, the first two chapters raise and analyze the questions related to the labor market and its adjustment to growing globalization and technological changes. Recently, the growing inequality in the labor market has been widely documented. The growing body of research in this area mainly questions technological advancement (Autor et al. (2003)) and growing global market integration (globalization; international trade, offshoring) (Goos et al. (2010) and Egger et al. (2016)). There is a lot of research that

[1]See the documents by Hijzen and Swaim (2010), Moore and Ranjan (2005), and Davidson et al. (2008)

addresses this issue by deviating from the traditional skilled-unskilled workers analysis view and focus on the task-biased (routinization) approach following the leading works of Autor et al. (2003). The literature on task biased analyses pays no/little attention to the labor market in developing countries. Thus, in the following two chapters this study tries to focus on the interaction between the labor market and globalization and technology in the case of developing countries. The fourth chapter analyzes the link between the new trade model of heterogeneous firms and frictional labor market.

1.1 Job Polarization in Developing Countries: Evidence from Ethiopia

This chapter analyzes the Ethiopian labor force survey data with the aim of finding evidence for the presence of job polarization. Given the large body of evidence on employment polarization in developed countries and the driving forces behind the phenomenon, it is of interest to assess the trends of the labor market in developing countries. To our knowledge, there is no evidence from the point of view of developing countries, apart from some reports by the World Bank and others, which in fact report the presence of employment polarization in some developing and emerging countries.

The idea of job polarization as discussed in Autor et al. (2003) and Goos and Manning (2007), is the growth in employment at both bottom and top tails of skill distribution at the expense of those at the middle of the distribution. Technological advancement and globalization are among the main driving forces behind this phenomenon. The advancement in computer and robotic technologies and others, as well as the reduction in the price of these technologies, makes it easier for a firm to substitute workers who perform routine tasks. However, technology complements those who engage in non-routine abstract tasks and enhance the demand for the workers engaging in the abstract task (high skilled workers), while it has an insignificant effect on those who participate in the non-routine manual tasks (low skilled workers) [2]. Globalization, on the other hand, makes it easier to move tasks to other places where they can be performed

[2]Acemoglu et al. (2012) grouped occupation into four; non-routine abstract, non-routine manual, routine cognitive and routine manual tasks. Autor and Dorn (2013) define the non-routine manual task as the service occupation tasks which involve giving services to others like assisting or caring for others.

at a low cost.

There are insurmountable volumes of literature that provide evidence and explain this issue for developed countries. Autor et al. (2006) for the US, Goos and Manning (2007) for the UK, and Goos et al. (2009) for the EU are few examples. Blanchard and Willmann (2016) developed a trade model to explain the employment trend in both home and foreign countries. Their work shows the hollowing out of employment in the home country (developed), while the opposite happens in a foreign country (developing). This is the starting point for this chapter. The main question is: does the data reveal flourishing middle-class employment for developing countries? There are a number of reports on the issue of job polarization in developing countries. The report from CITI and the Oxford Martin School[3] explores the impact of automation on the labor market of different countries of the world and calculate the risk of automation for each occupation. The report reveals the risk of job automation is highest in Ethiopia with 85% and the lowest in Uzbekistan with 55%. In fact, this is the first insight for prediction of employment polarization in Ethiopia and other developing countries.

The analysis in this study shows clear evidence for job polarization in Ethiopia. Measuring the quality of job by the skill content at the beginning, the finding shows negative growth of employment in the routine (middling) tasks between 2005 and 2013, while there is positive growth for the abstract (top) and manual (bottom) tasks. The U-shape pattern of employment is derived from the quadratic regression suggested by Goos and Manning (2007). The shift-share analysis technique shows the presence of polarization and the fall in the employment share of the middle-skilled workers could be partly explained by the routinization hypothesis as in other literature in this area. Moreover, the result is mainly driven by female workers, because female workers are more vulnerable than male workers. Some regions in Ethiopia are also hit by the phenomenon. We find clear evidence of job polarization in the Oromia region and Addis Abeba city administration.

[3]see https://www.oxfordmartin.ox.ac.uk/downloads/reports/Citi_GPS_Technology_Work_2.pdf

1.2 The Impact of Firms' Global Market Engagement on the Local Labor Market

This chapter aims at using the Ethiopian large and medium scale manufacturing (LMSM) survey data from the central statistics agency (CSA) to analyzes, how the firms' foreign market involvement (export) and the firm ownership type affect the labor demand in the manufacturing sector in Ethiopia and thus, the wage distribution. Additionally, the change in the demand of different groups of employment and the labor market inequality due to the firms' participation in the global market, mainly through export and the firms' ownership type will be examined.

Developed countries have recently experienced a large decline in the employment of mainly low-skilled workers [4] (see for example Feenstra and Hanson (1997), Katz and Murphy (1992), Katz et al. (1999) and Autor et al. (2003)). At the same time, the wage differential between skilled and unskilled workers is growing. The factors responsible for this growing wage gap and increasing unemployment are technological advancement and international competitions. Focusing on the growing international competitions, trade with less developed countries, which are endowed predominantly with unskilled labor and according to Stolper-Samueleson (S-S) theorem, can explain the growing inequality especially from the point of view of advanced countries. In fact, the S-S theorem is the natural starting point to develop a link between globalization and the local labor market. However, there are few studies that examine the effect of globalization from the context of a developing country, compared a wide range of literature on the case of advanced countries. Thus, this chapter takes this opportunity to deepen the understanding of the effect of globalization on the labor market of less developed countries by considering the Ethiopian labor market.

Regardless of many works in this area, the results reported are mixed. Fu et al. (2004) show that international trade has a positive and significant impact on the labor market outcome, while Greenaway et al. (1999) reports negative impact and Raj and Sen (2012) found insignificant impact globalization. This study uses the annual survey data on the Ethiopian large and medium scale manufacturing establishments from the Ethiopian Central Statistics Agency for the years

[4] The SBTC hypothesis explains this dynamics by focusing on skilled and unskilled workers. On the other hand, the task-biased hypothesis shows as the middle-skilled employment is declining. However, in both hypothesis the countries are experiencing growing unemployment and wage inequality.

1999 to 2011. The dynamic panel data estimation technique (SY-GMM model) is employed to estimate the dynamic model for employment and wages. The result from this analysis shows a positive relationship between the export dummy, and employment and wages. This suggests that exporting firms are not only employ more but also pay higher wages. Foreign-ownership variable, which is used as a proxy for the FDI, affects the labor market variables positively. The foreign-owned firms employ more and pay higher wages. Concerning the skill composition, the result shows that globalization has a relative effect on the demand for labor and wage. As a result, the wage gap between skilled and unskilled workers increases. The result is, moreover, in line with the routinization hypothesis. It is found that the firms' participation in export and foreign ownership affects the demand and wages of highly skilled workers. The result is positive, but with a lower level of significance for the low skilled workers, while it is negative and significant for the middle-skilled workers.

1.3 International Trade and Equilibrium Unemployment with Heterogeneous Firms and Workers

The third chapter analyzes the behavior of an open economy model with matching and search frictions in the labor market, in the framework of heterogeneous firms and workers. Thus, it bridges literature on international trade with heterogeneous firms and the equilibrium unemployment with search and matching literature. In the Melitz (2003) model trade liberalization puts the inefficient firms out of the market, while the efficient firms are offered new opportunities. Thus, this selection effect of the firms lead to aggregate productivity gain and hence, an adjustment in the economy.

Our model shows the relationship between the trade and labor market variables is vise-a-vise. Openness by increasing the participation productivity, increases the flow of workers into unemployment pool, while the reduction in the trade costs (both variable (τ) and fixed f_e) makes the labor market tighter. Since the firms' revenue is a positive function of productivity, the firms pay different wage for workers depending on their ability. Moreover, the model shows that the wage differential between the workers in the export and non-export sector increase with

the trade liberalization.

1.4 Contributions

Each chapter of this thesis contributes to the respective existing literature in many ways. The Second chapter dealing with the issue of job polarization developing country's case could complement the existing literature. As already mentioned there is no evidence of job polarization in the context of developing countries, and even the existing reports show mixed evidence. Moreover, the literature which explores this phenomenon in developed countries pays little attention to developing countries. Thus, I strongly believe this is the first attempt to find evidence of job polarization in a Sub-Saharan African country. Moreover, since the questions and analyzes raised in this work need further investigation using different method and data, this work could put the foundation for the forthcoming research works in this line.

The third chapter actually comes up based on the fact that there are few works especially in the case of SSA in general and Ethiopia in particular. Thus, this work could be an addition to the body existing literature in;

- Showing the impact of globalization on the Ethiopian labor market. This important, as it helps to know the impact of firms participation export and FDI in fast-growing economies.
- It also contributes to the routinization hypothesis,

This thesis also contributes to the literature which link the open economy model with equilibrium unemployment model.

The outline of this document is as follows. The second chapter explores and presents the evidence of job polarization growing wage inequalities in developing Sub-Saharan African countries using the Ethiopian labor force survey data. The third chapter presents the analysis of the impact of the firms' global market engagement on the local labor market. The fourth chapter discusses international trade and equilibrium unemployment with heterogeneous firms and workers in the setup of Melitz (2003) and Pissarides (2000).

Chapter 2

Job Polarization in Developing Countries: Evidence from Ethiopia

Abstract

This paper attempts to document and to present evidence of job polarization in the context of a developing country, with a special focus on Ethiopia. Job polarization has been a widely documented and discussed phenomenon in developed countries in the last few decades. However, there is hardly any existing evidence for developing countries and this would be the first attempt to our knowledge. Using the Ethiopian labor force survey data from the Central Statistics Agency (CSA) of Ethiopia for the year 1999 to 2013, I find the decline in the growth of the middling occupations (routine tasks), evidence for the existence of job polarization. The employment share of routine jobs is negative and significant over the sample period, while it is positive significant for non-routine tasks in the same sample period (1999-2013). The quadratic regression suggested by Goos and Manning (2007) also confirms the U-shape pattern of employment over the sample years. The shift-share decomposition analysis result shows the fall in the employment share in the routine occupations can be partly explained by the routinization hypothesis. Moreover, female workers are more vulnerable to job polarization. Additionally, the regional variation is also observed as some regions also face the phenomenon.

2.1 Introduction

One of the most discussed topics in economics during the last few decades has been the polarization of the labor market in developed countries, which is described as the growing share of employment for high-skilled, high-paying occupations and low-skilled, low-paying occupations and the decline in the share for middle-skilled, middle-paying tasks. This phenomenon has been evidenced for the US and other developed countries since the late 1980s. Economists have identified two main reasons to explain this issue, namely technological progress, and globalization, which affects the distribution of the skill demanded. Technological advancement is believed to be skill-biased, which means technological innovations complement high-skilled workers and hence, increases their productivity and demand. Contrary to high-skilled workers, new technology might substitute those workers who perform routine tasks, which are typically middle-skill intensive and relatively medium wage paying jobs[1]. Low paying, low-skilled jobs are less likely to be affected by technological progress. Globalization, in the form of international trade and offshoring, facilitate the movement of the tasks, especially routine tasks, to where they can be performed at a lower cost.

The task-biased/routinization hypothesis first discussed by Autor et al. (2003), argues that the advancement in computer and robotic technology leads to the disappearance of routine task occupations, as these tasks can be easily performed by those technologies. Accordingly, the fall in the price of a computer reduces the demand for routine task workers, while it increases the demand for those who perform non-routine tasks, i.e technology substitutes routine task workers and complement the non-routine cognitive task workers, while having no direct effect on non-routine manual tasks.

The term *job polarization*, as defined in the literature, refers to the disappearance of jobs from the middle of the wage distribution due to a movement of workers from jobs concentrated on routine tasks to jobs highly intensive in abstract or service tasks at the upper and lower tail of the wage distribution, respectively[2]. In other words, it could be that the relative employment growth in the share of both well-paid skilled jobs and low-paid unskilled jobs increases and the

[1]Routine tasks are, as defined in Autor et al. (2003), those tasks which can be accomplished by machines following explicitly programmed rules

[2]This definition is adopted from Egger et al. (2016) and Goos and Manning (2007)

employment share of the medium-paid middle-skilled jobs decreases. This results in the U-shape pattern of employment changes along wage and/or skill percentile, depending on the components used to approximate the quality of the job.

There is considerable empirical evidence of employment polarization in the case of developed countries. The evidence for the US is provided by David Autor and his coauthors[3], Acemoglu et al. (2012), and all these works documented the hollowing out of the middling occupations. In the case of the UK, Goos and Manning (2007) and Salvatori (2015) present the existence of job polarization. For Germany, there is also evidence of employment polarization presented by Black and Spitz-Oener (2010) and Egger et al. (2016), while the evidence for some EU countries is presented by Goos et al. (2009).

The evidence of job polarization in the context of developing countries is lacking and the literature on the polarization of the labor market has paid no/little attention to examining the labor market of developing countries. Regardless of the growing inequality and the fact that developing countries are also exposed to the externalities of globalization and fast-changing technology, there is no existing evidence of the effect of technological advancement and/or globalization on labor markets in the context of developing countries, which is in line with the task biased hypothesis. However, the report from "citi" and the Oxford Martin School (titled Technology at work v2.1: The Future is not what it used to be) explores the impact that the automation of jobs have on the labor market of these countries[4]. Using new World Bank data, the report considers the risks of job automation for developing countries. The report shows the risk ranges from 55% in Uzbekistan to 85% in Ethiopia. There is also a substantial share of jobs at high risk in emerging economies like India and China.

The purpose of this paper is to explore the evidence of job polarization in the context of developing countries and to analyzes employment, namely wage trends in the labor market of these countries. This study focuses on finding the growth of employment in different percentiles of the job, by ranking the tasks, depending on the wages paid to and/or education level of the worker performing the task, following the task-based approach. The techniques used in the paper are

[3]Autor et al. (2003), Autor et al. (2006)Autor et al. (2008)Autor et al. (2010), Autor and Dorn (2013)
[4]One can access the report: https://www.oxfordmartin.ox.ac.uk/downloads/reports/Citi_GPS_Technology_Work_2.pdf

similar to the ones used in the literature dealing with the same idea in the context of industrialized countries. Hence, the main objective in this study is to answer the questions; IS the labor market in Ethiopia polarized? If so, what could be the main driving forces? Particularly, can the employment pattern, especially the routine occupations, be explained by the technological change or by the changes between industries? To answer these questions this study investigates the work of Autor et al. (2006) for the US, Goos and Manning (2007) for the UK, as well as other literature in this area. Because the literature on the polarization of the labor market has paid little or no attention to the labor market in developing countries, I strongly believe that this work could complement the existing literature by providing evidence of job polarization in developing countries.

To achieve the goal, this study employs the Ethiopian labor force survey data from 1999 to 2013 [5] from the Central Statistics Agency (CSA). The result of the analysis shows the presence of employment polarization in Ethiopia. Measuring the quality of job by the skill content at the beginning, this study shows a negative and statistically significant growth of employment in the routine (middling) tasks between 2005 and 2013, and significant and positive growth for the abstract (top) and manual (bottom) tasks. Moreover, this result is mainly driven by female workers, which means that female workers are more vulnerable than male workers. Some regions in Ethiopia are also hit by the phenomenon. We find clear evidence of job polarization in the Oromia region and the Addis Abeba city administration. From the results, one can see that the evidence for employment polarization in developing countries exists as well. The shift-share analysis suggests that the routinization hypothesis suggested by Autor et al. (2003) can explain the most changes in the growth of the routine tasks, even though it is not as strong as in the case of industrialized countries.

The remainder of this paper is organized as follows. Section 2 presents the related literature on job polarization and labor market inequalities. Section 3, will discuss the data and present the descriptive analysis of some key variables. Section 4 presents and explains the empirical strategies and results. The discussion will then be presented in section 5. The last section provides a summary and final remarks and some figures and tables will be provided at the end.

[5] For more details on the data source and descriptive statistics see the appendix

.

2.2 Literature Review

2.2.1 The Skill-Biased Technological Change SBTC from Factor-Neutral to Factor-Biased Technological Change

In economic theory, production technology is viewed as a function representing how combinations of factor inputs can be transformed to outputs and the technical change is a shift in this production function. Traditionally, the technological change is measured by the aggregate total factor productivity (TFP) as introduced by Robert Solow (1957). Solow (1957) define TFP advancement as an increase in output without changing the marginal rate of transformation of a given input. According to this definition, TFP is a form of factor-neutral technical change Violante (2002).

However, the key facts that emerged from the data contradict the factor-neutral theory of production. The data, especially from the early 1980s and 1990s, reveals a high increase in the rental price of skilled labor relative to that of unskilled labor, despite the fact that the supply of college graduates increased dramatically. This fact leads to the notion that technology is rather factor augmenting and favors the skilled over unskilled workers, which is known as skill-biased technical change (SBTC). The concept here is that technology is assumed to complement skills and to increase the productivity of the high-skilled workers and thus, their wages. The SBTC hypothesis was primarily used to explain the growing wage inequality among college graduates or high-skilled and low-skilled workers.[6]

Thus, the SBTC hypothesis has become more popular and is used to analyze labor market inequality, following the seminal work by Katz and Murphy (1992). This hypothesis has successfully explained the growing wage inequality in the labor market almost since economists first noticed the rise in wage inequality at the end of the 1950s. The idea is that technological progress increases the productivity of more skilled workers and thus, their demand.

[6]for detail see Acemoglu et al. (2012) Autor and Katz 1999

Krueger and Kumar (2004), provide two explanations for the increased share of skilled employees due to the technical change. The first explanation assumes complementary relationship between technology and skilled workers, which increases their demand after the new technology is introduced. The second explanation of SBTC is the difference in the ability to adapt to the new technology or to a new business environment. Because high-skilled employees are fast learners and perform better with new machines and technology than low-skilled workers, it is more attractive for the employer to hire skilled workers.

Acemoglu et al. (2012), presents the modified setup of the SBTC in what they call the canonical model. The model assumes as that technology is factor augmenting and thus, compliments either high-skilled or low-skilled workers. It includes two skill groups which perform two different and imperfectly substitutable occupations. The college-high school log wage ratio is used as a measure of the skill premium, which is determined by the relative supply and demand for skill. The relative demand for the skill increases due to the technological change and in turn increases the premium[7]. The production function of the aggregate economy in this model takes the form of CES.

$$Y = [\theta(A_L L)^{\frac{\sigma-1}{\sigma}} + (1-\theta)(A_H H)^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \tag{2.1}$$

Here, $\sigma \in [0, \infty)$ is the elasticity of substitution between high-skill and low-skill labor and it plays a big role in defining the effect of the technological change. Since technology is factor augmenting the change in technology either increases the productivity of high or low skilled or both. Since in the competitive market, the factor prices ($\omega_H and \omega_L$) can be given by the marginal products of each factor of production and thus, the skill premium is:

$$\omega = \frac{\omega_H}{\omega_L} = \frac{1-\theta}{\theta}(\frac{A_H}{A_L})^{\frac{\sigma-1}{\sigma}}(\frac{H}{L})^{\frac{-1}{\sigma}} \tag{2.2}$$

Taking the logs,

$$\ln \omega = constant + \frac{\sigma-1}{\sigma} \ln \frac{A_H}{A_L} - \frac{1}{\sigma} \ln \frac{H}{L} \tag{2.3}$$

Equation 3 is the key to understanding the canonical model as it links the skill premium to the relative supply of skills $\frac{H}{L}$ and to the relative technology $\frac{A_H}{A_L}$. From equation 3, there is a log-

[7] Acemoglu et al. (2012)

linear relationship between skill premium and relative supply of skills which can be given by $\frac{-1}{\sigma}$ which is negative. If σ is larger than one, the high skill augmenting technological change increases the skill premium which can be $\frac{\sigma-1}{\sigma}$. Additionally, from the model factor-augmenting technical change increases the wages of both high and low skilled labor, which could be obtained by differentiating equation 3 with the respective technical terms[8]. Despite its success in explaining the wage inequalities before and in the early 1990s, the canonical model (SBTC) fails to capture the key facts observed from the data in recent decades. Some of the facts stressed by the literature are:

- The non-monotonic growth of the employment by skill level. Even though the SBTC suggests the monotone growth of employment by skill, this fact is not reflected in the data. Recent findings show employment growth is non-monotonic.
- The non-monotonic change in wages by skill percentile. Like the growth in employment the wage growth also does not grow monotonically. Recent studies show both wages and employment growth has a U-shape pattern, which implies the polarization of the labor market.

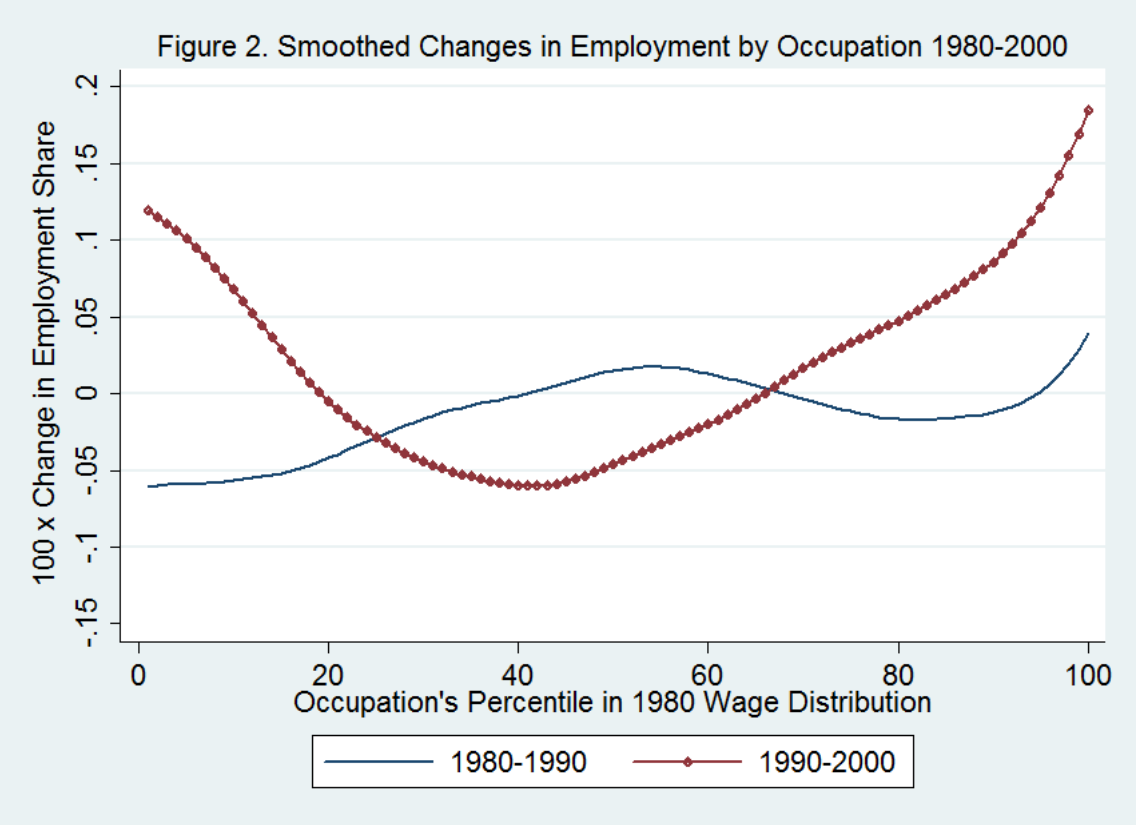
2.2.2 From the Skill-Biased to Task-Biased Technological Change

The SBTC fails to capture some of the key facts revealed by the data (for detail see Autor and Dorn (2013)). The seminal work by Autor et al. (2003) introduced the concept of the Task or routinization Biased Technological Change (hereafter RBTC) or simply the routinization hypothesis. The basic idea of the RBTC is that technology substitutes workers who perform routine tasks and complements those who engaged in non-routine cognitive tasks, while it does not have a direct effect on manual workers. Routine tasks are mainly performed by the middle-skilled workers and thus, they are negatively affected by technological progress. As a result, one can have the U-shape trend of employment over the skill percentile and a similar trend for wages, which the SBTC cannot explain.

The two figures above show the non-monotone growth in both employment and wages for the US since the 1980s. In fact, the SBTC hypothesis cannot explain the downward sloping part

[8]See Acemoglu et al. (2012) pp 434-436

Figure 2.1: Smoothed change in employment by occupation ranked by wage level



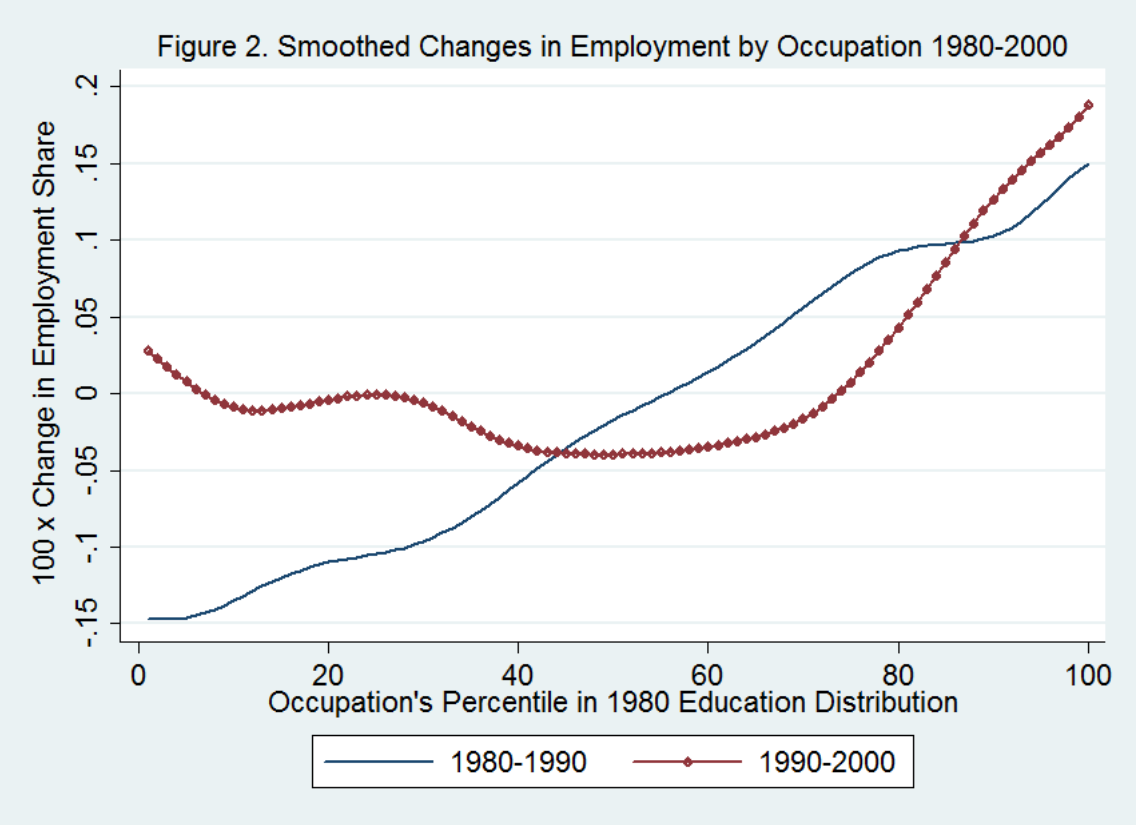
of the relationship shown in the figures[9].

This U-shape trend of employment over skill is called ***job polarization***. It is the phenomenon which refers to the rising relative demand in well-paid skilled jobs (that typically require non-routine cognitive skills), in the low-paid least skilled jobs (that typically require non-routine manual skills), and falling relative demand in the middling jobs that typically require routine manual and cognitive skills (Goos and Manning (2007)).

Following the task-biased approach presented by Autor et al. (2003), much work has been undertaken to find evidence to explain job polarization in industrialized countries. In their work, Autor et al. (2003) analyzed the impact of advancement (reduction in price) of computer technology on the labor demand. According to the approach, as the price of computer technology falls, the demand for workers that perform routine tasks decreases, while the demand of the workers who perform non-routine tasks increases. Therefore, in industries that are routine worker intensive, the relative demand for these workers falls as they invest in the relatively cheap

[9]I used the Data from D.Autor et al 2006 to generate the figures.

Figure 2.2: Smoothed change in employment by occupation ranked by education percentile



computer technology. They find this for the US, as computerization is linked to the reduction in the routine labor input.

Acemoglu et al. (2012), present the modified setup of the SBTC to explain the finding in what they call a "canonical model." The model assumes as the technology is factor augmenting and thus, compliment either high-skilled or low-skilled workers. It includes two skill groups which perform two different and imperfectly substitutable occupations. The college-high school log wage ratio is used as a measure of the skill premium, which is determined by the relative supply and demand of a skill. The relative demand for the skill increases due to the technological change and which in turn increases the premium[10]. Accordingly, the canonical model is a special case from the task-biased framework.

Job polarization has been a widely documented phenomenon in industrialized countries. The first paper to formally propose a link between technology and polarization of employment was by Goos and Manning (2007) who presented evidence for the UK. The labor market in the UK

[10]Acemoglu et al. (2012)

has been polarized since the 1980s. Autor et al. (2006) have presented evidence for the US and they also found that the US labor market has been polarized since the late 1960s. Goos et al. (2009) present evidence for 16 EU countries, where they ultimately find evidence of polarization for 14 of the EU countries.

Generally, the labor market in industrialized countries is polarized. The main question in this field is: What are the driving forces behind the polarization of employment? Different researchers have tried to explain the polarization of the labor market of advanced economies. The main cause, as already first discussed by the seminal work of Autor et al. (2003), is the advancement in technology. Other research following this idea, have also reached the same conclusions and find technology to be the main driving factor of polarization. However, there are some other factors discussed by other researchers. Goos et al. (2010) and Goos et al. (2014) present that in addition to technology, globalization, in the form of offshoring and international trade could also be the driving factor. Keller and Utar (2016) conclude that international trade can explain polarization to some extent, even though technology is the main player, while Egger et al. (2016) develop a model to explain polarization by claiming that offshoring can also be the driver of polarization in Germany.

In general, job polarization, the hollowing out of middle-class workers, has recently become a widely documented phenomenon. Though technology is assumed to be the main driving force for this phenomenon, there are also other factors which can play a role; like globalization Goos et al. (2010) and offshoringEgger et al. (2016) in explaining the shift in employment from the routine sector to where it can be performed cheaply. International trade could also reduce the demand for routine employment, thus some of the routine tasks might disappear as a result of international trade Keller and Utar (2016). International migration and the shift in the composition of consumption and the shift in the demands are also some of the widely discussed factors in the literature used to explain employment polarization in developed countries.

Apart from the report by CITI, there is no evidence of job polarization in low-income countries. However, other literature discusses the growing income/wage inequality in these countries. Mainly using the labor demand and supply analysis, the literature discusses the growing labor market inequalities in developing countries.

2.2.3 The Labor Market in Developing Countries

The labor market of developing countries is characterized by low productivity, low-skilled employment, and low quality in terms of wages, benefits, and job security. According to the International Labor Organization (ILO) report, the overall unemployment, especially in Sub-Saharan Africa, is around 7% which is well above the global average of 5% even though it is argued that ILO underestimates the unemployment level in Sub-Saharan Africa. Moreover, in many developing countries, their growth and employment intensity is negatively related. As discussed by Page and Shimeles (2015), for fast-growing Sub-Saharan economies like Ethiopia, Rwanda, Tanzania, and Uganda the relationship between their growth and employment intensity is strongly negative.

A number of studies have been completed by researchers to assess the overall inequality, as well as the labor market inequality in developing countries. Different economic literature has explained the growing wage gap observed in the last three decades. Among economists, change in the structure of the labor demand in favor of skilled workers is commonly accepted as a cause for the growing wage inequalities. There is also empirical evidence that shows the relationship between growing globalization, and wage distribution, and level of employment. These studies suggest openness as a factor that contribute to the widening gaps in the labor market.

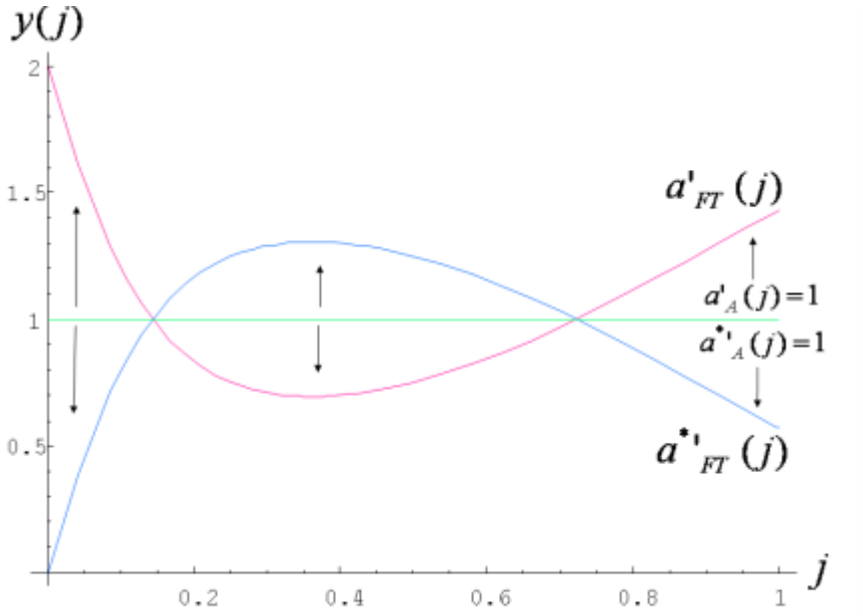
2.3 Data Sources

2.3.1 Our Argument and Research Questions

Blanchard and Willmann (2016) developed a trade model in which educational institutionalist drive, comparative advantage, and the distribution of human capital within and across the countries. Their model, like standard trade models, assumes two countries: (home (developed) and foreign (less developed)). They show that for the home/industrialized country, there would be a polarization of employment and educational choice and the middle ability agents lose more as a result of trade liberalization, while the opposite happens in the foreign/developing country. Hence, the model presents evidence of the hollowing out of the middle-class workers in industri-

alized countries and is in line with the evidence from the US, the UK, and some EU countries.

Figure 2.3: Employment Density by Sector: Autarky and Free Trade



[source: Blanchard and Willmann (2016)]

However, there is no empirical evidence in support of their explanation with regard to the growing middle ability occupations in developing countries. Contrary to this finding, the report by CITI and the Oxford Martin School predicts that because the risk of automation for some jobs in the developing countries is high, the workers are also at high risk. The report estimates the risk of automation in Ethiopia to be around 85% which is the highest in the world. This information could encourage more focus on the situations in developing countries too. There is hardly any evidence regarding labor market polarization in low-income countries, apart from the reports and some predictions by the World Bank and other institutions. From a theoretical point of view, the model by Blanchard and Willmann (2016) is convincing and thus, one might think, that it is possible to have a flourishing middle class, even though it might be difficult to explain the bottom and top trends. Moreover, one can at the same time question if the model can be supported by the data. Therefore, this paper will try to find empirical evidence and analyzes the labor market of developing countries using Ethiopian labor force survey data. Additionally, I will try to explain the evidenced trend and identify the driving forces for the

existing trends.

Given these facts, the study intends to answer the following questions:

- Is the labor market polarized in Ethiopia? As mentioned, regardless of existing evidence of polarization in high-income countries, there is no evidence for low-income countries.
- What are the driving forces behind the existing phenomenon? This question refers to, whether it is possible to explain job polarization using the same factors as in the case of high-income countries? To what extent can technology explain the polarization in low-income countries and also what could be the role of other factors like globalization, trade, FDI and immigration, and structural change?

2.3.2 Data and Descriptive Analysis

This study employs the Ethiopian labor force survey data for the years 1999 to 2013 collected by the Central Statistics Agency (CSA) in collaboration with the World Bank and Ministry of Finance and Economic Development (MoFED) for our analysis. The survey contains information on the personal characteristics (sex, age, and educational status), economic activities, and other important information of individuals surveyed[11] . Except for the 1999 survey, which is only used for qualitative analysis, the 2005 and 2013 surveys contain detailed information on the wages and hours worked.

Only wage earners who are active in the labor market, according to the standard set by the national labor office are considered. Thus, I keep employed workers, regardless of the sector in which they are employed, who are between 16 and 65 years old and whose wages and educational information is given. For simplicity, the surveyed individuals are grouped into three age categories. The majority of the individuals (73%) are between 30 and 50, while about 18% are below the age of 30. The self-employed and armed workers are also excluded from the analysis. Agricultural workers, who are the main self-employed workers are not included too.

The education level is used as the proxy for the skill level of the workers. Since there is no national education category, the educational achievement of surveyed individuals are mapped

[11]See the appendix for the descriptive statistics of the data

to the International Standard Classification of Education (ISCED) standard and four groups of education; high school dropout, high school degree, some college and college graduates are defined based on ISCED. Workers are further grouped into: low-skilled, middle-skilled, and high-skilled workers. Low-skilled workers are those whose educational level is below high school. High school and some college workers are considered middle-skilled workers, and the high-skilled group includes those who have completed post-college or university education. In 2005, around 38% of those surveyed were high-skilled, while 30% are low-skilled.

The information on the occupation and industry classification of the year 2013 is derived from the International Standard Classification of Occupation (ISCO) 2008. However, the 1999 and 2005 classifications are given in 4-digit ISCO and thus mapped to the 2013 three-digit classifications based on the information given in the survey. To avoid complications those occupations that are not in the 2013 but in the rest of the surveys are dropped. In the survey, the individuals were asked about the type of main activity and major product or services of the establishment or industry in which they were engaged during the survey reference year in order to know which kind of task they perform. For those participating in multiple activities, the activity that took up the largest share of their time was taken as the main task. Then, the responses of the survey regarding the occupation were coded using the National Occupation and Industry Classification (NOIC) codebook which was adopted from the International Standard Classification of Occupations (ISCO-88) and International Standard Industrial Classification (ISIC, 1990).[12]

The wage information is reported on a monthly basis in Ethiopian Birr. Employment (labor supply) is measured as total hours worked by the worker in each occupation[13]. The survey reports monthly hours worked by individual workers. Since our average employment in each industry and/or occupation is calculated from the hours worked by the interviewed person, the observations with no hours worked are also excluded.[14]

[12]See the CSA report on the labor force survey for the year 2005
[13]We alternately also measure employment as the number of workers in each occupation.
[14]See the appendix for more information and descriptive statistics of the variables in 2005.

2.4 Empirical Strategy and Results

2.4.1 Job Complexity and Routines

The key issue in the empirical work of labor market polarization is the measure and definition of job complexity because once the complexity of the job is defined, it becomes easier to extract the distribution of skills from the reported occupations in the survey. In the literature, there are two main strategies used for this purpose. The influential work of Autor et al. (2003) used the Dictionary of Occupational Titles (DOT) to define and to categorize jobs and to measure the skill content of occupations. Using DOT, they associated each occupation with the tasks, taking into consideration the educational attainment (skill) of the job holder and the task activity accomplished at the workplace by the same worker.

However, DOT measures and its successor Occupational Information Network (OINET), have certain drawbacks as both contain numerous task scales. To overcome this drawback Goos and Manning (2007) used wages as a proxy for the skill content of the jobs and also as a measure of the quality jobs.

Because this is the first study done in the case of a developing country, for simplicity I used both strategies in DOT and Goos and Manning (2007) to proxy the skill contents and quality of jobs. I first, ranked the change in employment shares by the median wage in 2005 and kept occupations that were observed in both surveys. After doing this, I am left with 101 occupations, which are grouped into 21 occupations to make it more tractable.

Autor et al. (2003) in their seminal paper, categories tasks into two major groups (routine and non-routine), which they further decomposed into five. Non-routine tasks are those task which require both visual and manual skills. Routine tasks are, those that can be sufficiently well specified or performed in a well-controlled environment and can be automated despite the seeming need for visual or manual skills that at present are poorly simulated by machines. The non-routine tasks are further grouped into three categories; cognitive, abstract, and manual tasks, while the routine tasks are classified into cognitive and manual tasks. This categorization is adopted in different literature.

In this study, the classifications by Acemoglu et al. (2012) are adopted for occupational classifications and occupations are thus, grouped into four main categories[15]:

- The non-routine abstract: includes occupations which require a higher level of skills or highly paid tasks like managers, professionals, associate professionals, lawyers, writers etc. These jobs are highly likely to be complemented by technology.
- The routine cognitive: includes occupations like secretaries, cashiers, typists, etc. The jobs are well organized and can easily be computerized.
- The routine manual: includes occupations like salespersons, machinery operators, handcrafts, etc. Like routine cognitive, these tasks can be performed by machines and other technologies.
- Non-routine manual: includes occupations like drivers, protective services, and others which Autor and Dorn (2013) called service occupations[16]. Service occupations are jobs which involve assisting or caring for others and are usually at the lower tail of the skill and earnings distribution.

2.4.2 Employment Growth by Major Occupations

After grouping and rearranging the occupations following a method similar to Acemoglu et al. (2012) and Acemoglu (2002), I first compute the growth in employment share for each major occupational group. As reported in Table 1, appendix, the growth rate of clerical jobs and crafts production jobs share significantly decreases between 2000 and 2013 while the employment share in service occupations (manual jobs) increases significantly over the sample year. On the other hand, managers, professionals, and associate professional occupations grow by around 20% over the sample year, while assembly and operator jobs share (these jobs are considered to be routine manual and decline over time Autor and Dorn (2013)) grow by 6% over the sample period. The top quality occupations grow by a significant rate, and employment in operators and assembly jobs also increases. This result is in line with the result of Autor and Dorn (2013) for the US and with other literature for other industrialized countries. Hence, this could be the first indicator for the existence of job polarization in Ethiopia.

[15]Detailed classification of occupations is given in appendix A
[16]Service occupations are different from services like medical doctors, education...

As the evidence from industrialized countries, the growth of employment in manual occupations is positive in Ethiopia. This result might not be surprising if one considers the government attention and the countries economic performance. It might be the case due to the government's focus of on job creation for the unemployed and low educated groups, huge government expenditure on infrastructures, and the high inflow of the foreign direct investment. The booming private construction sector also absorbs a significant number of manual workers and professional graduate engineers. The expansion of the micro and small enterprises could also play a meaningful role in creating employment for this group[17]. Moreover, the structural changes implemented by the government at different times and stages can also be a driving factor.

2.4.3 Regression Estimates

I estimate the simple regression model of a quadratic relation between change in the log of employment in job j, ΔE_j , and the log initial median wage in 2005, w_{j0} suggested by Goos and Manning (2007).

$$\Delta E_j = \beta_0 + \beta_1 \omega_{j0} + \beta_2 \omega_{j0}^2 + \epsilon_j \tag{2.4}$$

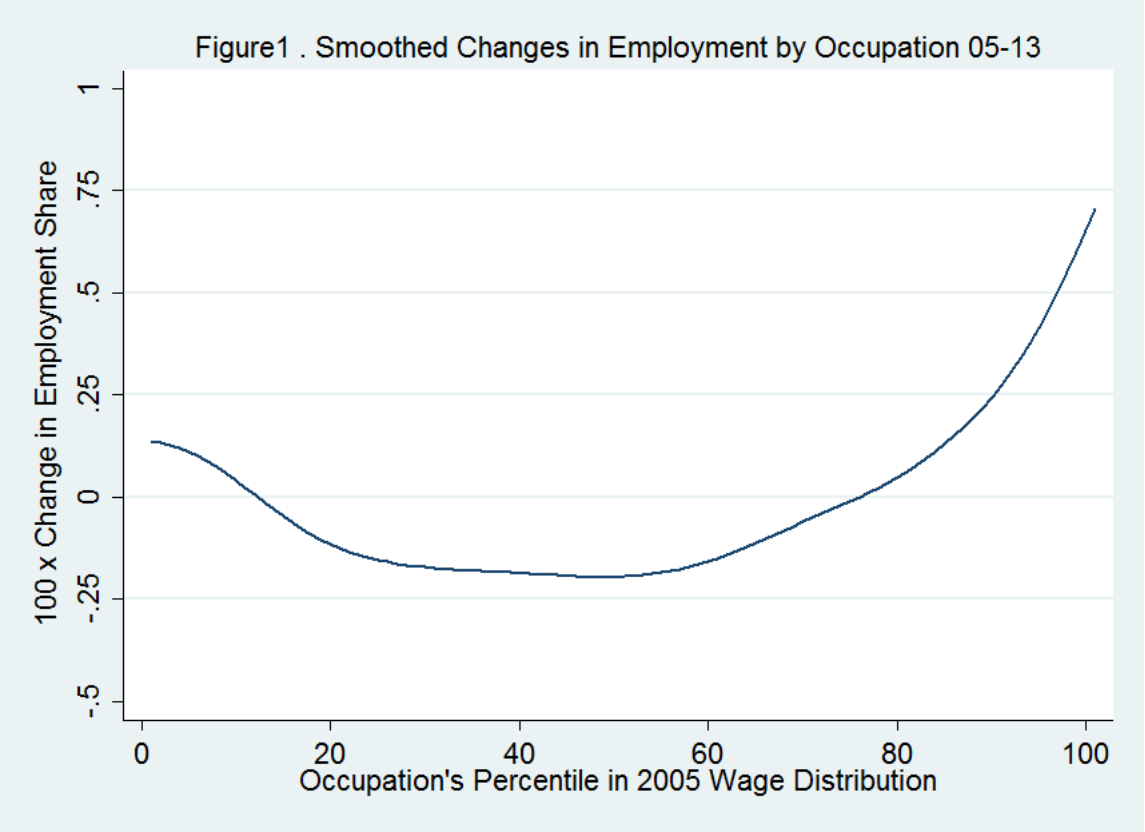
Where ΔE_j is the change in the log employment in occupation j, and ω_{j0} is occupation j's initial median log wage in 2005.

If changes in employment by skill percentile follow a u-shape pattern, the linear term in the regression should be negative and a positive quadratic term in the estimation of the equation. The result of the regression is reported in Table 3, appendix. The result shows the U-shape pattern of the relationship between change in employment over the sample period and initial wage. The linear term in the equation is negative, while the quadratic term is positive and significant. Again, this result is in line with the result of Goos and Manning (2007) for the UK and other related studies for other countries. What is different from the SBTC change is the downward sloping part of this relationship, in addition to the decline in employment of the middle-skilled occupations. The results of this study are in line with the routinization hypothesis and hence, could mainly be explained by routine biased technological change.

[17]show in number

Figure 4 below shows the result of the estimation. The figure shows the percentage change (growth) in employment over occupation percentile ranked by initial wage distribution. By measuring the employment growth on the y-axis, this study finds the U-shape pattern of employment growth. As shown, the employment growth is positive for occupations at both extreme tails of the distribution, while it declines for those occupations at the middle of the distribution. Furthermore, as represented by the graph, employment growth increases for workers earning less than the 15^{th} percentile and more than the 75^{th} percentile, while it declines for workers earning in between. This shows that the job quality is polarized and the growth in the employment share for the top quality job is strong.

Figure 2.4: Smoothed changes in occupational employment shares, with occupations ranked by their 2005 average wage



As mentioned above, employment can be measured in monthly hours and/or number of workers employed in the occupation. However, measuring employment by number of workers does not alter our result. This method is also used by Goos and Manning (2007) and I do the simple estimation of the quadratic relationship between employment growth measured by

number of workers and the initial wage.

$$\Delta\iota = \beta + \beta\omega + \beta\omega^2 + \epsilon \tag{2.5}$$

It would be also interesting to see the trends in employment change by gender and age group. Repeating the above analysis, the result shows a strong u-shape pattern in the growth of employment of female workers. Relative employment increases for female workers earning below the 20^{th} percentile and 80^{th} percentile. the same analysis could not find convincing evidence of polarization for male workers. The study shows the growth in relative employment only for those who are at the top quality job[18].

One of the main features of developing countries is that they have a large young population. Around 70% of the Ethiopian population is below the age of 35, 43% of which are below the age of 15. The age composition of the population directs and affects the economic and political decisions of the country. Given the large size of the country's population, it is also of interest to check for polarization at different age groups. The whole sample is grouped into three categories: those who are between 15 and 30, those who are between 30 and 50, and above 50.

As mentioned in Goos and Manning (2007), one might think this result can be driven by different terms of employment, especially by the casual and temporary workers as they are mostly the low earning group. Unlike the result of Goos and Manning (2007), the result of this study is sensitive to the term of employment. Classifying workers based on their term of employment (temporary workers, casual workers, and contract workers), it is possible to find evidence of job polarization for each group of workers[19].

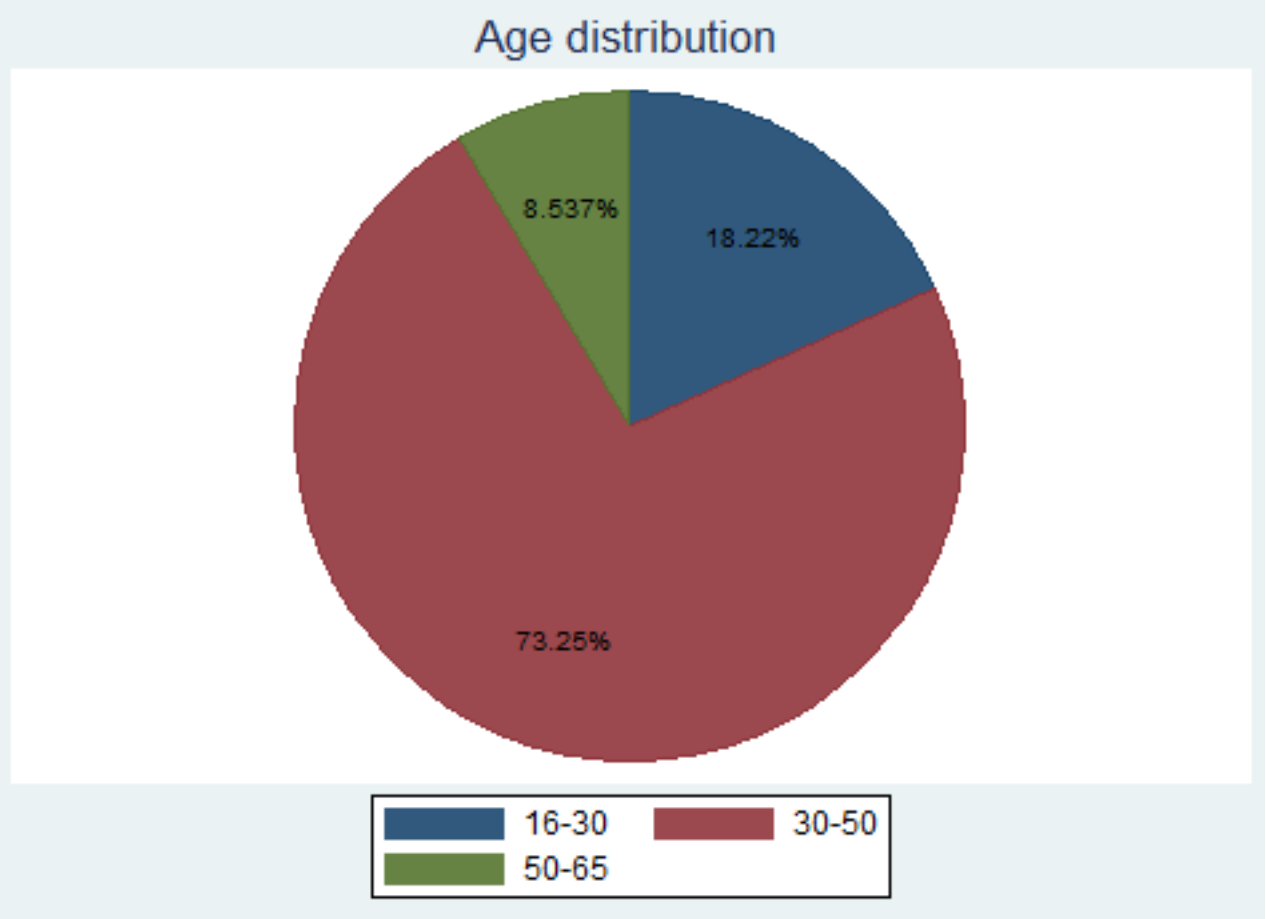
2.4.4 Job Polarization and Industry Composition: A Shift-Share Analysis

Following Acemoglu et al. (2012), this study analyzes the standard shift share decomposition of the change in the overall share of employment in occupation j over time. This analysis is used to understand if the change in the total employment of non-routine and routine occupations are

[18]The fig. in appendix shows the trend of employment for both male and female. This result is closely related to Keller and Utar (2016) for Denmark where they find that women overall experience more job polarization than men

[19]Permanent employment increases from 44% in 2005 to 56% in 2013, while the temporary employment and casual workers decline from 41% to 30% for temporary and 7% to 5% in the case of casual employment. Contract employment slightly increases from 9% in 2005 to 10% in 2013.

Figure 2.5: Age composition



due to technical change or result of the changes in the composition of the industry. Accordingly, the task demand, which is the main explanation for job polarization, is altered due to the shift in the industry structure towards the sectors that intrinsically use fewer routine occupation and more non routine occupation. I perform the standard shift-share decomposition by following Acemoglu (2002).

$$\Delta E_{jt} = \sum_{k} \Delta E_{kt} \lambda_{jk} + \sum_{j} \Delta \lambda_{jkt} E_k \tag{2.6}$$

$$\equiv \Delta E_t^B + \Delta E_t^W \tag{2.7}$$

The overall share of employment E_{jt} can be decomposed, as given in the above equation, into the parts due to changes in industry composition ΔE_t^B and into the part due to the within-industry shifts ΔE_t^W [20]. The change in the industry K's employment share during the time interval t is given by $\Delta E_{kt} = E_{kt1} - E_{kt0}$, while the average employment share of industry k over the time interval is given by $E_k = (E_{kt1} + E_{kt0})/2$. The change in occupation j's share of

[20] used as the measure of structural change

the industry k employment during time interval t is given by $\Delta\lambda_{jkt} = \lambda_{jkt1} - \lambda_{jkt0}$, while the occupational *j's* average share of industry k employment during the sample interval is also given by $\lambda_j k = (\lambda_{jkt1} + \lambda_{jkt0})/2$.

As reported in Table 1, the share of the employment of clerical jobs (routine cognitive) and craft production jobs (routine manual) decrease. The interesting thing here is to know where this change comes from. This change could be explained by the routinization hypothesis (technical change) as explained in the existing literature or by changes in industry compositions. I used shift share decomposition to test this hypothesis. If technical change is the factor that explains this fall in the growth rate of employment in routine occupations, then the within industry change should be negative and greater (in absolute value) than the between industry components. However, if the between component is greater than the within component, the change in employment could be better explained by the change in the industry composition rather than a technical change.

The result from the shift-share decomposition is presented in Table 3. The within industry changes are negative for routine cognitive, and routine manual occupations, while it is positive for the rest of the occupations. Moreover, it is larger than the between components for both occupation groups hence, it can explain the falling share of employment. This result is in line with routinization or the task biased technical change hypothesis.

2.4.5 Regional Employment Distribution and Job Polarization at Regional Level

This section will investigate the trend of employment at the regional level and explore the existence of labor market polarization in some regions of Ethiopia. The labor force survey data employed for this analysis, as explained under the data section, includes information of the surveyed individual's region, which makes the analysis possible at the regional.

Since 1996, Ethiopian has been divided into nine ethnically based and politically autonomous regional states: Oromia, Amhara, Tigray, Harari, Somali, Benishangul-Gumuz, Afar, Gambela,

and SNNP, and two chartered city administrations: Addis Abeba and Dire Dawa[21]. However, this study focuses only on three regions and one city administration, which are more important from an economic and political point of view: Oromoia, Amhara, Tigray, and Addis Abeba.

The Oromia region is the largest region both in terms of population and land area. It also contributes a major share to the GDP of the country. More than 50% of exported coffee is produced in this region. According to a report by CSA, the overall contribution of the region to export sector is significantly above 45%. The report also shows the region is inhabited by 40% of the total population with a 70% literacy rate in 2013. Moreover, it is one of the chosen sites of investment by both foreign and domestic investors mainly due to its location. The capital city, Addis Abeba, is located in this region which pave way for the better development of infrastructures, especially in the cities close to the capital.

I estimated the quadratic equation above, as suggested by Goos and Manning (2007), and the result of the regression confirms employment polarization in the Oromia region[22]. The results at the regional level are similar to the one found at the national level, i.e the linear term of the equation is negative and the quadratic term is positive, implying the U-shaped distribution of employment over job quality.

This analysis shows the presence of job polarization in the region over the surveyed years, 2005-2013. The occupations are ranked by the initial median wage (wage in 2005). Figure 10 shows the trend of employment growth in Oromia in the sample year. The figure shows employment growth in the first 5 deciles and the last decile, while there is a significant decline for the jobs between the fifth and eight decile distributions. The increase in the bottom and top distribution of jobs, and the decline for those in the middle demonstrate employment polarization in the region. Given the large proportion of the illiteracy rate in the region, it is not be surprising to see a large share of employment at the bottom of the distribution.

[21]See the Administrative map of Ethiopia in appendix
[22]See table in appendix for the estimation result for the selected regions. The sample varies for each region.

Table 2.1: Employment growth by major occupation in the Oromia region

Major Occ.	Share in 05	Share in 13	Growth
Man./prof./ass.prof/tech	21.57	26.89	27.17
Clerical jobs	19.34	15.59	-12.72
Craft prod	12.31	12.79	11.68
Ope and Assem	7.91	8.33	8.38
Service occ	38.87	36.41	40.05

2.5 Why Job Polarization Exists: Discussion

Two main driving forces for employment polarization in industrialized countries were widely mentioned in the literature. Rapid technological advancement and globalization (international trade, offshoring, and migration) are widely assumed to be the main causes of polarization in the US and in some EU countries. In fact, these factors have clear implications not only for the labor market of developed countries but also for developing countries which could be the recipients of the technologies and offshore jobs. However, Goldberg and Pavcnik (2007) show that some goods defined as unskilled-labor intensive from the point of view of developed countries become skilled -labor intensive from the point of view of developing countries. Hence, the tasks which can be performed by the low-skilled workers in a developed country can be operated by the middle or even, high-skilled workers, and those which can be executed by middle-skilled workers in advanced countries can be performed by high skilled-workers in low-income countries.

i. Globalization:

Ethiopia moved from a centrally planned command economy to a mixed free-market economic system following the fall of the Derg government in 1991. Since then many trade liberalization and deregulation reforms have been established and these have influenced employment and wages in the local economy. Major trade reforms have included a policy shift from the import-substitution to export-promotion strategy and the gradual reduction/removal of tariff and non-tariff trade barriers. The government has established industrial zones to allow export-oriented manufacturing activities to be freely performed and also to give preferential treatment with respect to taxation, infrastructure, and few regulations, especially for foreign investors. Moreover, several restrictions on foreign investment have been removed and the investment environment has been improved through different timely regulations with a variety of special incentives in place to attract FDI. As a result, Ethiopia has recently become one of the main

FDI destinations of FDI, making it among the top five recipients FDI in 2015. Numerous international partnership agreements, like the African Growth and Opportunity Act (AGOA), the Economic Partnership and the Common Market for Eastern and Southern Africa (COMESA), and others are also among the factors for the dramatic growth in export-platform FDI inflows (UNCTAD, 2016). Its global competitiveness in light manufacturing industries, particularly garments and leather products, coupled with the cheap labor and large market sizes, are the factors that attract foreign direct investment, even though the ups and downs in political stability, corruption, and bureaucracy are pushing the FDI out. The FDI in Ethiopia increased from 135 million USD to 2.2 billion USD in 2014 and in the same time span employment increased from 27,000 in 2000 to 44000 in 2014(EIC, 2016 and ILO 2016).

Even though giving the same conclusions, for developing country needs further analyzes and also considering other low-income countries, it is possible to put forward some points that are affecting both the demand and supply side of labor in developing countries focusing on the Ethiopian labor market. As Ethiopia is one of the fastest growing economies in the world, both government reforms and the increasing market demand can affect the labor market and its demand composition. This fact is also reflected by the rapid change in the employment and economic structure of the country.

Like in other developing countries case, technological change can explain the trend. The innovation and introduction of new sophisticated technology can make it easier for firms to perform tasks by using new machines. Computer technology and the increasing use of internet connections reduces the demand for some types of workers. Moreover, due to recent policy reformations to enhance the inflows of the foreign direct investment and the imports of the capitals goods, it is easier for foreign companies to bring new machines and facilities into countries.

Institutional Changes and Urbanization:

Another factor which may contribute to the existing trend of employment could be urbanization and structural changes. In Ethiopia, since the fall of the socialist (DERG) regime, many economic reforms have been undertaken. The government has liberalized the market and privatized government-owned industries. This action has laid the foundation for the expansion of existing industries and the establishment of the new ones. Moreover, the current shift from an

agricultural development led industrialization policy to an industrial development led policy has paved way for the expansion of big and small industries. A number of industrial parks have been established and have started operating in recent years. In fact, those industries are more labor intensive and create more employment for both highly educated and low educated groups of people.

The expansion of the construction sector in recent years is creating more jobs. Ferede et al. (2015) The huge government investment in infrastructure, the housing of the city municipalities, and other construction sites take a lion share in creating jobs for both the unskilled and skilled labor force (see Kibret (2014)).

Since a new national policy of industrialization that replaced the agricultural development led industrialization policy was introduced in 2005, the government promoted and facilitated ways for the introduction of new industries. The new industrial zones were identified in different cities in the country and created huge employment opportunities. According to the report by the Ministry of Industry, they created thousands of jobs in 2015 and the majority of the created jobs were low-skilled labor force intensive.

Even though some possible factors which are expected to affect the demand and supply of the labor force are mentioned, It is difficult to identify which factor the major deriving force for the disappearing middling occupation. In fact, some of the factors given for industrialized countries, like international trade, can play a major role in affecting the routine occupation. The reduction in the price of computer technologies and other electronic instruments might make it convenient for investors and existing industries to substitute the labor force with these technologies. It might not only be the price, as the price labor force is very low in Ethiopia, but the international competition through globalization could also motivate the firm to install new technologies. Recently, for example, the Ethiopian telecommunication fired a large number of employees as it introduced new technology, while banks are also changing their system from manual to electronic in recent years.

2.6 Conclusion

In this paper, I analyzed the employment changes along skill distribution in the low income country, Ethiopia. For the analyzes, the Ethiopian labor force survey data from the CSA was utilized. Motivated by the result from the work of Blanchard and Willmann (2016), I intended to answer two questions: are the middle occupations declining developing countries? If so, what factors could be the driving forces?

I followed the studies by Goos and Manning (2007) and Autor et al. (2006) to find evidence of employment polarization in Ethiopia. I first approximated the employment share of major jobs from which one can initially observe the fall in the employment share of the routine occupations (crafts production and clerical jobs). Then I estimated the quadratic regression suggested by Goos and Manning (2007). The quadratic regression of the change in employment over initial wage also confirms the result and it is in line with the other literature in the field. Moreover, I found that female workers are affected by the phenomenon, while it is not clear for male workers. Age wise, those who are between the ages of 30 and 50 are most affected. There is also evidence that the Oromia region and the Addis Abeba city administration's labor markets are polarized.

I also used the shift share analysis to find if the reduction in the routine job is due to technical change or a change in industry composition. According to the result, technical change can explain the reduction of employment share in the routine occupation. I did the analyses at the regional level, where I found the same result as the national level.

I approximated employment by the monthly hours supplied and used the simple head count to check the robustness of our analysis. In both cases, the quadratic estimation of the correlation between changes in the employment share and the initial wage confirms our conclusion. The parameters of this estimation, both the linear and quadratic terms, have the expected sign and significant. The plot of this correlation also shows the U-shape pattern of employment. However, more research is required to find out to what extent technology can explain this change in employment and the employment pattern and how other factors mentioned in the text could also play a role in shaping this pattern of employment.

Appendix

Table 2.2: Classification of occupations

No.	Occupation	Group
1	Managers, Lawyers, professional, Physics, mathematicians, engineering professionals, associate profes. life science and health professionals, Life science and health associate professionals , Economist, accountants, Writers, artists and sportsmen, Education workers, Other professionals, Other associate professionals, Executive managers...	Non routine cognitive tasks
2	Secretaries, stenographers, typists Cashiers, tellers and the similar Telephone switchboard operators, Other clerks Sales	Routine cognitives
3	Street salesperson, Machinery operators, Precision, handicraft, and related workers	Routine manual
3	Drivers,Building workers,Cookers, bartenders, porters, Protective services workers, hair dressers, cleaners, Other services	Non routine manual

Table 2.3: Employment growth by major occupations

Major occp.	2000	2005	2013	perc. chnage 00-05	perc. change 05-13	perc. change 00-13
Man./prof./ass.prof/tech	21.57	26.89	27.17	19.78	1.03	20.61
Clerical jobs	19.34	15.59	12.72	-24.05	-22.56	-52.04
Craft prod	12.31	12.79	11.68	3.75	-9.50	-5.39
Ope and Assem	7.91	8.33	8.38	5.08	0.59	5.60
Service occ	38.87	36.41	40.05	-6.79	9.11	2.95

Table 2.4: Regression result: Employment change and initial median wage

Coefficient	Overall	Male	Female
β_1	-1.516	-0.35	-2.182
	0.088	1.088	0.079
	-1.724	1.045	-1.692
β_2	0.123	1.203	0.145
	0.008	0.889	0.893
	1.629	-1.786	1.893
constant	4.932	2.546	1.459
	0.255	1.673	0.607
	1.935	1.789	-1.605

Note: Dependent variable is the log of changes in employment. The value for the coefficients are given in the first row of the respective coefficient and the standard error and t-values are in the second and third row. The R^2 and the adjusted R^2 are in fact very low, which is to mean that the explanatory power of the independent variable wage and initial wage is low. This might be because of change in employment can be caused by other factors as well and including other variables could improve the explanatory power of the model. Moreover, I am interested in the sign of the coefficients and the result is in line with other findings .

Table 2.5: Shift share decomposition

Occupations	Between	Within	Total
Non-routine cognitive	-1.16	1.62	0.46
Non-routine abstract	-0.28	1.21	.93
Routine cognitive	0.16	-1.12	-0.96
Routine manual	-0.90	-1.09	-2.00
Non routine manual	-0.7	1.50	0.75

Figure 2.6: Age and education composition in 2005

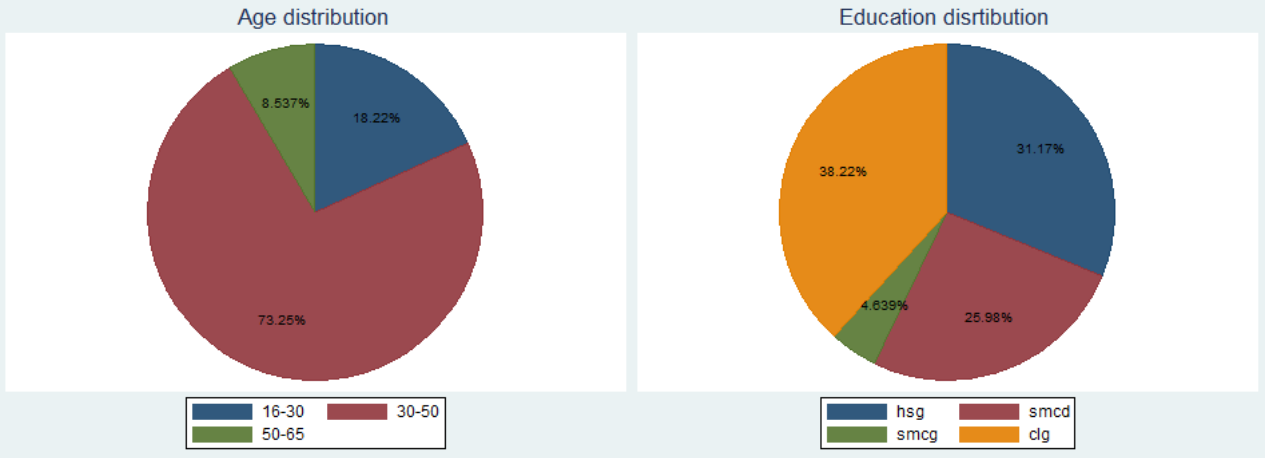


Figure 2.7: Smoothed changes in occupational employment shares for female, with occupations ranked by their 2005 average years of schooling

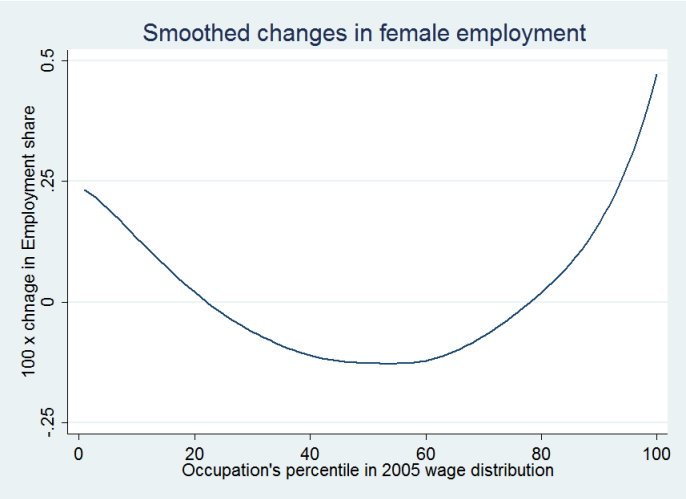


Figure 2.8: Smoothed changes in occupational employment shares for males, with occupations ranked by their 2005 average years of schooling

Figure 2.9: Smoothed changes in occupational employment shares, with occupations ranked by their 2005 average years of schooling

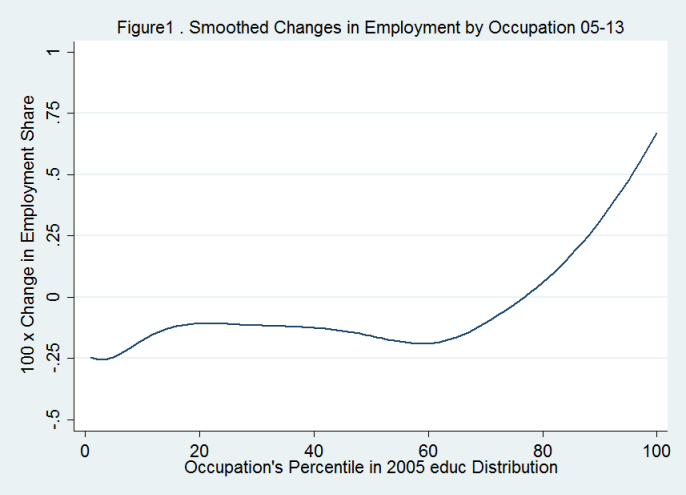


Figure 2.10: Smoothed changes in occupational employment shares, with occupations ranked by their 2005 average years of schooling: Oromia

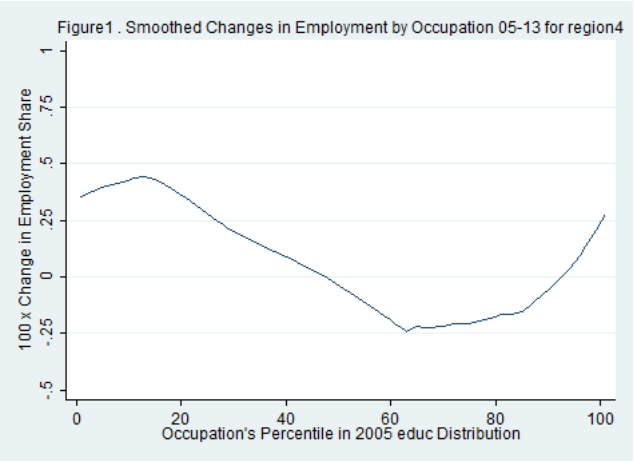


Figure 2.11: Smoothed changes in occupational employment shares, with occupations ranked by their 2005 average years of schooling: Tigray

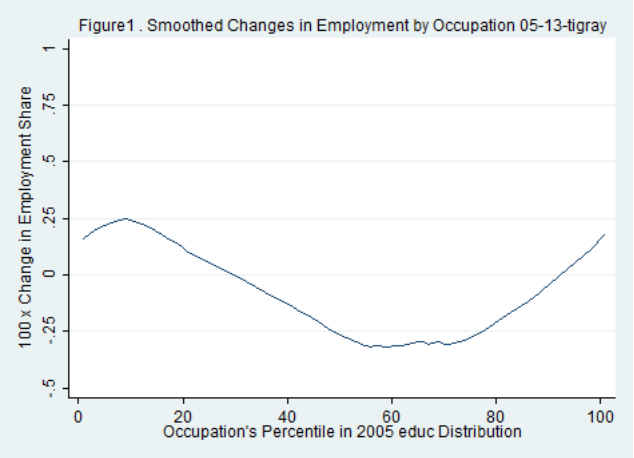


Figure 2.12: Smoothed changes in occupational employment shares, with occupations ranked by their 2005 average years of schooling: AA

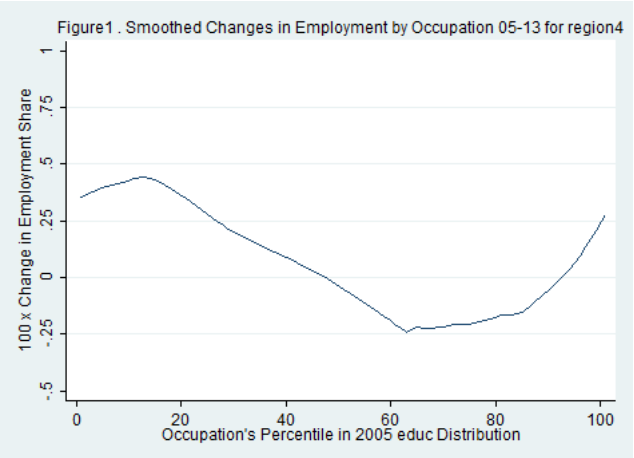


Figure 2.13: Smoothed carnages in occupational employment shares of permanent workers, with occupation ranked by their 2005 average years of school

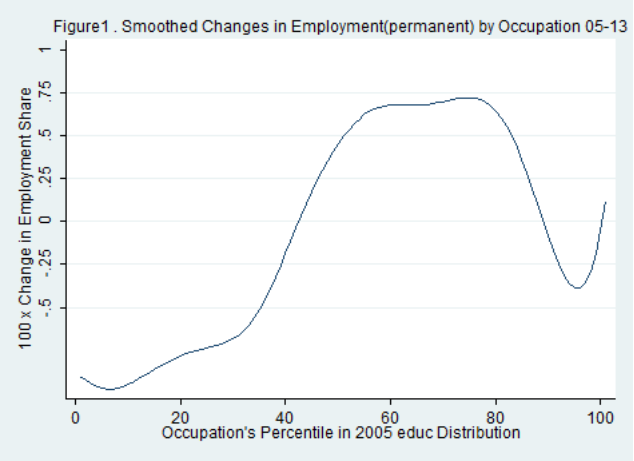
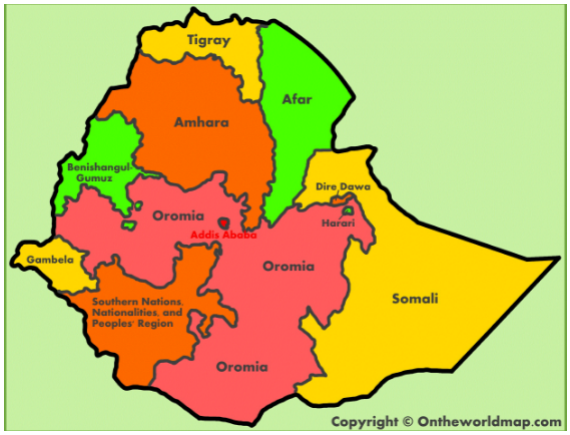


Figure 2.14: Ethiopian administrative map



Chapter 3

The Labor Market Impact of Globalization

Abstract

Even though growing labor market inequality is a global phenomenon, there exist few studies analyzing the phenomenon, especially in the case of the Sub-Saharan African countries. This study aims to assess the link between globalization, the labor market, and inequality in a developing country using the unbalanced panel data of the Ethiopian manufacturing firms (LMSM) over the period from 1999 to 2011 by employing the alternative econometric method of panel data estimation technique to estimate the dynamic models of employment and wages. The result of the dynamic regression shows that the participation of firms in the foreign market through export contributes positively to the creation of employment and wage growth in general. However, the wage gap between skilled and unskilled employment (wage inequality) increases as a result. Foreign direct investment, though, contributes positively to the creation of employment and wage growth, and also mitigates the wage gap. Firms which are located closer to the capital city not only employ more employees but also pay higher wages. Moreover, the result shows import has an insignificant effect on both employment and wages. However, it has a minimal effect on the demand and thus, the wages of unskilled workers, especially if the simple OLS estimation technique is employed.

3.1 Introduction

The purpose of this paper is to analyze the impact of globalization on the labor market in developing countries. The main focus is on the impact of firms' engagement in the international market through export and/or import and the firm's ownership type (whether the firm is locally owned or foreign owned, which is the proxy for FDI and technology transfer) on wages and employment in the manufacturing sector of Ethiopia[1]. Moreover, another motivation of this study is looking at globalization driven labor market inequality by following both the traditional skilled and unskilled wage differential (SBTC) and the recent method of analyzing the trend of inequality which is linked to polarization (routinization hypothesis). The study will also try to examine whether economic liberalization (openness) can lead to inequality in the labor market through the effect on labor demand.

Compared to the bulk of existing studies and evidence for developed countries, there are very few studies on the impact of globalization on the local labor market of developing countries, especially for Sub-Saharan African countries mainly due to lack of good data. As stated in Epifani and Gancia (2008), trade flows, especially between developing and developed countries have recently increased considerably following the liberalization of most countries in both the North and South. Since the late 1970s, extraordinary trade liberalization has taken place. The share of countries classified as open according to the Sachs-Warner (1995) criteria rose from 35% in 1980 to 95% in the late 1990s and the trade share of the average country rose from 59% of GDP to 74%. Over the same period, the skill premium, which is the difference between the wages of skilled and unskilled workers, rose on average by 8% (for more details see Epifani and Gancia (2008)).

The well-known H-O theorem is the natural starting point in understanding the link between international trade and wage inequality. The main prediction of the H-O model is that countries produce and export goods that intensively use the factors of production in which they are endowed abundant, hence trade increases the real return to the relatively abundant factors. Hence, in developing countries with abundant labor (unskilled), the wages of unskilled labor is expected to increase relative the scarce factor (capita; skilled labor), which creates inequality.

[1] The firms ownership type can be used as a proxy for the FDI inflow to the country Haile et al. (2013)

The opposite was expected in developed countries. Following this seminal work, there has been extensive research done in this area, but with many papers focusing on developed countries rather than on developing countries.

There are several studies that examine the impact of globalization on the labor market for developed countries. The empirical work by Greenaway et al. (1999) for the UK is worth mentioning. There is also work which looks at the impact of market liberalization on the local labor market from the viewpoint of emerging countries like India (Marjit and Acharyya (2003), Raj and Sen (2012)), China (Fu et al. (2004)), Turkey (Meschi et al. (2008)), Mexico (Feenstra and Hanson (1997)), and Latin American countries (Wood (1997)).

The literature on the recent trend of labor market inequality due to globalization and technology also mainly exists for developed countries. The pioneering work of D. Autor and his co-authors (Autor et al. (2003)) is one of the most influential in this area. It shows the growing inequality in the labor markets of developed countries. The idea is there is a relative growth in employment/wages at both extreme distributions of skill, while there is a negative growth in the middle. Routine task workers, who are found at the middle-skill distribution, are suffering as a result of technological change and international trade. Autor and Dorn (2013) show the change in employment in the US manufacturing sector as a result of China's import penetration, specifically that the middle-class employment in the US manufacturing sector is declining. Other works in this branch of idea are Goos and Manning (2007), Salvatori (2015) for the UK, Goos et al. (2010) Goos et al. (2014) for the EU, and Black and Spitz-Oener (2010) for Germany and these papers show the same trends of the employment and wages except for Germany, where there is no clear evidence of wage polarization. Gourdon (2007) followed this idea and analyzed the impact of international trade for a panel of developing countries.

This paper uses the Ethiopian Large and Medium Scale Manufacturing (LMSM) establishment survey data to show the response of the labor market variables (employment and wages) to the firms' participation in the international market through import and/or export and the inflow of FDI. Using the SYS-GMM model, the result suggests that there is a positive relationship between employment/wages and the export dummy. This shows that the exporting firms not only employ more employees but also pay higher wages. Even though the relative increase in wages for

skilled workers is higher than that of unskilled ones, the relative demand for unskilled (production) workers is relatively higher. With regards to the firms' ownership, foreign-owned firms are paying relatively higher wages for skilled workers and employ more skilled workers. Firms in or around the capital city of Addis Abeba are not only employing more, but also pay higher wages[2].

Developing countries like Ethiopia are relatively abundant in the unskilled labor force. Thus, according to the standard trade models, globalization should increase the relative demand for the abundant factor, unskilled labor in these countries, and thus, decrease wage inequality. However, empirical evidence like this one does not support this expected theoretical result and rather shows the opposite. Even though studies on income distribution does show mixed results, empirical studies on wages mainly show increasing wage inequality due to trade liberalization. The main explanation was the skill-biased technological change and according to this theory, technology is factor augmenting, therefore the advancement in technology favors the skilled over the unskilled workers. The most recent explanation, routine biased technological change, explains this phenomenon. Technology can easily substitute routine workers while it complements the abstract workers and does not have a direct effect on those who are engaged in manual tasks of production. It also shows the growing wage and employment inequality.

Being one of the fastest growing economies and among the preferred destinations of FDI, Ethiopia implements a different comprehensive program to enhance its employment and to improve wages and labor market income distribution. National policies under different regimes like trade liberalization and deregulation policies were implemented to open the market and to attract the foreign capital. Additionally, as the country is striving to attain the status of a lower-middle income country by 2025, the growth and transformational plans (GTP I, and currently GTP II) strategies. The industrial zones were identified by the government and also facilitates ways for the expansion of the export-oriented manufacturing activities (See report by MoFED 2016).

Given the above mentioned facts, there are few empirical studies which assess the Ethiopian labor market, especially with a focus on trade liberalization and technological advancement. The

[2]Vicinity to the capital city is useful in influencing the labor market outcomes. Firms which are closer to the capital are larger in nature and export oriented. Thus firms and workers in this area are more exposed to the globalization wave than those far from the capital

study in the Ethiopian context, which is close this one is the one by Haile et al. (2017) which analyzes the impact of the technological change on permanent skilled and unskilled employment over the period between 1996-2004. Their findings show that trade liberalization enhances skills, although it is weak. This work expands the scope by using the most recent data available from CSA for the years 1998-2011. In addition to this, this study attempt to look at the impact of different workforce composition (skilled (administrative) vs unskilled (Production)) on the wages and try to analyzes the globalization driven inequality in the labor market. Additionally, this work deviates from the previous study, by shifting the focus from the skilled-unskilled composition of the workforce to the more detailed categorization of skill following recent literature.

Thus, this work is expected to contribute to the body of existing literature in different ways. First, it analyzes and looks at the evidence for the labor market (both employment and wages of the different workforce) response to trade liberalization and technological changes in the context of fast-growing economy[3]. Second, it could contribute to the little existing literature on Sub-Saharan African countries, since it focuses on the context of a developing country. As mentioned above, there is little work that links labor market, globalization, and technology in the case of developing countries. Thus, this work can fill the gap in this aspect. Moreover, it is useful to understand the link between globalization and the labor market in fast-growing economies like Ethiopia. Finally, it would contribute to the routinization hypothesis literature by looking at the more detailed categorization of the industries based on their skill intensity and the impact of globalization on each skill group.

The rest of the paper is organized as follows. Section 2 explains the data used in the analysis and presents the descriptive statistics of the key variables. Section 3 presents the overview of globalization and the labor market in Ethiopia. Section 4 shows the empirical model specification and presents the estimation methods. In section 5, results and discussions will be presented, and the last section provides conclusions.

[3]Fast growing economies are more open and globalized (Gygli et al. (2018)). Moreover, fast growing and large countries like Ethiopia, are the most preferred destinations for international firms, FDI

3.2 Overview of the Related Literature

Much of the literature on trade and labor markets are discussed both theoretically and empirically in the context of developed countries. Moreover, the literature depends on the skilled-unskilled labor hypothesis to analyzes the impact of globalization in general. The core issues at the heart of the discussions are globalization (trade liberalization as in Were (2011), Manda and Sen (2004)), skill-biased technological change (as in Acemoglu (2002), Katz and Murphy (1992), among others), and the task-biased hypothesis (Autor et al. (2003), Goos and Manning (2007) Goos et al. (2010), among others). Recently, some studies have started investigating the impact of globalization on the labor market in emerging countries like Mexico Feenstra and Hanson (1997), India Raj and Sen (2012), China Fu et al. (2004), and Latin America (Wood (1997)).

The main argument in the literature is whether globalization in the form of trade liberalization leads to labor market inequality. Early work which links trade and inequality is the HeckscherOhlin (H-O) theorem of international trade. The theorem states that countries export goods that use its abundant factors of production intensively and import goods that use its scarce factors of production. Thinking of the two factors of production in this theorem as skilled and unskilled labor, skilled labor might suffer in developing countries as a result of skilled labor intensive goods and services imports from developed countries and unskilled labor suffer in developing countries due to imports from developing countries. Simply, H-O predicts that trade results in the redistribution of employment from an import substitute sector to an exporting sector.

The skill-biased hypothesis was used to explain the growing wage gap among college graduate and the labor market inequality since the 1950s. Krueger and Kumar (2004) explains the increased share of skilled employment due to technological change. Accordingly, the introduction of new technology increases the demand for skilled workers and moreover, the skilled workers are fast learners which can help them to adapt to new technology (new business environment) easily. Were (2011) argues that trade involves technology transfer, and if the technologies transferred to developing countries are in favor of skilled labor, then the structure of labor demand will tend to the shift towards skilled labor.

Ghosh (2008) argues that more and more developing countries are drawn into an export-oriented strategy. This strategy has adverse affects because the firms are competing for the same markets and they are producing and trading similar goods. This further affects the terms of trade. Similarly, Pastore (2008) stated that trade liberalization fires up the competitiveness of the global market and increases the search for lower production costs, where firms look for low-cost and more flexible labor markets. Many also argue that this stiff competition and firms' intentions lead to change in the labor market structure (Were (2011)).

Autor et al. (2003) introduced the task-biased hypothesis. The idea of the hypothesis is that technology can easily substitute routine tasks, which are mainly performed by the middle-skilled workers, while it complements the high-skilled workers and has insignificant or no effect on those who are low-skilled. Thus, the reduction in the price of computer technology, makes it easier for firms to substitute the middle-skilled workers. As a result, inequality in terms of the wages of workers increases.

Goos et al. (2014) and Egger et al. (2016) also explain the role of offshoring and international trade in widening employment and wage growth. Offshoring involves the movement of a task to where it can be performed cheaply. The routine tasks are well organized to export or simply to move to another country and as a result, the corresponding type of employment might disappear.

Empirical studies are also available, even though most focuses on advanced countries. However, there is no common conclusion of the impact of globalization on labor market outcomes from the available literature. Some researchers found that globalization in the form of international trade has a significant and positive impact on labor market outcomes (Fu et al. (2004)). Contrary, others find negative impact of trade on the labor demand (Greenaway et al. (1999)), while there are few which show the insignificant effect of trade on labor market outcomes (Raj and Sen (2012)).

Gourdon (2007) investigates the impact of the direction of trade on wages. He identifies the impact of South-South and North-South trade and analyzes the impact on wage inequality using sample data from over 70 countries. His findings show increasing wage inequality due to

South-South trade liberalization.

3.3 Data Sources and Descriptive Analysis

The data set employed in this study is form the annual census data for Large and Medium Scale Manufacturing industries (LMSM) between 1998 and 2011, collected annually by the Ethiopian Central Statistics Agency (CSA). The data covers all private (both domestic and foreign-owned) and public manufacturing industries with 10 or more employees and provides detailed information about the establishment. The industries are classified based on the international standard industrial classification, ISIC Rev. 3. Firms with less than 10 workers are not considered. The data gives a wide range of information generated using the 8-section questionnaires regarding the establishments properties such as the number of owners, paid-up capital, total wage, total employment, total sales (domestic sales and exports), inputs (local and imported), costs of production, initial and current capital value-added, and others[4].

Employment is measured as the number of workers in each quarter of the Ethiopian calendar year, which runs from September (Meskerem) to August (Nehase). Therefore, the total employment is the average over those quarters and it is the sum of both permanent and temporary employees in each quarter. The other variable of interest, the firms' ownership type is defined based on the share of initial paid-up capital. It is the ration of initial paid-up capital by domestic, foreign investor, and/or government to the total initial paid-up capital. A firm is domestic if the share of the initial paid-up capital by the domestic owners is higher, it is public owned if the state share in the initial paid-up capital is higher and it could also be a foreign owned firm if the share of the initial paid-up capital by the foreign investors is higher. To be more precise, I set the cut at 50%. Since the study is intended to look at what happens in private enterprises, the beginning of this work focuses on only private (domestic or foreign) firms. This variable is used in many literature as a proxy for foreign direct investment (FDI) since it shows the flow of foreign capital and full or partial involvement of the MNCs in the production process of the partner industries. All the financial variables are expressed in Ethiopian currency (Birr) and

[4]For the detailed lists and definition of the variables and information on the number of firms in each sample years see the appendix

deflated using GDP and/or CPI deflators when it is important.

I categorize the establishments into three groups based on their skill intensity level using the ISIC rev.2 following Gourdon (2007). High-skill intensive (HSI) firms, require workers of higher skill like basic chemical, pharmaceutical, assembly etc firms. Low-skill intensive (LSI) firms are those which mainly employ workers of lower skill and include firms like dairy product, agricultural. and agro-processing firms. The third category is the middle-skill intensive (MSL) firms like sugar and confectionery, pasta and macaroni, etc [5].

Export and import are also adjusted depending on how they are utilized in the regression. We consider the dummy value of those variables in the benchmark regression[6]. The location dummy variable is also generated depending on whether the firm is in/close to the capital Addis Abeba. I only consider firms with an average of 10 or more employees. Establishments with missing output and input variables (employment and others) are also deleted. Since the empirical analysis depends on the lagged values of the dependent variables, firms who are observed only once will be excluded for regression purposes. This omission means that the data used in the analysis is of an unbalanced nature.

Table 3.1: Descriptive statistics of the key variables

Variable	N	Mean	Std. Dev	Min	Max
Total employment	5037	101.9705	247.7963	12	44756
Average wage	5034	3096.312	2807.647	74	47134.04
Total output	5028	1.30e+07	5.27e+07	1983	1.34e+09
Export share of output	5022	.0260367	.1399982	0	1
Import share of input	5022	.2897255	.3559368	0	1
Export	295	15.19769	2.145428	7.718686	19.68987
Import	3324	12.35109	2.654119	3.465736	19.71881
Export dummy	5022	.0585424	.2347896	0	1
Import dummy	5022	.6600956	.4737236	0	1
Location dummy	5022	.5575468	.4967268	0	1
Foreign ownership	4182	.0551347	.2155087	0	1

[5]The firms' detailed category will be shown in the appendix. This categorization is adapted from Gourdon (2007) and used to link the labor market and globalization variable using the concept of job polarization/routinization hypothesis

[6]In fact, the regression result shows that import has an insignificant impact on both wages and employment, thus, I did not pay much attention to import and rather focused on export

3.4 Globalization and the Labor Market in Ethiopia: An Overview

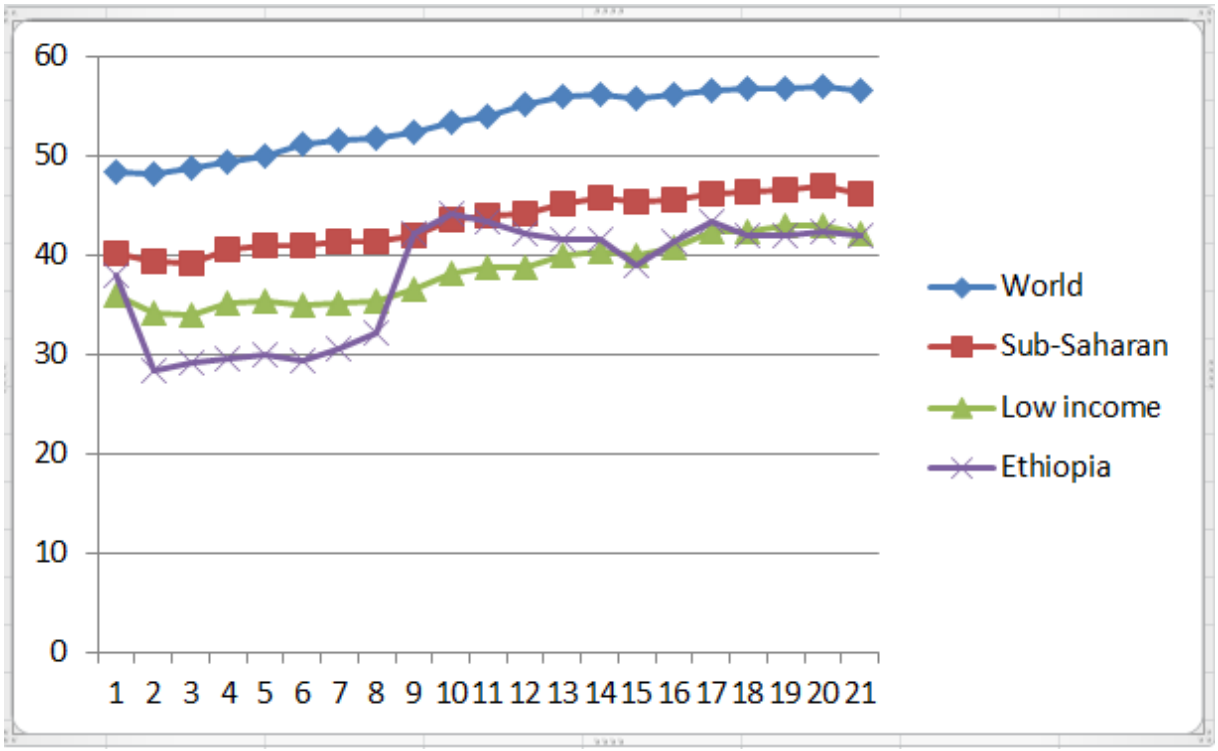
3.4.1 Globalization Index

Globalization is defined as a comprehensive process of economic integration that can enhance the international mobility of the national resources and increases interdependency of national economies (OECD 2005). In fact, there are, the social, political, and cultural aspects of globalization as well, but this study focuses on the economic aspect of globalization. Bhagwati (2004) also define economic globalization as:

'integration of the national economies into the international economy through trade, direct foreign investment (FDI) through cooperation and multinational (MNCs), short-term capital flows, international flows of workers and humanity and generally flows of technology.'

Keeping this in mind, the Ethiopian economy also went through ups and down with respect to globalization. Figure 1, below shows the dynamics of economic globalization of Ethiopia and compares it with that of low-income and Sub-Saharan African countries, as well as the average world economic globalization index (KOF) for the years between 1995-2015. Over this period the index shows the dynamics are well below the average world index and also that of other Sub-Saharan African countries. Regardless of the effort from the country to open the economy and to create links with other African countries and world economies, through participation in different regional and international organizations, its economic network remains low Gygli et al. (2018).

Figure 3.1: KOF Globalization index for the year 1995-2015



Source: Own computation using data from KOF Swiss economic institute

3.4.2 Trade and Trade Reforms in Ethiopia

Ethiopia has implemented many regulations and comprehensive programs to liberalize its economy like many other developing countries. Especially in the past three decades, the country has launched different programs like trade liberalization, privatization and deregulation reforms to attract foreign capital and to boost international involvement in terms of merchandise trade and capital inflow.

Ethiopia has adopted different policies that advocate for international trade like merchandise trade and capital flows during the past three regimes. Both the Imperial regime (pre-1974) and the DERG regime (1974-1991) follow the import substitution policy with the aim of protecting the local infant industries. Despite local firms' strong protective policies, these regimes undertook different development plans to promote international trade and FDI. The Imperial regime's plans (the first five-year plan from 1958 to 1963, the second five-year plan from 1964 to 1969, and the third-five year plan from 1970 to 1974) focused on promoting import substitution strategies. However, the degree of emphasis these plans gave to export incentives was different. The first plan gave relatively low emphasis to export promotion and highly focused on the im-

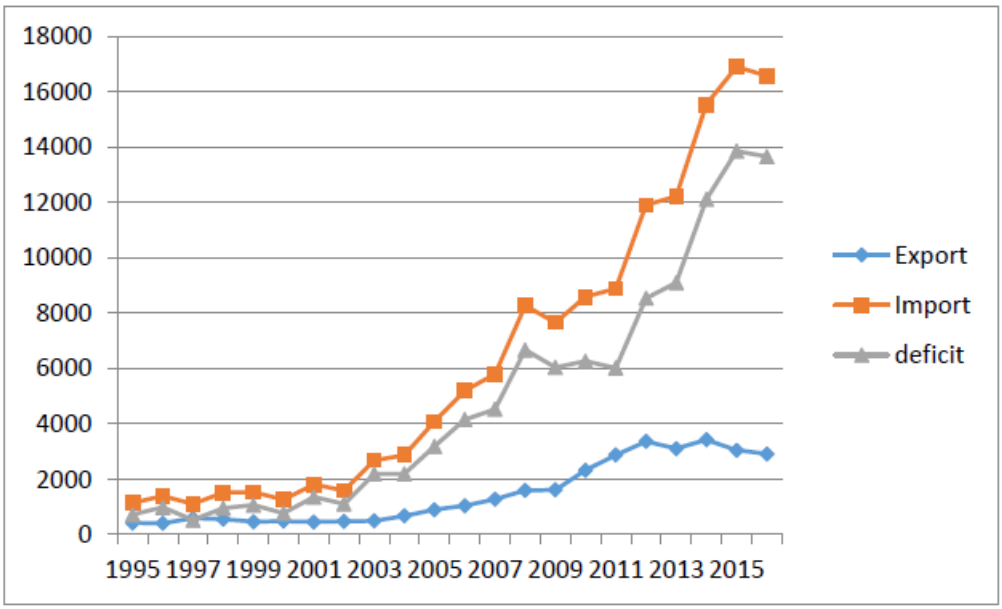
port substitution strategy. Even though there was improvement in this regard, in the other two plans the main attention was given only to traditional export products like coffee and other raw materials. Despite those facts, in this regime, there was over valuation of the exchange rate and high tariffs up to 240 on average (see Hansson (2004), Geiger and Moller (2015) Hansson (1995)).

Following the fall of the imperial government, the Derg government came into power in 1974 and continued under the import-substitution strategy. However, the military government adopted a socialist ideology and nationalized all large and medium manufacturing industries and all national policies were centrally planned. With regard to the trade policy, the system was more import protectionist, with high tariffs and central government involvement.

After almost two decades of a centrally planned and regulated economic system, the current government came into power in 1991 and implemented major policy reforms first under the Transitional Government of Ethiopia (GTE) and then later as Ethiopian People's Revolutionary Democratic Front (EPRDF) from 1995 onward. During the GTE, Ethiopia underwent major economic reforms and transformations. Some of the policy measures undertaken by the GTE were privatization of the previously state-owned large and medium scale manufacturing industries, trade liberalization and market deregulations. According to a document from the Ministry of Trade in 1993, the government made a structural adjustment program through the help of the World Bank (WB) and the African Development Bank (ADB). Quantitative restrictions and gradual import and export tariff reductions, as well as the removal of non-tariff barriers and import licensing measures, took place as trade reforms. The export-promotion strategy was introduced instead. Moreover, tariff harmonization, exchange rate devaluation, and relaxing non-tariff barriers were also at the center of the reform. Custom tariffs were substantially reduced between 1993 and 2003. Initially, the maximum tariff rate reduction fell from 230% to 80% and further, in the next rounds the tariffs gradually fell to 35% in 2003. Even though there was economic liberalization, after 1991, the state still continued to play an important role, as it had full and/or dominant control over some key sectors like; telecommunication and IT, bank and other financial institutes, transportation, and others. The land remained state owned (for more detail see Ferede et al. (2015), Gelan (2002).

However, the country continues to participate in multilateral and regional economic organizations such as; the World Trade Organization (WTO), the New Economic Partnership Agreement (EPA) with the European Union(EU), the Common Market for Southern and Eastern Africa (COMESA), the Free Trade Agreement (FTA), the Tripartite Free Trade Agreement (TFTA) which consists of COMESA, the East African Community (ECA), and the Southern African Development Community (SADC) member countries, the Sana'a Forum for Cooperation (SFC), and the Inter-Governmental Authority for Development (IGAD).

Figure 3.2: Trade balance between 1995 and 2015



Source: Own calculation using WDI data

Table 3.2: Trade balance growth between 1995 and 2015

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Ex growth	-1,2	40,8	-4,4	-16,7	4,0	-6,4	5,5	3,4	36,7	33,1	15,5	22,5	25,4	1,0	44,0	23,4	17,2	-7,6	10,1	-11,0	-4,3
Im growth	22,4	-20,6	36,3	1,4	-18,0	43,7	-12,0	68,6	7,0	42,5	27,2	11,5	42,5	-7,4	12,2	3,4	33,9	2,6	27,2	8,8	-1,9
Def. growth	0,4	-0,5	0,8	0,1	-0,3	0,8	-0,2	1,0	0,0	0,5	0,3	0,1	0,5	-0,1	0,0	0,0	0,4	0,1	0,3	0,1	0,01

Source: Own calculation using world development index (WDI) data

As one can see from the graph and table above, regardless of the policy reforms to promote export, the gap between export and import (trade deficit) grows over time. The gap did not show any sign of slowing down even after trade liberalization. The National Bank of Ethiopia (NBE) includes the main reasons why the trade deficit has been growing in the past decades and continues to grow after trade liberalization. Accordingly, the price and income inelasticity of Ethiopian export and the nature of the country's import and export are some of the main reasons mentioned in the report. The export component of the country being dominated by

agricultural commodities (mainly coffee), are both price and income inelastic.

3.4.3 Trends and Performance of FDI in Ethiopia

FDI is considered one way to boost the economic growth of a country because it helps the host nation especially with job creation, capital formation, technology transfer, etc. That is why the Ethiopian government has implemented several policy reforms to attract foreign direct investment. The identification of the industrial parks, privatization, and other pro-investment policies were amended to boost FDI.

According to the report from on Trade and Development (2017), although the global FDI and the FDI inflow to Africa has been in recent decline, Ethiopia has registered a strong increase in FDI inflows and has become one of the largest recipient of FDI[7]. Ethiopia is the fifth recipient of FDI in the continent with the highest growth rate of the FDI inflow[8]. Since 1992, FDI inflow has been growing regardless of fluctuations over the period. The political instability in the country and the region including border conflicts and financial crises are some the factors that have contributed to this fluctuating trend.

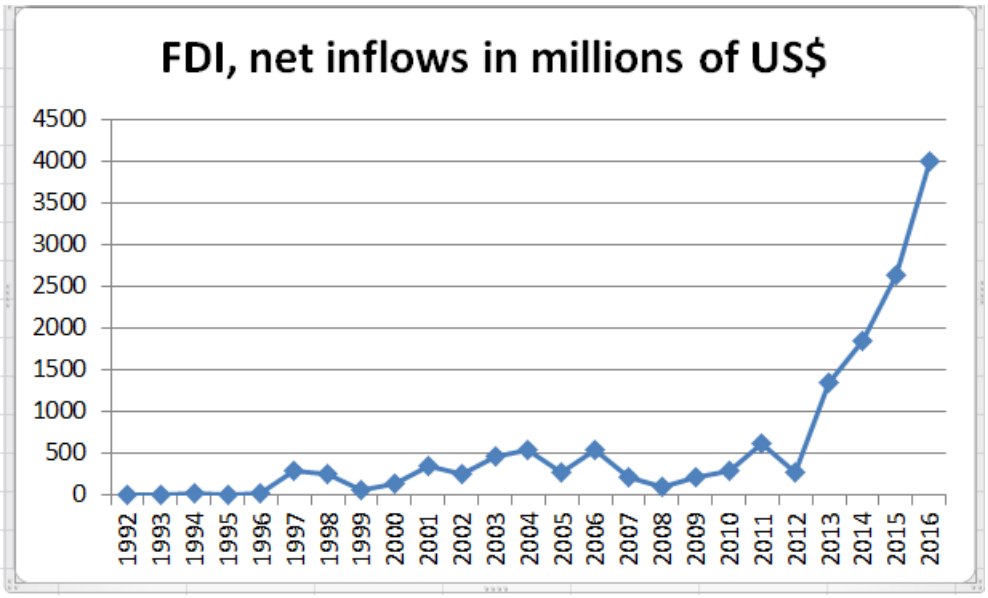
Figure 3 below shows the net FDI inflow since 1991. As demonstrated in the graph, the net inflow of FDI fluctuates over the period with a sharp increase in 2012. The highest growth before 2000 was observed in 1997. However, this was followed by the Ethio-Eritrea border conflict (1998-2000) and thus, FDI inflow sharply declined. Due to the speculation of the problems around the 2005 elections in the country, FDI inflows declined from 545 USD in 2004 to 265 USD in 2005. The financial crises in 2007/2008 also affected the country's FDI inflows and as a result, the FDI declined to its lowest since 2000. Growing at a rate of 46%, according to a report by UNCTAD, the FDI inflows from different source countries reach 3.2 USD billion in 2016 (see Mitiku (2013), Haile and Assefa (2006), and the reports by the Ethiopian investment commission in 2017 and UNCATD).

[7]In between 2015 and 2016 the global FDI inflow declined by 3%, while the inflow to Africa was also declining and according to the report (on Trade and Development (2017)), it decreased by 2%. Regardless of this decline in FDI inflows both at a global and continental level, the inflow to East Africa grew by 13%. The largest share was moved to Ethiopia, while it decreased in Kenya and Tanzania

[8]See the picture in the appendix

FDI distribution throughout the sectors is also different. With respect to the sectoral distribution, the industrial sector has become the leading sector in attracting FDI (accounts for 70.6% of the total FDI inflow in 2014) followed by the service sector and agriculture which shares being only 11% and 9% respectively. With regards to the source countries, China is the major source of FDI, followed by India, Turkey, and Saudi Arabia. Indeed, FDI from other developed countries has also significantly increased in recent years (see Mitiku (2013), Haile and Assefa (2006)).

Figure 3.3: The net FDI inflow since 1991



Source: Own calculation using WDI data

3.4.4 Labor Market Performance in Ethiopia

Agriculture, the backbone of the country's economy like in many other less developed countries, absorbs the majority of the labor force. More than 80% of the population resides in the rural areas of the country and thus, actively participate in agriculture. Regardless of fast and promising economic growth, the employment structure of the country has not changed significantly over the past decades.

In line with the high economic growth rate especially between 1999 and 2011, the unemployment rate decreased. In 1999 the unemployment rate was 8.2%, and it further reduced to 5.4% in 2011. Similarly, over the same years, urban unemployment also dropped from 26.1% to 21%. Regardless of this reduction in unemployment rate[9], there is still a long way to go in improving the employment sector both in urban, where unemployment is high, and rural sectors, where poverty is severe. According to World Bank reports, every year more than 600,000 individuals enter the labor force. However, the economy is not creating enough jobs and a large number of fresh graduates are left without a job every year.

The table below is from the World Bank's fourth update on the Ethiopian economy, which shows a 15% increase in the total employment between 1999 and 2013. One can also see there is no significant change in the employment share of agriculture and more than 75% of employment is absorbed by agriculture. Commerce (trade) plays a key role in absorbing a significant amount of employment next to agriculture. In 2013, this sector absorbed around 8% of new jobs, followed by the other service sector with 4% of new jobs. Moreover, the employment growth varies by sectors. The lowest growth is observed in the commerce sector with only 1.4%, while the maximum growth is in the mining sector with a 20% annual growth rate. The discovery of new minerals and the partial privatization of the sector might have contributed to the high employment growth in this sector. Regardless of the huge focus of the government in the sector, manufacturing sector employment growth is not as expected.

Source: Geiger and Moller (2015), and Martins (2018).

[9] According to the ILO report, the unemployment rate in developing countries is lower than its counterpart in developed countries

Table 3.3: Employment by sector

	Employment by sector (Thousands)			Employment by sector (% total employment)			Employment by sector(Annual Growth %)		
	1999	2005	2013	1999	2005	2013	1999-05	2005-13	1999-13
Agriculture	19869	25208	30821	79.8	80.2	77.3	4	2.5	3.2
Mining	16	82	195	0.1	0.3	0.5	31.8	11.5	19.8
Manufacturing	1,107	1,529	1,882	4.4	4.9	4.7	5.5	2.6	3.9
Utilities	28	33	90	0.1	0.1	0.2	2.7	13.4	8.7
Construction	229	446	825	0.9	1.4	2.1	11.8	8.0	9.6
Commerce	2,342	2,406	2,845	9.4	7.7	7.1	0.5	2.1	1.4
Transport	123	146	378	0.5	0.5	0.9	3.0	12.6	8.4
Finance	20	38	134	0.1	0.1	0.3	11.6	17.1	14.7
Public services	578	729	1,212	2.3	2.3	3.0	3.9	6.6	5.4
Other Services	585	818	1,492	2.4	2.6	3.7	5.7	7.8	6.9
Total	24,897	31,435	39,874	100	100	100	4.0	3.0	3.4

3.5 Econometrics Modeling and Specifications

This section, starting by presenting the econometrics model specification from the theoretical model, will analyze the impact of globalization on the labor market in Ethiopia using the GMM estimation technique.

3.5.1 Model Specification

The Cobb-Douglas production function is used to drive the employment and wages equations. Greenaway et al. (1999), used this approach to show the impact of openness on the labor demand using the firm-level data. The production function of the representative firm is given as:

$$Y_{it} = A^{\lambda} K_{it}^{\alpha} L_{it}^{\beta} \tag{3.1}$$

Where Y_{it} is the real output of industry i at time t, $K_{it}$is the capital stock L_{it} is the labor force utilized by industry i at time t, α and β are the measure of share of K and L respectively; and A is a proxy for technical change and λ allows for factors changing the efficiency of the production process.

From the basic labor economics concept, the profit maximizing firm employs labor and capital; such that the marginal revenue product of labor $\frac{\partial Y}{\partial L} = \beta \frac{Y}{l}$ equals the marginal cost of labor w and the marginal product of capital $\frac{\partial Y}{\partial K} = \alpha \frac{Y}{K}$ equals the cost of using one extra capital

r. Solving the simultaneous equation and rearranging it gives,

$$Y_{it} = A^{\lambda} \left(\frac{\alpha L_{it}}{\beta} \frac{w_i}{r} \right)^{\alpha} L_{it}^{\beta} \tag{3.2}$$

Log linearizing Equation 3 and normalizing r=1,

$$\ln L_{it} = \theta_0 + \theta_1 \ln \left(\frac{w_i}{r} \right) + \theta_2 \ln Y_{it} \tag{3.3}$$

Where,

$\theta_0 = -\frac{\lambda \ln A + \alpha \ln \alpha - \alpha \ln \beta}{\alpha + \beta}$

$\theta_1 = -\frac{\alpha}{\alpha + \beta}$

$\theta_2 = \frac{1}{\alpha + \beta}$

Since I am interested in linking the globalization variables (import, export, and FDI) to the labor market variables (employment and wage), the next step could be relating the employment equation to the components of globalization. Greenaway et al. (1999), Manda and Sen (2004), and Were (2011) argue that technical efficiency could be affected by the increased openness. Specifically, Greenaway et al. (1999) state that technical efficiency can change over time and the rate of technology adoption can be related to globalization. Thus, the parameter A in the production function can be formulated as;

$$A_{it} = e^{\delta_0 T_i} M_{it}^{\delta_1} X_{it}^{\delta_2} I_{it}^{\delta_3} \tag{3.4}$$

Where T is time trend, M, X, and I are import, export, and foreign investment penetration respectively[10].

Log linearizing Equation 4 and substituting it into 3, one can rewrite the employment and wage equation as follows respectively;

$$\ln L_{it} = \theta_0^* - \mu_0 T_i - \mu_1 \ln M_{it} - \mu_2 \ln X_{it} - \mu_3 I_{it} + \theta_1 \ln w_{it} + \theta_2 \ln Y_{it} \tag{3.5}$$

[10]As it is mentioned in Section 3, these variables are used in a different mode, like dummy variables. Thus, when the variables are dummy, the above equations would be meaningless. However, it is very important to understand the general relationship and to drive the econometric model.

$$\ln w_{it} = \theta_0^* - \mu_0 T_i - \mu_1 \ln M_{it} - \mu_2 \ln X_{it} - \mu_3 I_{it} + \theta_1 \ln L_{it} + \theta_2 \ln Y_{it} \tag{3.6}$$

Where,

$\theta_0^* = -\frac{\alpha \ln \alpha - \alpha \ln \beta}{\alpha+\beta}$

$\mu_0 = \frac{\lambda \delta_0}{\alpha+\beta}$

$\mu_1 = \frac{\lambda \delta_1}{\alpha+\beta}$

$\mu_2 = \frac{\lambda \delta_2}{\alpha+\beta}$

Equation 5 and 6 are used as a benchmark to formulate the econometric regression models. For this purpose, it is necessary to control for other variables which affect both employment and wage like firm specific variables, and time and random fixed effect variables.

Empirical Models and Estimation Method

i. Employment

Using Equation 5 as a benchmark, it is possible to develop the dynamic employment model to be estimated using the panel data.

$$\ln L_{it} = \theta_0 + \theta_1 \ln w_i + \theta_2 \ln Y_{it} + \theta_3 \ln M_{it} + \theta_4 \ln X_{it} + \theta_5 FO_{it} + F_{loc} + F_{time} + (U_{it} + \epsilon_i) \tag{3.7}$$

All variables, except dummies, are expressed in natural logarithmic terms. The real average wage w_{it} is computed as the ratio of the firm $i's$ total wage and its employment. The variables X and M are dummy variables which take the value of one if the firm exports and/or imports and zero otherwise. The ration of the total export to the total output of the firm and import to total input of the firm is also used for the robustness check. In the former case, it is possible to see the impact of firms' participation in the global market, while the latter case can tell the marginal effect of global market participation.

With respect to the expected coefficients, the estimates of the coefficient of wage is expected to be negative $\theta_1 < 0$ and the coefficient of output to be positive $\theta_3 > 0$. The variables of interest are the one which is used as a proxy for the globalization (global engagement of the firm). Export X, import M and the foreign ownership FO are used for this purpose. The firm's

foreign ownership is used as a proxy to measure the degree of foreign direct investment Haile et al. (2013)[11]. F_{loc} is the location dummy which takes the of value one if the firm is located in Addis Ababa and zero if the firm is located in other regions. As Addis is the business, financial and political (administration process) center, the firms which are located here are expected to be larger, technologically advanced, and relatively exposed to the foreign competition. Standard to the panel data analysis, the error term is composed of idiosyncratic error component u_{it} and the time invariant firm fixed effects component ϵ_i.

An advantage of the panel data is that it help to understand the dynamic adjustment of the economic variables. Thus, it is important to transform the above employment equation into a dynamic equation for our regression purpose by incorporating the first lag of employment (L_{it-1}). In addition to its dynamic environment, the cost of labor adjustment and persistence in employment evolution justify this transformation from static to a dynamic equation (for more details Baltagi (2008) Greenaway et al. (1999), Haile et al. (2013)).

$$\ln L_{it} = \theta_0 + \gamma L_{it-1} + \theta_1 \ln w_i + \theta_2 \ln Y_{it} + \theta_3 \ln M_{it} + \theta_4 \ln X_{it} + \theta_5 FO_{it} + F_{loc} + F_{time} + (U_{it} + \epsilon_i) \quad (3.8)$$

Additionally, the impact of globalization on different classifications of employment could also be addressed in the paper. Thanks to the data set, it is possible to repeat the above analysis for production (unskilled) and administrative (skilled) workers. The econometric equation to be estimated for both groups of workers could be respectively given as,

$$\ln L^a_{it} = \theta_0 + \gamma L^a_{it-1} + \theta_1 \ln w^a_{it} + \theta_2 \ln Y_{it} + \theta_3 \ln M_{it} + \theta_4 \ln X_{it} + \theta_5 FO_{it} + F_{loc} + F_{time} + (U_{it} + \epsilon_i) \quad (3.9)$$

$$\ln L^p_{it} = \theta_0 + \gamma L^p_{it-1} + \theta_1 \ln w^p_{it} + \theta_2 \ln Y_{it} + \theta_3 \ln M_{it} + \theta_4 \ln X_{it} + \theta_5 FO_{it} + F_{loc} + F_{time} + (U_{it} + \epsilon_i) \quad (3.10)$$

Where L^a_{it} and L^p_{it} are the number of administrative and production employees of firm i at time t respectively, while w^a_{it} and w^p_{it} are the average wages of administrative and production workers

[11]Haile et al. (2013) and Haile et al. (2017) claim FO measures the degree of foreign investment which is the channel of technology transfer through full or partial involvement of multi national companies MNCs in the production process of the partner firm.

respectively.

The estimation method of two-equation setting is used to analyze the relative versus absolute employment quality (skill) impact globalization variables. Estimating and testing the difference in the magnitudes of the coefficients of the variables of interest helps test for the relative and the absolute quality impact. The absolute quality impact appears if the coefficients of the variables of interest display positive and significant for skilled (administrative) workers and negative and insignificant for unskilled (production) workers. On the other hand, relative bias occurs if the coefficients for both production and administrative employees are positive and significant, with smaller coefficients for production workers. This setting is also important to explore the autoregressive employment dynamics of both types of employment separately (see Haile et al. (2013) and Baltagi (2008)).

Wages and Globalization

To analyze the impact of globalization on average wage the the following dynamic model could be developed based on the above formulations.

$$\ln w_{it} = \theta_0 + \theta_1 \ln w_{it-1} + \theta_2 \ln Y_{it} + \theta_3 \ln L_{it} + \theta_4 \ln X_{it} + \theta_5 \ln M_{it} + \theta_6 FO_{it} + Z_i + F_{loc} + F_{time} + (u_{it} + \epsilon_i) \tag{3.11}$$

Like in the case of employment, the two equations of wages for administrative and production workers' wages could also be estimated as follows:

$$\ln w^a_{it} = \theta_0 + \gamma w^a_{it-1} \theta_1 \ln L^a_{it} + \theta_2 \ln Y_{it} + \theta_3 \ln M_{it} + \theta_4 \ln X_{it} + \theta_5 FO_{it} + F_{loc} + F_{time} + (u_{it} + \epsilon_i) \tag{3.12}$$

$$\ln w^p_{it} = \theta_0 + \gamma w^p_{it-1} \theta_1 \ln L^p_{it} + \theta_2 \ln Y_{it} + \theta_3 \ln M_{it} + \theta_4 \ln X_{it} + \theta_5 FO_{it} + F_{loc} + F_{time} + (u_{it} + \epsilon_i) \tag{3.13}$$

Labor Market Inequality and Globalization

This section analyzes the impact of globalization on labor market inequality, specifically wage and employment of different groups. Labor market inequality can be seen from the point of view

of the traditional SBTC hypotheses as in (Krueger and Kumar (2004), Katz and Murphy (1992)) as well as the recent trend of labor market inequality, the routinization hypothesis, as in (Autor et al. (2006), Autor and Dorn (2013), Autor et al. (2015), and others). In the case of the SBTC hypothesis, I will analyze the wage/employment differential between skilled (administrative) and unskilled (production) workers[12]. The recent trend of labor market inequality "job polarization" is the relative growth of employment/wages of high or low skilled workers and relative negative growth for those in the middle of the skill distribution (see Goos and Manning (2007), Goos et al. (2009) and others). At the center of this phenomenon is technological change (see Autor et al. (2003), Dorn et al. (2009)) and globalization in the form of International trade(see Keller and Utar (2016), Blanchard and Willmann (2016)), offshoring (see Goos et al. (2010), Goos et al. (2014),Egger et al. (2016)), and others.

This study focuses only on globalization (international and FDI(foreign ownership)) to investigate the polarization and to link it with labor market inequality. For this purpose, the work of Gourdon (2007) is followed. Firms are grouped into three categories based on their skill intensity[13]; High-skill labor (HSL) intensive firms, medium-skill labor (MSL) intensive and low-skill labor (LSL) intensive firms, following the same paper. Then each categories separate equations of wages and employment growth rate are set and estimated.

Formally:

$$d\ln L_{it}^{i} = \theta_0 + \gamma L_{it-1}^{i}\theta_1 \ln w_{it}^{i} + \theta_2 \ln Y_{it}^{i} + \theta_3 \ln M_{it}^{i} + \theta_4 \ln X_{it}^{i} + \theta_5 FO_{it}^{i} + F_{loc}^{i} + F_{time} + (U_{it}^{i} + \epsilon_i) \tag{3.14}$$

$$d\ln w_{it}^{i} = \theta_0 + \gamma w_{it-1}^{i}\theta_1 \ln L_{it}^{i} + \theta_2 \ln Y_{it}^{i} + \theta_3 \ln M_{it}^{i} + \theta_4 \ln X_{it}^{i} + \theta_5 FO_{it}^{i} + F_{loc}^{i} + F_{time} + (U_{it}^{i} + \epsilon_i) \tag{3.15}$$

Where $i \in \{HSL, MSL, LSL\}$, $d\ln L_{it}^{i}$ and $d\ln w_{it}^{i}$ employment growth and wage growth respectively, and each variable corresponds to the firm's category. For instance, L_{ht}^{h} the total employment of HSL intensive firm at time t.

[12]Haile et al. (2013) Measure the number of skilled and unskilled workers by the amount of administrative and production workers respectively

[13]Haile et al. (2017) looked at the phenomenon of skill bias within the Ethiopian manufacturing sector; grouping workers into unskilled and skilled measured by the amount of production and administrative workers respectively

Finally, the overall inequality in the labor market will be assessed, using the standard deviation of the logarithm of wage by the industry as a measure of inequality Gourdon (2007).

$$in_{it} = \theta_0 + \gamma w^i_{it-1} \theta_1 \ln L^i_{it} + \theta_2 \ln Y^i_{it} + \theta_3 \ln M^i_{it} + \theta_4 \ln X^i_{it} + \theta_5 FO^i_{it} + F^i_{loc} + F_{time} + (U^i_{it} + \epsilon_i) \quad (3.16)$$

3.5.2 Model Estimation Method

The econometric models given above are analyzed and estimated following various panel data estimation methods. Previous work in this area estimated dynamic employment and wage equation using the simple ordinary least-squares (OLS) method and fixed effect (FE) or random effect (RE) regression methods. However, these methods have endogeneity and heterogeneity problems and thus, the estimators are biased. The presence of individual-specific effects creates a correlation between the lagged value of the dependent variables and the individual fixed effect, which violates the condition for exogeneity of the estimators. Thus, those methods (OLS, FE, and RE) resulted in biased and inconsistent estimates (for more detail see Baltagi (2008)).

The fixed effects model assumes that unobserved effects (omitted variables) differ between cases (in our case, across the establishments) but are constant over time. However, it is not possible to estimate coefficients on time-invariant variables, and all inference is conditional on the unobserved effects in the sample. On the other hand, the random effects approach assumes that the unobserved effects are not correlated with the explanatory variables, that is, they are random and can vary over time, and thus treats them as part of the error term (Blundell and Bond (1998), Baltagi (2008).

To overcome the problems with using the above-mentioned estimation methods, the Instrumental Variable (IV) and/or the General Method of Momentum (GMM) are used and these methods give unbiased and consistent results. Arellano and Bond (1991) used the First-Difference General Method of Moment (DIF-GMM). In the model, the instrument matrix includes the lagged values of the dependent variables and the DIF-GMM estimator is used to overcome the problem of endogeneity. The DIF-GMM estimator, however, has poor finite sample properties, with regards to biasedness and imprecision (see Blundell and Bond (1998), Blundell and Bond (2000), Judson and Owen (1999) and Blundell et al. (2001)), if

- there is persistence in the time, as the lagged values are weakly correlated to the differences in the explanatory variables and
- the cross-section variability dominates time variability

Later, the System General Method of Moment (SYS-GMM) was proposed by Arellano and Bover (1995) and Blundell and Bond (1998). The SYS-GMM imposes additional moment conditions to improve the efficiency of the DIF-GMM model. The SYS-GMM estimator is reduced from the estimation of a system of two simultaneous equations to one in first difference, with lagged levels as instrument variables, which is similar to the DIF-GMM estimator. This model specification method is used to control for the endogeneity problem, sectoral unobserved time invariant heterogeneity, and time effects (see Blundell and Bond (1998) and Blundell and Bond (2000)).

The econometric models specified above are estimated, using the SYS-GMM and for robustness check the FE and OLS methods are used. Estimating the pooled OLS and FE helps to check the robustness of the results easily, as the pooled OLS methodology would lead to upward biased and inconsistent estimate coefficients of the lagged dependent variable, while on the contrary FE would lead to the downward biased estimators. Thus, the results from GMM-SYS would be used in the analysis as it seems to fit best with the characteristics of the panel data and the nature of the empirical model (Baltagi (2008), Arellano and Bond (1988) and Hsiao (2014)).

The fitness and consistency of the SYS-GMM model estimators, which depends on the validity of the values of the lagged values of the explanatory variables in the regression, will also be tested using the Sargan test of over identification and Arrellano-Bond for autocorrelation tests. The Sargan test of over identifying restrictions tests the overall validity of the instruments by analyzing the sampled analog of the moment's conditions used in the estimation. Failure to reject the null hypothesis gives support for the model. The AR test, tests the null hypothesis, where the error term is not serially correlated, hence, test whether the differenced error term is second-order serially correlated.

3.6 Result: Impact of Globalization

3.6.1 Total Employment and Average Wage

The results from the empirical analysis are reported below in Table 4. The table reports the OLS, FE, and GMM estimators for both employment and wages. The results for the corresponding decompositions of employment and wages and inequality are reported in the next subsections. Regardless of the biasedness and inconsistency in the results from OLS and FE, results are still important in order to verify the results from GMM. The OLS method is expected to result in upward biased estimates in the presence of the firm specific effect and provide the upper bound of the estimate coefficients. The FE method on the other hand, resulted in the downward biased estimates and hence, provide the lower bound for the GMM estimates.

Looking at the table below which reports the results for both employment and wage equations, one can see the coefficients have the expected sign. The GMM estimation shows the positive and significant value of the lagged total employment coefficient, implying the persistence in the time series and the presence in the costs of adjustment of the change in employment level. This could imply that a firm always bases its current employment decisions on the previous level of employment, which further creates the cost of adjustment which could affect the current employment level. The coefficient for the lagged wage in the average wage equation is also positive and significant, further asserting the persistence in the time series. Moreover, the magnitude of the coefficients of the lagged dependent variables in both equations are positive and statistically significant and lie between the upper bound value set by the OLS result and the lower bound set by the fixed effects estimation results. Thus, this verifies the importance of the dynamic model GMM estimate.

The coefficient of the average wage for the employment equation and of employment for the wage equation is negative and statistically significant. This implies a negative relationship between labor demand and wage. The coefficient of output for both equations has the expected sign and is statistically significant at 1% level of significance. This shows that the expansion in output requires higher employment, independent of the change in wage. On the other hand, a firm with a higher capacity due to increased output pays a higher wage which is directly linked

with the total revenue of the firm.

The coefficient of the export dummy is positive and statistically significant at a 10% level of significance. This implies being an exporter enhances employment, thus, helps the economy reduce unemployment. Moreover, participating in export may help firms expand their markets, which requires more employment. The impact of firms' participation in export on wages is also positive and statistically significant at a conventional level of 10%. This implies that the high profit generated from enjoying a wider market through export does generate higher wages. Moreover, since participating in export requires additional labor, the firm has to pay a higher wage to attract more and quality workers. This result is in line with the idea of "*an export premium*" which means the exporting firms pay higher than the non-exporting firms Egger et al. (2017). Exporters not only employ more, but also pay a higher wage and also demand quality workers (skill-biased).

The other two variables foreign ownership and location dummy, have the expected sign and are statistically significant at a conventional level for both employment and wage equations. The foreign-ownership coefficient has a positive sign, suggesting that foreign owned firms pay higher wages than domestic-owned firms[14]. However, the magnitude and level of significance of the coefficients in both equations are lower than that of export[15]. The coefficient of location dummy has a positive sign and is statistically significant, suggesting that the firms located in the capital (Addis Abeba) not only employ more workers, but also pay more. The import dummy has a positive sign in the employment equation and a negative sign in the wage equation, but it is insignificant in both equations.

Different statistical tests have been performed to check the model fitness and robustness of the estimation results. The overall significance of the independent variables are tested using the Wald test[16]. The null hypothesis of joint insignificance of the coefficient is rejected, thus confirming the joint significance of the variables and the robustness of the results. The Hansen test of over-identifying restriction, where the null hypothesis of adequate instruments is used, is

[14]Foreign owned firms are, firms with a foreign share of more than 50%. Thus, this analysis shows that firms with higher foreign shares have a higher tendency to expand and hence, pay higher wages.

[15] (Azatbek and Ramazanov (2015))

[16]The wald test is used to test the joint significance of the independent variables. The hypothesis are: H_0 : $\theta_0 = \theta_1 = ... = 0$ and $H_1 : \theta_i \neq 0$

Table 3.4: Regression result from the total employment equation

	Employment equation			Wage equation		
	OLS	FE	GMM	OLS	FE	GMM
Lagged Empl	0.619	0.237	0.303***			
	(0.012)	(0.014)	(0.075)			
Lagged Wage				0.702	0.254	0.572***
				(0.109)	(0.017)	(0.013)
Average Wage	-0.134***	-0.179***	0.36*			
	(0.0322)	0.037	(0.11)			
Total employment				-0.11***	0.26***	-0.76***
				(0.032)	(0.052)	(0.11)
Output	0.537***	0.263***	0.72***	0.24***	0.24***	0.61***
	(0.013)	0.019	(0.07)	(0.02)	(0.02)	(0.099)
Export Dummy	0.434***	0.119*	0.251*	0.05*	0.24*	0.171*
	(0.074)	0.079	(0.17)	(0.05)	(0.06)	(0.15)
Import Dummy	0.028*	0.005	0.007	0.04**	0.02	-0.024
	(0.019)	0.021	0.044	(0.02)	(0.024)	(0.045)
Foreign Ownership	0.113*	0.069	0.231**	0.14***	0.023	0.062*
	(0.052)	0.058	0.097	(0.04)	(0.05)	(0.086)
Location Dummy	0.201**	0.044	0.77*	0.16***	-0.025	0.12*
	(0.029)	0.082	(0.64)	(0.03)	(0.079)	(0.19)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	No	Yes	Yes	No	Yes
R-squared	0.63	0.60		0.45	0.27	
Hansen Test			0.378			0.042
AR(2)			-3.4***			-3.4***
			(0.001)			(0.001)

also performed and failed to reject the null hypothesis (see Arellano and Bond (1988), Arellano and Bond (1991), and Baltagi (2008)). Additionally, the Arellano and Bond (AR) test is used for the autocorrelation test and supports the null hypothesis of no second autocorrelation was not rejected, which further justifies the validity of our SYS-GMM.

Table 3.5: Hausman Test for employment regression

Variables	FE	RE	Difference(FE-RE)	S.E
Average Wage	-.1785517	-.1421057	-.0364461	.0070159
Output	.2631941	.357057	-.093863	.0063146
Export Dummy	.1196774	.3614514	-.2417741	.0331255
Import Dummy	.0045947	.0269298	-.0223351	.0073751
Location Dummy	.0439142	.1721557	-.1282415	.0512349
Foreign ownership	.0694306	.1262507	-.0568201	.019713

3.6.2 Skill Specific Impact of Globalization

In this subsection, I will present the results from the skill specific (skilled and unskilled) employment and wage regression in Table 6 and 7 respectively. The study attempt to analyzes the conventional skill biased technological change (SBTC) theory before showing the new view of

job polarization.

As one can see from Table 6 and 7, the variables have the expected sign in both equations and are varyingly significant. The coefficients of the lagged dependent variable in both employment (lagged employment) and wage (lagged wage) are positive and strongly significant. This asserts the persistence of the time series in both equations for both skilled and unskilled workers. It also shows the presence of adjustment cost in the market of both skilled and unskilled workers.

Looking at the employment equation estimation results for both skilled and unskilled workers, the explanatory variable *wage* has the expected negative sign and is statistically significant, confirming the negative link between employment and wage as per the labor economics theory. Comparing the magnitude of the respective coefficients in both equations, the coefficients for the unskilled workers wage equation is higher than the coefficient of the skilled workers equation. This could indicate that the demand for unskilled workers is more elastic to the change in wages. This can be due to the high supply of unskilled workers, therefore it is simple to substitute those workers. The coefficient of *output* has a positive sign and is significant for both types of workers. The magnitude for skilled employment is slightly higher and tells that output could be relatively skill biased.

The *export dummy* has a positive sign and is statistically significant at 10%. However, the magnitude for unskilled workers is higher than that of skilled workers and the difference is also statistically significant. Thus, export, even though it positively enhances the employment of both groups, is biased towards unskilled workers. The *import dummy* has no significant effect on the demand of both skilled and unskilled workers. *Foreign ownership* has a positive and significant effect on the demand for skilled workers, while its coefficient for unskilled workers is positive, but insignificant. Thus, the positive effect on the demand of total employment is mostly due to its effect on the demand of skilled workers. The *location dummy* variable also has the expected result and the magnitude for skilled workers is higher than its magnitude for unskilled workers. Thus, proximity to the capital enhances the demand for administrative workers more than the demand for unskilled workers.

Like in the previous case, different statistical tests are undertaken to test the model specifications and the robustness of the estimation results. The Wald test confirms the joint significance of the independent variables for both skilled and unskilled equations. The Hansen test fails to reject the null hypothesis, confirming the adequacy of the instruments used and the AR test also supports the significance of the models.

Table 3.6: Employment equations for skilled and unskilled workers

	Skilled workers employment equation			Unskilled workers employment equation		
	OLS	FE	GMM	OLS	FE	GMM
Lagged skilled emp.	0.347	0.014	0.155***			
	(0.102)	(0.020)	(0.013)			
Lagged unskilled emp.				0.450	0.019	0.406***
				(0.040)	(0.021)	(0.016)
Skilled wage	-.129**	-.231***	-0.301*			
	(0.0181)	0.072	(-0.044)			
Unskilled Wage				-0.210***	-0.367***	-0.464**
				(0.016)	(0.026)	(0.058)
Output	.191***	.121***	0.429*	0.323***	0.203***	0.419*
	(0.007)	(0.016)	(0.008)	(0.002)	(0.027)	(0.011)
Export Dummy	.050	-0.002	0.224*	-0.003	-0.069	0.746*
	(0.268)	(0.272)	(0.798)	0.068	(0.123	(0.7051)
Import Dummy	.026	0.095	.056	0.069*	0.034	0.011
	(0.084)	(0.069)	(0.128)	0.027	(0.030)	(0.050)
Foreign Ownership	.025*	-0.013	.031**	0.094**	-0.068	0.192
	(0.010)	(0.011)	(0.0065)	(0.051)	(0.078)	(0.266)
Location Dummy	0.110*	0.391**	0.302**	0.0475**	0.102	0.247**
	(0.012)	(0.212)	0.093	0.146	(0.011)	(0.480)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	No	Yes	Yes	No	Yes
R-squared	0.68	0.67		0.65	0.55	
Hansen Test			0.382			0.513
AR(2)			1.68			2.4*
			(0.298)			(0.051)

Table 3.7: Wage equations for skilled and unskilled workers

	Skilled workers wage equation			Unskilled workers wage equation		
	OLS	FE	GMM	OLS	FE	GMM
Lagged skilled Wage	0.672	0.301	0.515***			
	(0.062)	(0.041)	(0.016)			
Lagged unskilled Wage				0.451	0.204	0.246***
				(0.024)	(0.043)	(0.06)
Skilled employment	-.229***	-.331***	-0.303*			
	(0.083)	0.092	(0.334)			
Unskilled Employment				-.190***	-.167***	-0.164*
				(0.053)	0.062	(0.084)
Output	.391***	.217***	0.419*	.330***	.207***	0.319*
				(0.022)	(0.026)	(0.105)
Export Dummy	.501	0.222*	0.245*	.891**	0.099*	0.298*
				(0.110)	(0.122)	(0.210)
Import Dummy	.026	0.095	.056	.069*	0.034	.036*
				(0.024)	(0.029)	(0.028)
Foreign Ownership	.065	-0.023	0.030*	0.194**	0.065	.092
				(0.078)	(0.081)	(0.065)
Location Dummy	0.080*	0.039	.747*	0.280*	0.139	0.247*
				(0.026)	(0.109)	(0.583)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	No	Yes	Yes	No	Yes
R-squared	0.68	0.67		0.65	0.69	
Hansen Test			0.188			0.277
AR(2)			0.68			-3.4***
			(0.498)			(0.0.0001)

Table 7 reports the results of the estimation of wage equations for both skilled and unskilled workers. The coefficients of both *output and employment* have the expected signs, statistically significant at conventional levels and in line with the prior results and also with theory. Expansion in production capacity boosts wages for both types of workers, with a higher magnitude for skilled workers which could imply that output is skill biased. However, the increase in the demand for the specific type of worker is negatively related to the wage of the corresponding group. Unlike the case of employment, the magnitude of the coefficient of employment is higher for the unskilled workers wage equation. The *export dummy and foreign ownership* variables also have the expected sign, but only have a significant impact on the wages of skilled workers, implying that both variables has absolute quality bias effect. This shows as firms' global engagement (opening up the economy) could increase the wage gap between skilled and unskilled workers. The *location dummy* variable has a rather significant impact on the wages of both categories and has positive signs. Like in the previous estimations, different diagnostic tests were undertaken to test the validity of the models.

3.6.3 Recent View of Inequality

In this subsection, I will analyze and report the globalization impact from the perspective of a recent view of inequality, *labor market polarization*. The recent strand of literature extends the view of inequality from the traditional skill-biased technological change (the skilled-unskilled classification of workers) to the routine biased technical change (which considers continuous classification workers). Job polarization is the growth of employment/wage for higher and lower skilled distribution workers at the expense of the middle-skilled workers' employment/wage. The main explanation for the phenomenon are technological change (see Autor et al. (2003)), globalization(Autor et al. (2010), Goos et al. (2010)), offshoring (Goos et al. (2014)), and institutional change (Mishel et al. (2013)). Even though the central idea is that technological change complements skilled workers, substitutes the middle-skilled and does not directly affect the less skilled workers, globalization and institutional changes also play a role in explaining it (Goos et al. (2010)).

To analyze this phenomenon, I followed the work by Gourdon (2007). I will estimate three separate econometric equations (for low-skilled, medium-skilled, and high-skilled workers). Then I will estimate the econometric equation for each categories of the industrial classifications for both wages and employment to analyze the effect of the global variables' change on the wages and employment in all industries. Having three equations is important to see the relative change in the dependent variables due to the change in the explanatory variables.

The econometrics equations to be estimated for both employment and wage:

$$\ln L_{it} = \theta_0 + \theta_1 \ln w_i + \theta_2 \ln Y_{it} + \theta_3 \ln M_{it} + \theta_4 \ln X_{it} + \theta_5 FO_{it} + F_{loc} + F_{time} + (U_{it} + \epsilon_i \quad (3.17)$$

$$\ln w_{it} = \theta_0 + \theta_1 \ln w_{it-1} + \theta_2 \ln Y_{it} + \theta_3 \ln L_{it} + \theta_4 \ln X_{it} + \theta_5 \ln M_{it} + \theta_6 FO_{it} + Z_i + F_{loc} + F_{time} + (u_{it} + \epsilon_i \quad (3.18)$$

Table 3.8: Regression result for HSI

	Employment of HSI			Wage of HSI		
	OLS	FE	GMM	OLS	FE	GMM
Lagged HSI employment			0.595***			
			(0.014)			
Lagged HSI Wage						0.345***
						(0.066)
HSI employment				-.129***	-.131***	-0.103*
()				(0.083)	(0.092)	(0.334)
HSI wage	-.170***	-.198***	-0.264*			
	(0.053)	0.062	(0.084)			
Output	.331***	.187***	0.219*	0.223***	.253***	0.305*
	(0.21)	(0.001)	(0.21)	(0.012)	(0.016)	(0.115)
Export Dummy	.201	0.122*	0.324*	.091**	0.199*	0.434
	(0.010)	(0.012)	(0.102)	(0.210)	(0.112)	(0.110)
Import Dummy	.006	0.024	.106**	.019*	0.025	.060*
	(0.104)	(0.023)	(0.118)	(0.124)	(0.129)	(0.018)
Foreign Ownership	.113*	-0.223	0.130**	0.294**	0.105	.192**
	(0.214)	(0.210)	(0.18)	(0.068)	(0.031)	(0.055)
Location Dummy	0.120*	0.239	.447*	0.380*	0.039	0.203*
	(0.006)	(0.019)	(0.083)	(0.126)	(0.109)	(0.383)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	No	Yes	Yes	No	Yes
R-squared	0.77	0.71		0.75	0.67	
Hansen Test			0.178			0.777
AR(2)			0.608			.445***
			(0.498)			(0.0001)

3.7 Conclusion

The main aim of this analysis was to investigate the reaction of labor market variables to increased globalization through international trade participation of the manufacturing industries. I used the survey data from the Ethiopian Central Statistics Agency for large and medium scale manufacturing establishments. In order to minimize statistical errors, I estimated a dynamic model of employment and wages using panel data estimation techniques. Regardless of the improvements in the empirical analysis and theoretical understanding on the impact of globalization, there are little work on the developing countries of Sub-Saharan African. Thus, this study, aimed at filling this gap and tried to propose a new approach by disaggregating the labor market into more than the skilled-unskilled approach. The key findings in this study are summarized as follows.

First, the effect of firms' international market participation via export on the labor market outcomes has been discussed. The estimation result reveals that the firms' international exposure in general contributes positively in employment creation and wage growth in the manufacturing sector of Ethiopia. In other words, firms that export not only employ more but also pay higher wages than non-exporting firms. On the other hand, this study did not find a significant effect of import and this might be due to the fact that, more Ethiopian imports are consumption and/or capital goods. The firms' ownership type (which is a proxy for the FDI) also had the expected effect on both employment and wage. Foreign-owned firms create new employment opportunities and pay higher wages. The proximity to the capital city can also be used as an indication of global integration and investigating its impact on the employment sector is important. Firms which are located in/ near the vicinity of Addis create more employment and pay higher wages.

Second, the traditional way of analyzing the consequences of trade liberalization following the skilled-unskilled literature has been employed to see the impact of openness on different groups of workers. The result is in line with the findings of Haile et al. (2017). The empirical test for the skill bias effect showed exporters have relatively higher demand for unskilled workers. Among the variables of interest, only the foreign ownership had a higher demand effect for skilled workers, while location effect had no significant effect on the demand of both skilled and

unskilled workers over the sample period. Using wage as a proxy for employment quality, one can also draw a conclusion in regard to the quality-bias of the globalization variables. All the variables (export, foreign ownership share, and location) significantly increase the employment quality of the skilled workers over unskilled ones. With regards the effect on wages, export has relatively higher effect on the wages of skilled workers. Foreign ownership has absolute effect on the wages of skilled workers. In general, the variables has positive effect on the wages of both groups, with relativeely higher on wages of skilled workers.

Third, the empirical analysis to link routinization and openness has been performed by disaggregating the firms into three groups based on the skill intensity, following the work of Gourdon (2007). Here, empirical analysis supports the relative depression in the demand of middle-skilled workers relative to the demand of low and high-skilled groups. Therefore, this result confirms the evidence of hollowing out of the middle skilled workers.

Fourth, since both exporters and firms with higher foreign ownership pay more for skilled workers, this might increase the wage differential between the two groups and worsen the income distribution. The shrinking demand for middle-skilled workers could also be another indication of the growing inequality among different skill groups in the Ethiopian manufacturing sector over the sample years.

Appendix

Table 3.9: Description of variables of interest

variable	Description
Total employment	Total number of permanent employees measured on the quarterly basis and also includes adjusted temporary employees
Average Wage	Ratio of total wage paid by the firm to total number of employees
Skilled workers wage	Real average wages of the administrative workers
unskilled workers wage	Real average wages of the production workers
Export	Total value of export in Ethiopian Birr
Export dummy	one if the firm export, zero otherwise
Export share of output	Proportion of total output exported
Import	Total value of imported input used by the firm
Import Dummy	one if the firm uses imported inputs and zero otherwise
Import share of input	Proportion of total output imported
Foreign ownership dummy	one if the share of the initial paid up capital contributed by foreigner is above 50% and zero otherwise
Location dummy	one if the firm is the proximity of Addis, zero otherwise
Value added	
Total value of output	Total sales of the firm

Table 3.10: Classification of industries based on skill intensity

Category	ISIC code	Firm
Low skill labor intensive	1511	Production, processing and preserving of meat, fruit and veg
	1520	Manufacture of diary product
	1531	Manufacture of flour
	1533	Manufacture of animal feed
	1541	manufacture of bakery
	1549	Manufacture of food NEC
	1710	Spining, weaving and finishing
	1723	Manufacture of cordage rope and twine
	1730	kniting mills
	1810	manufacture of wearing apparal
	1910	tanning and dressing of leather
Middle skill labor intensive	1542	Manufacture of sugar and confectionery
	1544	manufacture of pasta and macaroni
	1551	Distilling rectifying and blending of spirit
	1552	Manufacture of wine
	1554	Manufacture of soft drink
	1600	Manufacture of tobacco
	2100	Manufacture of paper and paper product
	2200	publishing and printing services
	2422	Manufacture of painting varnishes
High skill intensive	1514	edible oil
	2411	manufacture of basic chemicals except fertilizers
	2421	Manufacture of Pharmaceuticals, medical chemicals botanical
	2423	Manufacture of Pharmaceutical, medicinal..
	2424	Manufacture of soap detergents, perfumes
	2429	Manufacture of chemical products NEC
	2925	Manufacture of other general purpose machineries
	3420	Manufacture of bodies for motor vehicles
	3430	Manufacture of parts and accessories

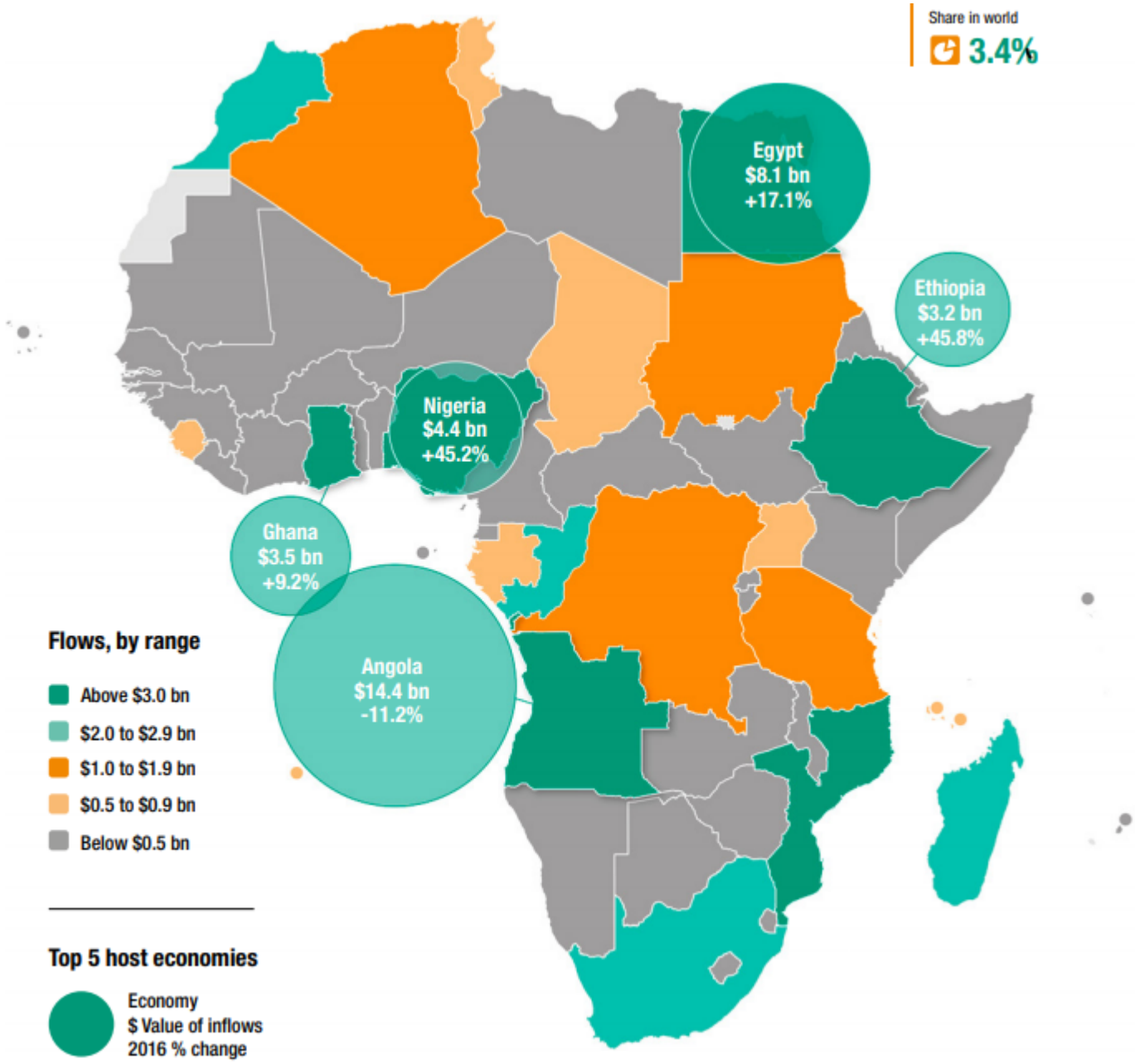
Table 3.11: Regression result for middle-skilled employment

	Employment of HSI			Wage of HSI		
	OLS	FE	GMM	OLS	FE	GMM
Lagged MSI employment			1.095**			
			(0.101)			
Lagged MSI Wage						0.534**
						(0.110)
MSI employment				-0.823***	-0.191*	-1.02**
				(0.172)	(0.101)	(0.033)
MSI wage	-1.20**	-1.105*	-1.45***			
	(0.452)	(0.052)	(0.192)			
Output	.033*	0.097**	0.102***	0.011***	0.023***	0.085**
	(0.011)	(0.040)	(0.201)	(0.011)	(0.063)	(0.006)
Export Dummy	0.002	0.010*	-0.088*	0.108**	-0.020*	-0.054*
	(0.040)	(0.001)	(0.802)	(0.010)	(0.102)	(0.021)
Import Dummy	.086	0.062	-.106**	.201*	0.185	0.130*
	(0.014)	(0.032)	(0.088)	(0.040)	(0.001)	(0.085)
Foreign Ownership	0.49*	0.52	-0.172**	0.49**	0.95	0.17**
	(0.410)	(0.180)	(0.901)	(0.241)	(0.111)	(0.134)
Location dummy	0.210*	0.231	0.217*	0.023*	0.065	0.105*
	(0.102)	(0.202)	(0.104)	(0.06)	(0.019)	(0.092)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	No	Yes	Yes	No	Yes
R-squared	0.57	0.54		0.68	0.59	
Hansen test			0.198			0.823
AR(2)			0.712			.545***
			(0.518)			(0.002)

Table 3.12: Globalization and low-skilled employment

	Employment of LSI			Wage of HSI		
	OLS	FE	GMM	OLS	FE	GMM
Lagged LSI employment			0.121***			
			(0.091)			
Lagged LSI Wage						0.214***
						(0.116)
LSI employment				-0.280***	-0.190***	-0.209*
				(0.135)	(0.052)	(0.019)
LSI wage	-0.391***	-0.013***	-0.264*			
	(0.053)	0.062	(0.084)			
Output	0.012*	0.019	0.016*	0.009*	0.033***	0.051*
	(0.012)	(0.072)	(0.010)	(0.002)	(0.042)	(0.201)
Export Dummy	0.091	0.055*	0.405	0.221**	0.1301	0.219**
	(0.001)	(0.112)	(0.210)	(0.0310)	(0.012)	(0.221)
Import Dummy	0.08	0.019	0.16***	0.019*	0.45	0.121**
	(0.041)	(0.035)	(0.102)	(0.010)	(0.105)	(0.054)
Foreign Ownership	0.104*	0.522	0.103**	0.140**	0.23	0.902***
	(0.024)	(0.020)	(0.019)	(0.054)	(0.023)	(0.112)
Location dummy	0.021	0.221	0.641*	0.369	0.129	0.123**
	(0.006)	(0.019)	(0.083)	(0.126)	(0.109)	(0.383)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	No	Yes	Yes	No	Yes
R-squared	0.49	0.44		0.55	0.47	
Hansen test			0.216			0.514
AR(2)			0.519			.445***
			(0.598)			(0.0011)

Figure 3.4: Distribution and Growth of FDI in Africa



Source: on Trade and Development (2017)

Chapter 4

International Trade and Equilibrium Unemployment With Heterogeneous Firms and Workers

Abstract

We develop a model of heterogeneous workers and firms which bridge the new new trade model of heterogeneous firms by Melitz (2003) and the Equilibrium unemployment with search-matching frictional labor market model by Mortensen and Pissarides (1994). Workers are heterogeneous in terms of the skill (ability) level which is correlated to the firms productivity in one-to-one relation. The trade liberalization affects the product market and thus, has significant impact on the labor market since opening to trade involves resource reallocation from the inefficient firms to efficient ones. However, in our model we showed the effect is vise-a-vise. International trade by increasing the minimum productivity threshold, increases the flow of workers into the non-participation/unemployment pool and the reduction in the variable and fixed trade cost also increases the labor market tightness. Since, the total revenue of the firm depends on the firms productivity or workers ability, firms pays different wage depending on the level of their productivity. We also show the wage differential between average wage paid by the non-exporting and exporting firm is positively influenced by trade liberalization.

4.1 Introduction

The objective of this study is to analyze the behavior of open economy model with search-frictions in labor market, in a framework of international trade with heterogeneous firms and heterogeneous workers. This is motivated by the fact that empirical evidence regarding the relationship between labor market and trade liberalization is unclear and mixed. In order to achieve this, the open economy set up of international trade with heterogeneous firms, Melitz (2003) model, is a natural starting point in recent labor market studies.

Melitz (2003) model, combines increasing returns to scale and product differentiation with heterogeneous firms. In the model, trade liberalization puts inefficient firms out of business while offering new opportunities to efficient ones. This selection effect leads to an aggregate productivity gain in the economy. There is ample evidence for this effect, both from micro-econometric and from aggregate data (Davidson et al. (1999), Bernard et al., 2003). Even though it is assumed in the model that at equilibrium there is full employment, this self-selection can affect the aggregate demand of variable inputs, labor. In the same vein, the search and matching model of Mortensen and Pissarides (1994) has been successfully applied to a large number of environments, both in theoretical and empirical studies.

This study contributes to the body of existing literature at the nexus of international trade and labor economics more specifically to those studies that focus on international trade with heterogeneous firms and workers, search frictions with endogenous separations and wage inequality in general equilibrium. The point of departure from the existing body of literature is based on Zaharieva (2010) who investigates the behavior of a model economy with search frictions, moral hazard and endogenous job separation rates in a closed economy and inclusion of heterogeneous workers. The set-up of the model is, firms are characterized by heterogeneous productivities in the same spirit as Melitz (2003) at the stage of a vacancy, workers differ in their productivity/ability which could be also defined as the skills level of the worker and it is observable to the firm's[1].

[1]One can measure the level ability of the workers by the educational level and or experiences

Zaharieva (2010) shows that firms with more productive matches offer higher wages to workers, motivate them to exert more effort and indirectly obtain lower separation rates compared to the firms with lower productivity. This mechanism creates a situation where productivity is positively correlated with wages and negatively with separations from a cross-sectional perspective. Strong empirical evidence of a negative relationship between wages and separation rates can be found in Leonard (1987). The question then arises what are the firm selection consequences of search frictions in an open economy with heterogeneous workers. Intuitively as heterogeneity is at the level of the firms and workers, wage dispersions within the firm and across firms should be a determined result. Moreover, as firm entry depends on fixed costs that are paid off once, there is a cutoff productivity threshold in the spirit of Melitz (2003) below which it is not profitable for firms to have the matching function sustained, similarly for heterogeneous worker ability the same principle applies.

In the Melitz (2003) model, there is a self-selection effect of the most productive firms into export markets, and resource re-allocation occurs such that the most productive firms produce more output and generate more profits. Moreover, the inefficient firms exit the market. Thus unlike the classical trade models, which assumes full employment, at equilibrium there happens the resource reallocations, which could affect the equilibrium unemployment. Additionally, in a unified frame work with labor search frictions, we postulate that these firm (with productivity greater than the export threshold) offer higher wages to high ability workers hence job search separation is lowers. However the least productive firms only capture a small market size hence small proportion of profits and lower wages, consequently they hire low skilled workers with high separation rate. Additionally, there are firms which exit the market due to trade liberalization, as they face new competition, which could affect the dynamics of unemployment.

The rest of the paper is organized as follows. Section 2, presents the summary of some related literature. Section 3, presents the benchmark model environment, solutions (with technical steps in Appendices), and main results and propositions. In section 4, we extend the model to multi-workers case and presents the main results. Section 5 concludes the paper.

4.2 Overview of the Related Literature

This paper links two strands of economic literature. It bridges the equilibrium unemployment in search and matching fricition model of Mortensen and Pissarides (1994) and the new new trade model of Melitz (2003). Thus it is related to the literature which deals with frictional labor market and international trade or both. These our work is closely related to Egger and Kreickemeier (2009), Egger and Kreickemeier (2012), Davis and Harrigan (2011), Helpman et al. (2010), Helpman and Itskhoki (2010), Felbermayr et al. (2011), Davidson et al. (2008), and others.

Given our objective of analyzing the behavior of an open economy in the presence of labor market friction and firms and workers heterogeneity, Melitz (2003) model is the ideal starting point. This model developed a framework that incorporates firm heterogeneity in general equilibrium. In this model, firms are heterogeneous with respect to their productivity and place of origin and supply under the monopolistic competition. Due to trade liberalization the inefficient firms exit the market, while the efficient firms gain a new opportunities, which leads to the average productivity gain. The model assumes full employment and at equilibrium the firms entry and exit do not have effect on the wage and employment. On the other hand, from the labor market point of view as well, the equilibrium unemployment of Mortensen and Pissarides (1994) is used to explain both unemployment and wage dispersion and is the natural starting point for the literature which deals with this ideas. Davidson et al. (1999) argue the search-matching model is useful in general equilibrium, as it could be a source of comparative advantage.

The work by Egger and Kreickemeier (2009) and Egger and Kreickemeier (2012) introduce the labor market imperfection by introducing fair wage and efficiency wage in the Melitz model. Wage is assumed to be fair and it depends on the productivity of the employer and due to the firm-specific components, identical workers can earn different wages at equilibrium. Trade liberalization (fixed cost of exporting) leads, to self-selection of the high productivity firms into export and exit of the least productive firms, hence affects all variables in the model including wage and unemployment. The firms gain from trade and the average profit increases due to the self-selection effect, while the unemployment rate and wage inequality increase. They also show

the existence of voluntary unemployment and positive profit at equilibrium.

Davidson et al. (1999) analyzed the trade and labor market interaction by introducing the search unemployment in the trade model. However, they kept the perfect competition and constant returns to scale assumption, they aimed to see the effect of search and matching on the pattern of trade. Their work shows, as the country with more efficient search technology has a comparative advantage in the sector with a high break-up rate. Davidson et al. (2008) analyzed how the presence of the search frictions affects the determination of the firms productivities by introducing the search unemployment in the environment of the heterogeneous firms. Exporting firms are bigger, more capital intensive and pay higher wages then the other firms. Moreover, they showed as the wage gap between high and low skill workers increases.

Carrère et al. (2015) developed a multi-sector, multi-country general equilibrium trade model with labor market frictions and equilibrium unemployment. They introduce the sector-specific Diamond-Mortensen-Pissarides search and matching frictions modeled in Helpman and Itskhoki (2010), into trade model of Eaton and Kortum (2002). They showed as trade opening reduces unemployment if the country has a comparative advantage in a sector with relatively high matching efficiency. Moreover, if trade leads to increase in the real wages, then there would be lower equilibrium unemployment rates and more jobs.

4.3 Framework and Analysis of the Model

In this section we outline the theoretical model. We assumed two symmetric countries with heterogeneous workers and ex ante homogeneous firms (Firms heterogeneity arises after firm learn their productivity). The starting point of this paper is to introduce dynamic search and matching framework developed in Mortensen and Pissarides (1994) and Pissarides (2000) into the new trade model developed by Melitz (2003). In the same spirit as Melitz (2003) first firms enter the (production) market by paying f_e units of the homogeneous good which are the fixed costs of entry and draw the productivity φ from the distribution $F(\varphi)$. Firm which draw the productivity large enough, stay in the market and thus, post the vacancy in search of worker with ability which matches the productivity level drawn by the firm. If the productivity is

low enough the firms exit the market, and stay in the non-participation pool, until she can draw a productivity level, enough to make positive profit. Additionally, firms are hit by an exogenous exit shock with probability δ. Job matches are heterogeneous with respect to the productivity parameter φ drawn from the productivity distribution $F(\varphi)$. Job search is random and undirected and the productivity realization is simultaneously revealed to the worker and firm once a match has been formed. Workers reject job offers below the reservation wage while firms reject productivity realizations below the reservation productivity.

4.3.1 Matching Function

Matching between firms and unemployed workers is modeled using the standard matching function approach by Mortensen and Pissarides (1994) and Pissarides (2000). Let u denote the unemployment rate and v - the vacancy rate (expressed as a ratio of vacant jobs to the size of the labor force). Then the number of job matches taking place per unit time and expressed as a fraction of the labor force, as given in the standard literature can be expressed: $m(u,v) = m(1,\frac{v}{u})u$. Following Albrecht and VROMAN1 (2002) and Albertini et al. (2015);

$$m = m(v,u) = \eta u^{1-\alpha} v^{\alpha} \tag{4.1}$$

Where v is the number of vacancies and u is the number of unemployed workers. Gautier and Moraga-González (2004) provide a number of explanations why this technology may be the most adequate assumption in a model with worker heterogeneity. The main reason is that this technology avoids congestion externalities between different worker types and jobs, where $\theta \equiv \frac{v}{u}$ is the vacancy-unemployment ratio (number of vacancies per unemployed workers), the labor market tightness. The probability that a vacant job matches with a worker (vacancy filling rate) is $q(\theta) = \frac{m(u,v)}{v} = \eta\theta^{\alpha-1}$ and is decreasing in labor market tightness θ as higher θ implies difficulty for the firms to fill the vacant job. The job arrival rate for the workers is, $\lambda(\theta) = \frac{m(v,u)}{u} = \eta\theta^{\alpha}$ and contrary to job filling rate, $\lambda(\theta)$ is increasing function of the labor market tightness.

Wage is assumed to be determined through bargaining between the worker and firm over the match surplus. This is discussed in the next subsection. The match surplus represents the value of the match relative to the summed workers' value of being unemployed and the entrepreneurs'

value of an unmatched vacancy, which is zero in equilibrium. There are no bargaining rigidities; separations for the worker-firm pair, occurring if and only if the match surplus falls below zero for both parties and thus the workers move to the unemployment pool and the firms exit the market.

4.3.2 Production and Revenue

We followed the new trade model literatures to formulate the revenue of the firm. In each country, firms produce a final output good Y under perfect competition. That good is assembled from a continuum of intermediate inputs, indexed by ω and supplied by domestic and foreign firms who operate under conditions of monopolistic competition. The final output good can be consumed or used by input producers. Denoting the quantity of inputs by $q(\omega)$, the aggregate production function could be given in the same way as in Felbermayr et al. (2011) and others, is given by:

$$Y = \{M_i^{(\nu-1)(1-\beta)} \int_{\omega\in\Omega} q(\omega)^{\beta}\}^{\frac{1}{\beta}} \tag{4.2}$$

Where $\beta = \frac{\sigma-1}{\sigma}and0 < \beta < 1$, Ω is mass of M available intermediate inputs produced under the monopolistic competitive condition and thus, M_i refers to the degree of input diversity, with σ referring to the elasticity of substitution between any two varieties of inputs[2].

Similar to Melitz (2003), intermediate input firms are uniquely described by different productivity level φ and place of origin, so that we can substitute the firm index ω with φ and index prices and quantities with country subscripts denoting the place of origin and destination. We borrowed the idea in Felbermayr et al. (2011) to understand the role played by the degree external effect ν. As in Ardelean (2006) $\nu \in [0, 1]$ is the parameter that governs the degree of external scale effect present in the final good production. The value $\nu = 1$ shows the exaggeration of the role of the diversity for the aggregate productivity.

Choosing the final good as the numeriare, which imply $P = 1$, the demand for intermediate inputs can be derived as follows;

[2] M_i refers to the number participating firms too, as each variety of intermediate good is produced by single firm. Thus, M_i is the sum of the firms serving the domestic market M_d and those participating in the foreign market

$$q(\omega) = \left(\frac{Y}{PM^{1-\nu}}\right)\left[\frac{P}{p(\omega)}\right]^{\frac{1}{1-\beta}} \equiv \left(\frac{Y}{M^{1-v}}\right)p(\omega)^{\frac{-1}{1-\beta}} \tag{4.3}$$

Where $P = [M^{\nu-1}\int_{\omega\in\Omega} p(\omega)^{\frac{\beta}{\beta-1}}d\omega]^{\frac{\beta-1}{\beta}}$ is the price index and normalized to one.

Given the demand function given above for intermediate goods, the revenue of the firm producing $q(\varphi)$, $r(\varphi) = p(\omega)q(\omega)$ is given by;

$$r(\varphi) = Dq(\omega)^{\beta} \tag{4.4}$$

Where $D = P[\frac{Y}{PM^{1-\nu}}]^{1-\beta}$ and it is the country specific demand shifter or simply the macroeconomic indicator.

Intermediate good production: Like in the standard new trade literature, there is a continuum of monopolistically competitive firms producing each unique variety of inputs. Labor is the only production input and inelastically supplied by the household and enters firms production function linearly[3].

$$y(\varphi) = \varphi(\omega)l(\omega) \tag{4.5}$$

Where $l(\omega)$ is the labor used in the production of intermediate good ω by the firm with productivity φ.

Input producer firms face fixed cost, f_D and f_X in domestic and export markets respectively. Like other literature we assume $\tau^{\frac{1}{1-\beta}}f_x > f_d$, since this assumption helps to ensure that, only a portion of firms participate in export and exporters are more efficient than non-exporters/domestic firms (Egger and Kreickemeier (2009)).

[3]In the bench mark model we assumed one-worker one-firm and firms operate with a linear production function with a one to one correspondence between worker ability and firm productivity given by $y(\varphi) = \varphi$

4.4 Value Functions and the Firm's Revenue Function: One-Firm One-Worker Case

The sequence of actions taking place in the economy are as follow. There is a continuum of intermediate good producing firms, each producing a unique variety of the intermediate good ω. These firms to enter the market must make the initial investment of fixed cost of entry $f_d > 0$ which is sunk cost. After interring the domestic market the firms draw the productivity φ from a common distribution $g(\varphi)$[4]. A firm that draw a productivity large enough to make positive profit stay in the market and post the vacancy. On the hand there are heterogeneous workers drawing their ability φ from the same distribution of firms' productivity. Hence, firms to start production needs to fill the open vacancy with workers of appropriate ability, which could be done through interview. After the match happens and production start taking place, firm decides to participate in the foreign market through export. Moreover, Each period firms face idiosyncratic shocks with probability δ and thus, forced to exit the market and with probability χ the match can be destroyed. These two shocks are assumed to be independent, i.e $s = \delta + \chi - \delta\chi$ Felbermayr et al. (2007).

Workers Value Functions

The economy consists of a continuum of heterogeneous workers N which can be normalized to unit without loss of generality. Each worker are heterogeneous in terms of their ability φ which is distributed Pareto in one-to-one correspondence with firm productivity.

Value functions: Workers can be in one of the two states; employed or unemployed. When unemployed, the worker can search for the job depending on the value functions. Employed workers earn flow of benefits from working. Let U and W be the present-discounted value of the expected income stream of unemployed and employed worker respectively and r be the discount rate. The match between a worker and a firm can happen if it is profitable for both parties. Thus, a worker who accepts the job, earns the wage of his ability $w(\varphi)$, determined through bargaining over the job surplus, until a negative productivity shock hits the match. When the

[4]For detailed explanation of firm entry and productivity distribution see the next section.

match is rejected the worker earns un unemployment benefit b, independent of her ability and continues searching for job. The Bellman equations for the worker in either states are given by:

$$rW(\varphi) = w(\varphi) - s[W(\varphi) - U(\varphi)] \tag{4.6}$$

$$rU = b + \lambda(\theta) \int_{\underline{\varphi}}^{\overline{\varphi}} max[W(\varphi) - U, 0] dG(\varphi) \tag{4.7}$$

Where s is the separation rate conditional on the ability of the worker or productivity of the firm, which further correlated to the wage. In other words firms with higher productivity, has a lower separation rate.The workers are willing to accept the match if the job surplus is positive i.e $W(\varphi) - U(\varphi) \equiv \frac{w(\varphi)-b}{r+s+\lambda(\theta)} \geq 0$. Thus, the minimum wage (reservation wage) is equals to the unemployment benefit.

Firms Value Functions

There are a pool of M heterogeneous firms in the economy who produces intermediate good in monopolistic goods market using the linear technology given by $y(\varphi) = \varphi$. To enter the market the firm pay fixed entry sunk cost f_e, and then post a vacancy if the value of posting the vacancy is positive, otherwise, she leaves the market. The entry of new firm into the market continuous till the value of posting a new vacancy is zero or less.

Before looking at the value functions of a firm, it is important to underline the revenue functions. Domestic firms after matched with a worker, decides whether to enter the foreign market via exporting and incur a fixed cost of exporting f_x. The decision to participate in the foreign market depends on the productivity level. If the firm is not productive enough she will sell all her outputs at home market (serve only the domestic market). If the productivity is large enough, she will enter the foreign market through export and divide the outputs between home and foreign markets according to the marginal revenue rule. The exporting firm optimize the revenue from both markets and distribute the output according to the marginal revenue rule which means equating marginal revenues from the domestic and foreign market. The total revenue of the intermediate good producer is thus the sum of revenues from both domestic and foreign markets;

$$r(\varphi) = r_d(\varphi) + I_x r_x(\varphi) \tag{4.8}$$

where $r_d(\varphi) = Dy_d(\varphi)^\beta$ is revenue from domestic market, $r_x(\varphi) = D^*[\frac{y_x(\varphi)}{\tau}]^\beta$ is revenue from foreign market generated from exporting and derived from equation (4.4), and I_x is an indicator which takes a value 1 if the firm export and zero otherwise.

The firms thus, equate the marginal revenue from both markets to split the output: $\frac{\partial r_d(\varphi)}{\partial y_d(\varphi)} = \frac{\partial r_x(\varphi)}{\partial y_x(\varphi)}$ and assume the symmetry between home and foreign i.e ($D = D*$). Moreover, we can write the amount to be exported as a function of the amount sold in the domestic market $y_x(\varphi) = \tau^{\frac{\beta}{\beta-1}} y_d(\varphi)$. Since the decision of a firm to export depends on the productivity and hence, not all firms export, let us define new variable $A = 1 + I_x \tau^{\frac{\beta}{\beta-1}}$. Thus total revenue is $r(\varphi) = DAy_d^\beta$ and $y(\varphi) = y_d(\varphi) + I_x y_x(\varphi)$.

This implies,

$y_d(\varphi) = \frac{1}{A} y(\varphi)$ and $y_x(\varphi) = \frac{A-1}{A} y(\varphi)$

Finally, the total revenue can be written as,

$$r(\varphi) = DA^{1-\beta}\varphi^\beta \tag{4.9}$$

Where, from the definition A is one if the firm does serve only the domestic market and more than one otherwise.

Value functions: Let J and V be the present-discounted value of the expected income stream of a filled jobs and an open vacancies respectively and r be the discount rate. When the job is vacant the firm pays the flow of cost c_v which is the extra cost that she might incur as a result of the job been open and not producing. However, if the vacant job is filled the firm will generate a flow of revenues. Then depending on their productivity level they either serve only the domestic market or participate in a foreign market through export.

The value function of the filled jobs can be given by;

$$rJ^i(\varphi) = r^i(\varphi) - w^i(\varphi) - f_d - I_x f_x - s\{J^i(\varphi) - V\} \tag{4.10}$$

Where $i \in \{d, x\}$ indicates domestic and export firms respectively, f_d is domestic fixed cost and f_x is export fixed cost.

A firm with open vacancy incurs a flow cost of c_v and matched with the worker of corresponding ability with job filling rate $q(\theta)$. The value of open vacancy is;

$$rV = -c_v + q(\theta)[\int_{\varphi_d}^{\overline{\varphi}} \{J^i(\varphi) - V\} dG(\varphi)] \tag{4.11}$$

Optimal Vacancy Posting Condition (Job Creation)

The free entry condition ensures that at equilibrium the value of posting a new vacancy is zero or less i.e $V(\varphi) \leq 0$. Thus, at equilibrium the vacancy posting condition can be expressed as:

$$\frac{c_v}{q(\theta)} = \int_{\varphi_d}^{\overline{\varphi}} J(\varphi) dG(\varphi) \tag{4.12}$$

This equation is job creation condition and it links mainly the labor market tightness θ to the participation productivity (φ_d^*). The higher participation productivity of the firm leads less job creation (for detail see Zaharieva (2010))[5]. The Job creation equation above equates the expected recruitment cost ($\frac{c_v}{q(\theta)}$) and the expected gain from the filled job. The left hand side of the equation (expected recruitment cost) is the increasing function of the labor market tightness θ parameter which is because higher θ makes it difficult to fill the open vacancy and thus increases the cost of filling vacancies. The right hand side (expected gain from the filled open vacancy) is increasing function of the average productivity, but a decreasing function of the participation productivity φ_d. Higher participation threshold leads to a higher wage and and reduces the acceptance rate of $1 - G(\varphi_d)$.

$$\frac{c_v}{(1 - G(\varphi_d))q(\theta)} = \int_{\varphi_d}^{\overline{\varphi}} \frac{J(\varphi)}{(1 - G(\varphi_d))} dG(\varphi) \tag{4.13}$$

The left hand side of the above equation is the expected cost of the open position (expected recruitment cost), while the the right hand side represent its expected gain (expected marginal profit from filling the next one vacancy). At equilibrium both have to be equal, this could rep-

[5]The participation productivity φ_d^* defined in the same way as the reservation productivity (p_0) in Zaharieva (2010)

resent the demand for labor.

4.4.1 Wage Determination

Following Stole and Zwiebel (1996) and Ebell and Haefke (2003) wages are supposed to be determined through individual Nash bargains between a meeting firm and a worker over a match surplus. The match surplus depends on the firm productivity and the worker ability[6]. Accordingly, the surplus from a job match is shared between both parties depending on their respective bargaining power, ρ and $1-\rho$ for the worker and firm respectively. The bargained wage $w(\varphi)$ can be derived from the following Nash-bargaining condition,

$$w^i_{Nash} = argmax[J^i(\varphi) - V(\varphi)]^{1-\rho}[W(\varphi) - U]^{\rho} \tag{4.14}$$

Where V is the value of open vacancy and at equilibrium, it has zero value due to the free entry condition. And is $\rho \in [0,1]$ the bargaining power of the workers, $W(\varphi), U$ and $J(\varphi)$ are workers, unemployment and filled job value functions respectively. In other word, the above equation can be simply rewritten as; $\rho J(\varphi) - V = (1-\rho)(W(\varphi) - U)$

$$W(\varphi) - U = \frac{w(\varphi) - rU}{r+s} \tag{4.15}$$

$$J^i(\varphi) = \frac{r^i(\varphi) - w^i(\varphi) - f_d - I_x f_x}{r+s} \tag{4.16}$$

Substituting equations 4.15 and 4.16 in 4.14 and rearranging and solving it, we can write the bargained wage as:

$$w(\varphi) = \rho(r^i(\varphi) - f_d - i_x f_x) + (1-\rho)rU \tag{4.17}$$

Where $r^i(\varphi)$ is the total revenue of the firm, $i = \{d, x\}$ indicating the domestic or exporting firm, and I_x is 0 if the firm is serving only the domestic market and one otherwise. It is possible

[6]The firm start producing only if the match happens after the negotiation on the surplus. Since the firms advertise its open vacancy after drawing productivity φ he knows the ability level which he needs, but he does not exactly know with which worker the match will happen (she knows only the distribution of the ability potential match)

to get rid of rU by solving its value using the job creation condition and the workers surplus; $(1-\rho)rU = (1-\rho)b + \rho c\theta$. Substituting this equation and the revenue equation $DA^{1-\beta}\varphi^{\beta}$ back in the wage equation it can be rewritten as;

$$w^{i}(\varphi) = \rho[DA^{1-\beta}\varphi^{\beta} - f_d - I_x f_x + c\theta] + (1-\rho)b \tag{4.18}$$

Unlike in Felbermayr et al. (2007) and other trade literature which assumes perfect labor market, one can see from the bargained wage equation, firms with different productivity pays different wages [7]. The bargained wage is the increasing function of marginal revenue, labor market tightness and the workers outside option. Moreover, since revenue is increasing in productivity, the wage is also increasing in firms' productivity or workers ability φ, which reflects the firm with higher productivity pays a higher wages. Higher productivity firm, employ high ability worker and thus, pays a higher wage rate. Since it is true that the higher productivity firms select themselves into the foreign market through export, our result supports the evidence that the exporting firms pay higher wages relative to the non-exporting firms "***export premium***" Egger et al. (2017). Moreover, the assumption of a one-to-one correspondence between the firm productivity and worker skill(ability) also help us to conclude workers are paid differently based on their ability and higher able worker earn more (similar conclusion could be also found by Davidson et al. (2008)).

4.4.2 Productivity Distribution and Threshold

Productivity is assumed to be Pareto distributed. There are a continuum of prospective entrants that are homogeneous ex-ante and to enter the market they pay a sunk entry cost, $f_e > 0$ units of labor. Thereafter, firms independently draw productivity levels from a common distribution $g(\varphi) = k(\varphi_{min})^{k}\varphi^{-(\kappa+1)}$ with positive support over $(0, \varphi_{max})$ and a continuous cumulative distribution $G(\varphi)$,where $G(\varphi) = 1 - \left(\frac{\varphi_{min}}{\varphi}\right)^{\kappa}$. Where φ_{min} is the minimum productivity in the productivity distribution. Productivity is assumed to be Pareto distributed, the degree of firm heterogeneity is summarized by the shape parameter $\kappa > \sigma - 1$. This ensures that the distribution of productivity draws finite variances. Since κ is an inverse measure of variance, lower

[7] $w^{d}(\varphi) = \rho[D\varphi_d^{\beta} - f_d - +c\theta] + (1-\rho)b$ and $w^{x}(\varphi) = \rho[DA^{1-\beta}\varphi_x^{\beta} - f_d - f_x + c\theta] + (1-\rho)b$

values of κ correspond to greater firm heterogeneity (larger variance of firm productivity).

The Pareto distribution has a number of properties that make it analytically tractable hence it is used in the models of a firm selection into export and FDI markets. From empirical evidence, it is a good approximation of the upper tail of the distribution of firms' sizes; this was first noted by Simon and Bonini (1958). Pareto distribution for US and European firms used to predict FDI was estimated by Helpman et al. (2004). A key feature of a Pareto distributed random variable is that when truncated the random variable retains a Pareto distribution with the same shape parameter κ. Therefore if entry is subject to an endogenous productivity cutoff, the distribution of the technologies that make the cut remains Pareto distributed. Another key feature of a Pareto distributed random variable is that power functions of this random variable are themselves Pareto distributed. Therefore, individual prices have a Pareto distribution, with a constant elasticity of demand, so do sales, hence firm size and variable profits are Pareto distributed.

In this model there exists two productivity thresholds. The first one is the minimum productivity below which workers remain unemployed as in the spirit of Mortensen and Pissarides (1994) as well as the firms do not enter the market and we call it *the participation threshold*. The second one is the productivity level in the spirit of Melitz (2003), above which it is profitable for a firm to enter the foreign market via export and it is called *the export threshold*.

Participation productivity (φ_d): is the minimum productivity blow which match cannot happen or the worker whose ability is below this threshold do not participate in the labor market, as it is not worth looking for job hence, remain in the unemployment pool. Hence, φ_d is the level of productivity for which the workers surplus is zero ($W(\varphi) - U \equiv \frac{w(\varphi)-rU}{r+s+\lambda(\theta)} \leq 0$. On the other hand, firm who drew a productivity level below (φ_d) exit the market as it is not profitable to stay, which means $J(\varphi_d) - V \leq 0$. From the definition thus, (φ_d) can be determined in either way (by setting $w(\varphi) = b$ or $J(\varphi_d) = 0$)[8].

Formally,

$$r(\varphi_d) - w(\varphi_d) - f_d = 0 \tag{4.19}$$

[8]In either way, the value of φ_d is the same.

Where;

- $r(\varphi_d) = D\varphi^{\beta}$ the revenue by the domestic firms
- $w(\varphi) = \rho[r(\varphi_d) - f_d + c\theta] + (1-\rho)b$ is the wage paid by the domestic firms to the worker.

Solving the above equation, the participation threshold is;

$$\varphi_d = D^{\frac{-1}{\beta}} \left(f_d + b + \frac{\rho}{1-\rho} c_v \theta \right)^{\frac{1}{\beta}} \tag{4.20}$$

Thus, φ_d is the minimum productivity level below which match can't happen and the firms do not enter the market as it is not profitable for both parties. At the φ_d the workers are indifferent between accepting the match and reject it and stay in the unemployment pool, while the firms are indifferent to exit or stay in the market. The participation productivity depends on the unemployment benefit b which affects the decision of the workers to search and accept the match and the fixed domestic entry cost f_d for the firm which on the other hand, affects the decision of the firm to enter the market. It is also positively affected by the marginal requirement cost $(c_v\theta)$. The level of competition D has negative impact on φ_d.

Export Threshold: Since serving the foreign market is costly, only a portion firms participate in foreign market through the export. Those firms who are productive enough to cover the costs can participate in the foreign market via export. Thus, there exists a productivity φ_x for which the firm is indifferent between serving the domestic and the foreign market. At this productivity level φ_x, therefore, the value of serving the domestic market is greater or equals to the value of serving the foreign market. Hence, $\{\varphi_x = \varphi : J(\varphi)|_{export} \geq J(\varphi)|_{non-export}\}$, which satisfies, $r_x(\varphi) - w(\varphi) - f_d - f_x \geq r_d(\varphi) - w(\varphi) - f_d$. Solving the equality gives,

$$\varphi_x = \left(\frac{f_x}{D} \right)^{\frac{1}{\beta}} [[1 + \tau^{\frac{\beta}{\beta-1}}]^{1-\beta} - 1]^{\frac{-1}{\beta}} \tag{4.21}$$

The export threshold does not depend on the labor market tightness. Once the match happens and the firm and worker finds it profitable they continue production and the firms with higher productivity $(\varphi \geq \varphi_x)$, would serve the foreign market via export. Hence, the export threshold is positively affected by the fixed cost of export f_x and the variable cost of export τ, while it is negatively related to the macroeconomic variable D .

Equilibrium Unemployment and Labor Market Clearing

To characterize the equilibrium unemployment we followed the seminal work by Mortensen and Pissarides (1994). The firm and unemployed workers are matched according to the function given under the search and matching section. However, since we are considering heterogeneous workers, our model shows the group of workers who do not participate in the labor market due to the fact that their skill level is below φ_d, in addition to the frictional unemployment discussed in the most search-match literature.

There could be two types of unemployment in this economy. The first type of unemployment can happen if the worker draws a lower ability level i.e $\varphi \leq \varphi_d$. This group of workers does not participate in the labor market due to the fact that their ability is low enough to find a match. Hence, they stay out of the lobar force till they draw the ability level above the participation ones. The second, type of unemployment is the one that can happen if the workers with ability above the participation threshold are not matched due the friction in the labor market, which is called frictional unemployment.

Therefor we can define the total unemployment in the economy as:

$$N_u = \begin{cases} 1 & \text{for} \varphi < \varphi_d \\ u(\varphi) & \text{for} \varphi \geq \varphi_d \end{cases}$$

Just for simplicity, let's focus only on the second case i.e the frictional unemployment for equilibrium unemployment analyses[9]. The law of motion of the unemployment flow can be given by the following dynamic equation.

$$\dot{u} = (1-u)s - \lambda(\theta)u(1-G(\varphi)) \tag{4.22}$$

In the stationary equilibrium the inflow into unemployment pool should be equal to the outflow of the workers from the employment pool, which gives $\dot{u}$ zero at the point. The first term in the above equation, the inflow into the pool of unemployment, consists the group of

[9]This does not hinder our result, as our main goal is to analyses the effect of trade liberalization on the labor market and vise a vise

employed workers who lose their job given the separation rate s, which is in fact negatively related to productivity.

Solving the above equation:

$$u = \frac{s}{s + \lambda(\theta)(1 - G(\varphi_d))} \tag{4.23}$$

This is the Beveridge curve (UV curve) showing the negative relation ship between equilibrium unemployment u and labor market tightness θ or Unemployment and job vacancy rate.

4.5 Trade Liberalization

In this section, we will discuss the effect of,

1. the reduction in trade variable cost (τ) and
2. change in the fixed export costs (f_x) on the firm and the worker decision.

4.5.1 Trade Liberalization and Productivity Thresholds

The participation threshold (φ_d): from the participation productivity threshold equation given by 4.20, one can see that it depends on the fixed entry cost into the domestic market f_d, the macroeconomic parameter D, the labor market tightnessθ and the workers outside option b. So it doesn't directly depend on the iceberg trade cost τ and the fixed cost of export f_x. However, since trade liberalization can influence the macroeconomic parameter D and the labor market tightness θ the participation threshold can be hindered by the level of openness, whenever these parameters change. Given the equation $\varphi_d = D^{\frac{-1}{\beta}}(b + f_d + \frac{\rho}{1-\rho}c\theta)^{\frac{1}{\beta}}$ we can draw the following conclusion;

Proposition 1. *The participation threshold φ_d increases if trade liberalization leads to,*

- *Increase in both the domestic market entry fixed cost f_d and the unemployment benefits b*
- *Increase in the recruitment (vacancy filling) cost ($c_v\theta$), which imply an increase in the labor market tightness θ and also higher bargaining power of the workers, which increases the cost of production for the firms.*

- *The macroeconomic variable D decreases, which could happen due to the increase in the number of varieties (competition).*

The first and second points under this preposition are straight forward. The increases in the workers outside option makes the match difficult and increases the reservation wages, that the firm should pay in order to to convince the worker to accept the match. On the other hand, the increase in fixed entry cost makes affects the firms decision to enter the market, while the recruitment cost makes it hard for the firm to finalize the match. Thus due to the increase in this threshold, the firms with lower productivity level exit the market. The third point is to refer actually the new competition the domestic firms face as a result of openness. Since openness increases competition only the able firms can exist and the inefficient firms exit the market and as a result the participation productivity increases.

Export threshold: Trade liberalization has direct effect on the export threshold through the change in the iceberg variable trade cost (τ), fixed export costs f_x and the demand shifter (macroeconomic parameter (D)). However, it does not depend on the labor market variable (labor market tightness (θ)). This due to the assumption of one firm on workers and in fact, once the firm is matched the match would be sustained unless the shock happens and the firm exit the market and the match separates[10].
Given, $\varphi_x = D^{\frac{-1}{\beta}} f_x^{\frac{1}{\beta}} [[1 + \tau^{\frac{\beta}{\beta-1}}]^{1-\beta} - 1]^{\frac{-1}{\beta}}$

Proposition 2. *Given,* $\varphi_x = D^{\frac{-1}{\beta}} f_x^{\frac{1}{\beta}} [[1 + \tau^{\frac{\beta}{\beta-1}}]^{1-\beta} - 1]^{\frac{-1}{\beta}}$ *the export threshold decreases, other things remain constant if:*

- *The trade is liberalized, which means the reduction in both fixed and variable trade costs.*
- *The macroeconomic parameter D increases, which implies the number varieties/firms decreases.*

4.5.2 Trade and Labor Market Outcomes

The bargained wage and equilibrium rate of unemployment, as well as labor market tightness, could be directly and indirectly affected by liberalization.

[10] In many literature like Felbermayr et al. (2007), Hawkins and Acemoglu (2014) it is assumed two shocks; bad shock which forces the firm exit the market and the shock which leads to match separation and these shocks are independent.

Labor Market Tightness

Given the free entry condition ($V = 0$), the value of the filled job and the matching functions given in the previous sections, it is possible to link the labor market tightness to the trade components (especially τandf_x). We can formally write the labor market tightness as;

$$\theta = \left[\frac{\eta\pi}{(r+\delta)c_v}\right]^{1-\alpha} \tag{4.24}$$

Where $\pi = r(\varphi) - w(\varphi) - f_d - I_x f_x$ is the firms profit level and increases with trade liberalization (by the reduction in τandf_x.

Proposition 3. *The labor market tightness θ increases, other things constant, if;*

- *Both the variable and fixed trade costs decreases*
- *The macroeconomic variable $D = \left(\frac{Y}{M^{1-v}}\right)^{1-\beta}$ increases, which implies if the number of varieties (firms) decreases M.*[11]

Equilibrium Unemployment

Intuitively trade liberalization reduces the frictional unemployment rate, as it increases the participation threshold and the labor market tightness. However, this is not to mean that it reduces the aggregate unemployment,since it increases the number of those workers who do not participate in the labor force or just do not search as the marginal cost of search become higher than the benefit of being employed.

Given the equilibrium unemployment rate $u = \frac{s}{s+\lambda(\theta)(1-G(\varphi_d))}$, we can find the total change in the equilibrium unemployment. However, as explained in the above section, the unemployment pool in our model consists of those who are unemployed as their ability is lower than what the market requires ($\varphi \leq \varphi_{min}$), *"labor force non-participants"* and those whose ability is above the minimum threshold, but unmatched due to market friction, *"frictional unemployed"*. Focusing on fricitional unemployment we can draw the following proposition.

Proposition 4. *Unemployment u decreases if,*

[11] The number of varieties could be equal with the number firms as each identical variety is produced by single firm

- *The participation threshold φ_d increases*
- *The labor market tightness θ increases.*

Wage Inequality and Trade Liberalization

One of the most argued issues in the recent studies is the growing wage inequality due to the growing globalization (trade liberalization). There is ample empirical evidence that larger firms have a high probability to export and thus, enjoy higher revenues from larger market size and pay higher wages and employ more workers. Since we assumed firms' productivity is in one-to-one relation with workers ability and firms employ only one worker, thus, our analysis could also fit in the skilled-unskilled wage differential argument. The firms with higher productivity employ higher ability worker and the worker earn higher wages.

Openness to trade reduces the trade cost. Thus, it has effect on the wages of the workers for domestic and exporting firms. Since wages are determined through Nash-bargaining on the match surplus, a worker who is employed in the domestic firm will bargain over the match surplus from the domestic market and earn the wage determined through the individual Nash-bargaining, $w^d(\varphi) = \rho(r^d(\varphi) - f_d + c_v\theta) + (1-\rho)b$ as given under wage determination section. Those who are working for the exporting firm will bargain over the surplus from the sector and earn $w^x(\varphi) = \rho(r^x(\varphi) - f_d - f_x + c_v\theta) + (1-\rho)b$ as wage.

As we have already stated there exists marginal firm who is indifferent between serving the domestic market and foreign market. To see the wage gap between the workers in both sectors (domestic and exporting) we can thus, see the difference between the wages by the marginal firms, which is the difference between the wage of exporting and non-exporting marginal firm: $w^x(\varphi_x) - w^d(\varphi_d)$[12]. Solving this difference,

$$\Delta = \rho(D\varphi^{\beta}(\left(1+\tau^{\frac{-\beta}{1-\beta}}\right)^{1-\beta} - 1) - f_x) \tag{4.25}$$

Proposition 5. *The wage differential (wage premium) paid by domestic and exporting firm Δ is increases,*

[12]One can also take the difference between the wage paid by the average domestic firm and average exporting firms

- *As a result of trade liberalization; if both the fixed exporting costs f_e and the variable exporting costs τ decreases.*
- *The macro variable D and the marginal productivity (φ) increases.*

There is a number of theoretical and empirical supports for the above prepositions (See Davidson et al. (2008) Egger et al. (2013), Egger and Kreickemeier (2012), Egger et al. (2017)).

4.6 Multiple-Worker Firms

In the previous section, we have shown the one-firm one-worker case as it is assumed in the standard matching model of Mortensen-Pissarides. Under perfect goods markets this assumption can fit well since the number of firms and workers dos not have a significant impact. However in monopolistic competition case varying the number of the worker is the only way the firm can vary its output for a given level of technology (for a detail explanation see Ebell and Haefke (2003)). In this section, we will relate international trade and labor market by relaxing the assumption of one-firm one-worker.

Like in the one worker case firms maximize the discounted current value of the job. However, the total production of the intermediate goods and total costs now depends on the number of employed workers. The total production is $y(\varphi) = \varphi l(\varphi)$ and the total cost is also $c(\varphi) = w(\varphi)\frac{y(\varphi)}{\varphi} + f$. Given the search friction labor market, the firm post the open vacancy which could be filled at a rate $q(\theta)$. The filling rate is decreasing function of vacancy-unemployment ratio, θ. The firm incurs a constant cost c_v per vacancy. To formulate the value functions for both firms and workers, we followed Bertola and Garibaldi (2001), Ebell and Haefke (2003), and Felbermayr et al. (2007).

The value functions for employed and unemployed workers are similar to the one explained in the previous section. However, the firms value functions for open vacancy V and filled job $J(\varphi, l))$ could be formally written as:

$$rV = -cv_i + (1-\delta)q(\theta)J(l', \varphi) - V \tag{4.26}$$

The equation states that the expected value of the open vacancy is the sum of the per unit vacancy posting cost and the value of the vacancy being filled next time weighted by the probability that the firm survives.

$$rJ\varphi = r_i(\varphi, l) - w(\varphi, l) - f - cv + (1-\delta)J(\varphi, l') \tag{4.27}$$

Subject to:

$(1) r_i(\varphi) = p(q)q(\varphi, l)$

$(2) q = \varphi l$

$(3) l' = (1-\chi)l + q(\theta)v$

Constraint one shows the total revenue of the firms. As shown in the previous case the total revenue is the sum from both the domestic and foreign market and depends on the demand curve of the firms. The second equation is the total output of the firm which depends on the firm productivity φ and its employment level $l(\varphi)$. The third equation shows the level of employment next period and it gives the low of motion of employment at the firm level. The first term shows the total employment from the previous match, maintained with probability $(1-\chi)$ and the second term is the new match to fill the open vacancy v if any.

The first order condition for vacancy posting function could be thus;

$$\frac{c}{q(\theta)} = (1-\delta)\frac{\partial J(l', \varphi)}{\partial l} \tag{4.28}$$

Which is the marginal value of one more worker is equals the cost of recruiting weighted by the probability of the firms survival. Thus, the profit maximizing firm equates the recruitment cost and the workers shadow value.

To drive the pricing rule of the firm, first we obtain the shadow value of the labor by differentiating the value function of filled job and assuming $l' = l$, which is,

$$\frac{\partial J}{\partial l} = \frac{1}{1+r}[\beta\varphi P(l, \varphi) - w(l, \varphi) - \frac{\partial w}{\partial l}l] \tag{4.29}$$

Rearranging the equation and with some manipulation we obtain the pricing rule of the firm,

$$p(\varphi, l) = \frac{1}{\beta}\frac{1}{\varphi}[w + \frac{\partial w}{\partial l}l + \frac{c}{q(\theta)}(\frac{r+s}{1-\delta})] \tag{4.30}$$

4.6.1 Wage Determination

Like in the previous case wage is determined through individual Nash-bargaining following Stole and Zwiebel (1996). Thus, wage can be derived from the following Nash-bargaining condition;

$$(1-\rho)(W(\varphi) - U) = \rho(\frac{\partial J(\varphi)}{\partial l}) \tag{4.31}$$

Following Ebell and Haefke (2003), Bertola and Garibaldi (2001), we solve for wage equation as follows,

$$w(\varphi l) = (1-\rho)rU + \rho(\beta D A^{1-\beta}\varphi(\varphi l)^{\beta-1} - \frac{\partial w}{\partial l}l) \tag{4.32}$$

This wage equation is the first order linear differential equation in the wage and it has the following solution[13].

$$w(\varphi, l) = (1-\rho)b + \rho\left[\frac{\beta}{1+\rho(\beta-1)}\varphi p_i + c\theta)\right] \tag{4.33}$$

Where $p_i = DA^{1-\beta}(\varphi l)^{\beta-1}$

From the above wage equation one can observe that, like the standard labor literature, wages are increasing in the marginal revenue of the firm, and workers bargaining power and labor market tightness, the marginal cost of hiring. Moreover, the bargained wage depends on the productivity of the firm φ which proportional to the average skill employed.

4.6.2 Productivity Threshold

We followed the same techniques used in a single-worker case explained in the previous section to solve the productivity thresholds. The participation productivity, which is the minimum productivity below which workers remain unemployed in the spirit of Mortensen and Pissarides (1994) and the firms do not enter the market and the production do not take place. The Export productivity cut off is the productivity in the spirit of Melitz (2003), above which it is profitable

[13]We followed Ebell and Haefke (2009), Ebell and Haefke (2003). The solution for the first-order differential equation is also given in the same literature and for detail see the appendix

for firms to enter and serve the foreign markets through export.

Participation productivity: is the minimum productivity blow which match cannot be accepted and there is no production taking place. In other words, the worker whose ability is below this threshold do not participate in the labor market and thus, do not search for a job and remain unemployed. Hence, φ_d is the level of productivity for which the difference between the values of being unemployed and employed is zero for the worker. On the hand, firm who draw productivity below this threshold exit the market and thus, production do not take place. Since we assume a one to one correspondence between the firms productivity and the ability of workers, it also implies at this productivity level the firm is indifferent to stay or exit the market. This could happen if the value of the firm from domestic market is less or equals to zero, which means; $\{J(\varphi_d) = 0\}$. Solving for equality φ_d is given by:

$$\varphi_d = D^{\frac{-1}{\beta}} l^{-1} \left(\frac{1 + \rho(\beta - 1)}{1 - \rho} \right)^{\frac{-1}{\beta}} [(1 - \rho)bl + \rho c\theta l + f_d]^{\frac{1}{\beta}} \tag{4.34}$$

Export Threshold Not all firms serve the foreign market through export. It is only firms who are productive enough, can export. Thus, there exists a productivity φ_x at which the firm is indifferent to serve either domestic or foreign market. At productivity level φ_x, the value of serving the domestic market less than or equals to the value of serving the foreign market through export, $\{\varphi_x = \varphi : J(\varphi)|_{export} \geq J(\varphi)|_{notexport}\}$.

Following the previous techniques, the export threshold can be given as[14]:

$$\varphi_x = \left[\frac{1 - \rho}{1 - \rho(\beta - 1)} (A^{1-\beta} - 1) \right]^{\frac{-1}{\beta}} l^{\frac{-1}{\beta}} \left[\frac{f_x}{D} \right]^{\frac{1}{\beta}} \tag{4.35}$$

As we see from both equation the cutoff productivities are clearly proportionate to their respective one-firm one-worker productivity. The only difference is the dependency on the level of employment. One can simply let the level of employment one and no renegotiation, and then have the level of productivity cutoffs in explained in the previous section.

The φ_d do not directly depend on τ and f_x, rather it depends on the other variables which are affected by trade liberalization. The export cutoff, on the other hand, does directly influ-

[14]See the appendix for the detailed solution.

enced by both parameters. However, it does not depends on the labor market tightness

4.6.3 Unemployment

Similar to the single worker case the equilibrium unemployment is characterized as in Mortensen and Pissarides (1994), and thus, we have similar equilibrium unemployment and labor market clearing condition.

$$u(\theta) = \frac{s}{s + \lambda(\theta)(1 - G(\varphi))} \tag{4.36}$$

As in standard matching literature, this equation ensures the flows in and out of the unemployment pool is equals the flows in and out of the employment pool at equilibrium point. This is the Beveridge curve (UV curve) equation, which shows the negative relation ship between unemployment and labor market tightness or unemployment and job vacancy rate.

4.6.4 Trade Liberalization

In this section, we will see how the reduction in trade costs (τ and f_x) will affect the firms and workers decision and thus, the labor market outcomes.

Trade liberalization and Participation productivity:

As seen from the equation of φ_d above, it depends on the workers outside option, recruitment cost, and the fixed entry cost into the domestic market. Hence both the iceberg trade cost and fixed cost of entering the foreign market affects the participation cutoff through their effect on these, variables.

Proposition 6. *The Participation productivity φ_d increases if;*

- *The workers outside option b increases, as it makes hard for the firms with lower productivity to find a match.*
- *The fixed entry cost into the domestic market f_d increases.*
- *The macroeconomic variable D decreases, which implies the number of verities/firms increases as it implies increasing competition.*

- *If the recruitment cost $c\theta$ increase, as this also implies the labor market tightness θ increase, which makes it hard to get the match for the firms with relatively lower productivity.*

Trade liberalization and export threshold: The export cutoff productivity, directly depends on the iceberg trade cost and fixed cost of entering the export market. Additionally, it is also affected by the number of verities/firms (M).

Proposition 7. *The export threshold φ_x increases if,*

- *If the iceberg trade cost τ decrease. The reduction in variable trade cost induces other firms with lower productivity than the pre-liberalization cutoff productivity to serve the foreign market.*
- *If the fixed cost of export f_x decreases.*
- *The macroeconomic variable D decrease, which implies an increasing number of verities.*

4.6.5 Trade Liberalization and Labor Market Tightness

Again By combining the free entry condition ($V = 0 \Leftrightarrow \frac{c}{q(\theta)=J(\varphi)}$), the firms value function and the matching function ($q(\theta) = \eta\theta^{\alpha-1}$), we can drive the labor market tightness;

$$\theta = \left(\frac{\eta}{c(r+\delta)}\pi\right)^{\frac{1}{1-\alpha}} \tag{4.37}$$

As seen from the equation it depends on the firms profit and which increases with the trade liberalization (the reduction in both variable and fixed trade costs boost firms revenue and thus,profit and one can clearly see it from the value function of the firm).

Proposition 8. *The labor market tightness θ increases with the reduction in both the variable and fixed trade costs of serving the foreign market.*

4.6.6 Trade Liberalization and the Wage Differential

It is important to see how wage inequality responds to the trade liberalization in the model of our type. The empirical evidence in fact shows somehow a mixed result for with regards to the effect of openness on wage in general and wage inequality in particular. However, recent studies from both the developed and the developing countries show the growing wage gap due to the

trade liberalization.

In our model of n-workers too, it is possible to show the reaction of the wage differential to trade liberalization. Given the bargained wage equations in (1.38), we can formulate the wage differential equation. As in the previous case, there exist a marginal firm who is indifferent between serving the domestic market and export. Then, we take the difference between the wage she pays if she serve only the domestic market and export $(w^x(\varphi) - w^d(\varphi))$.

$$\Delta = \rho \left[\frac{\beta}{1 + \rho(\beta - 1)} DL^{\beta-1} \varphi^{\beta} (A^{1-\beta} - 1) - f_x \right] \tag{4.38}$$

Proposition 9. *The wage differential Δ is increasing*

- *With trade liberalization; the reduction in both variable trade cost and fixed cost.*
- *If the marginal productivity φ and the D goes up.*
- *If the labor demand is low*

As stated in the previous section, this proposition confirms the idea of wage premium due to participating in foreign market. At the same time the wage inequality between the workers in the domestic market and exporting market is also widening. This result is in line with the existing literature in trade and inequality (see Egger and Kreickemeier (2012), Egger et al. (2017), and Davidson et al. (2008))

4.7 Conclusion

In this paper, we have developed a model of heterogeneous firms and workers to bridge the Melitz (2003) of international trade and Mortensen and Pissarides (1994) model of the search-friction labor market. Firms pay the fixed entry cost and post the vacancy to match with a worker in the frictional labor market. Both parties negotiate and production takes place only if the match happens after negotiation. We showed that, the relation ship between international trade and labor market is vise-a-vise.

Workers are heterogeneous with respect to their ability. But, for simplicity, we assumed the workers' ability and firms' productivity are in one-to-one correlation. Thus, high productivity firms employ high ability workers. The labor market is imperfect and there is friction, while the intermediate good producers are in the monopolistic market. With respect to international trade, not all firms participate in international market via export. Only those who are productive enough will engage. Thus, if the firm is productive enough then, the firm pays the fixed costs of exporting and split its product into the domestic and international market, since firms do not serve foreign market without serving the domestic one.

In our model, there exist two productivity thresholds. The first one is the participation productivity (φ_d), which is the minimum productivity at which a firm is indifferent to stay or exit the domestic market and hence, the value of the firm is zero. Not only the firms but also worker is indifferent to accept or reject the match at this productivity level, as the worker surplus from the match is zero. Thus, workers with ability below this threshold do not participate in the labor market and rather stay unemployed. This leads to the state of non-employment unlike the frictional(involuntary) unemployment. The volume of the non-participant depends on the magnitude of the productivity threshold. The higher φ_d, the higher the non-employment, but the lower the frictional unemployment. The second threshold is the export productivity threshold (φ_x), for which the firm is indifferent between serving the domestic and foreign market via export.

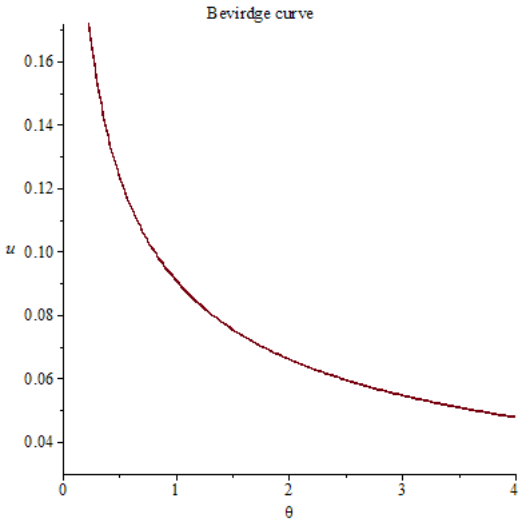
Trade liberalization (reduction in the trade costs), has an impact on both firm and worker decision. Openness to trade, increases the participation threshold through its effect on the labor market tightness θ (increase) and macroeconomic variable D (decrease). Thus, this leads to an

increase in the flow of employed workers to the non-participation pool. Thus, trade leads to increased non-employment among the lowest ability workers. The export threshold also reduced due to liberalization, while the labor market becomes tighter. We also showed that the wage differential between the worker in domestic and exporting sector increases with international trade. Due to the increase in φ_d and decrease in φ_x, the domestic sector shrinks, while the export sector expands.

Appendix

Beveridge curve (UV curve)

Figure 4.1: Beveridge curve (UV curve)



Unemployment value function

From the Nash-equilibrium equation,

$\frac{\rho}{1-\rho}\ J(\varphi) - V = (W(\varphi) - U)$

and from the flow of unemployment value function

$rU = b + \lambda(\theta)[W(\varphi) - U])$ and by substituting the former equation into this on we can solve rU,

$(1-\rho)rU = (1-\rho)b + \rho c\theta$

A. Wage bargaining under n-worker

From the Nash-bargaining equation we derived the wage equation;

$$w(\varphi) = (1-\rho)rU + \rho[(\beta DA^{1-\beta}\varphi(\varphi l)^{\beta-1}) - \frac{\partial w}{\partial l}l] \tag{4.39}$$

Equation (45) if a differential equation with a solution of;

$$w(\varphi) = L^{\frac{-1}{\rho}}\left\{c - \int_0^{l_i} y^{\frac{1-\rho}{\rho}}[\frac{1-\rho}{\rho}rU + \beta DA^{1-\beta}\varphi(\varphi l)^{\beta-1}]\right\} \tag{4.40}$$

From the revenue function we know that, $p(\varphi) = DA^{1-\beta}\varphi(\varphi l)^{\beta-1}$ and c is constant. The first term in the integration can be solved easily, while the second term could be solved by part[15],

$$\frac{1-\rho}{\rho} rU \int y^{\frac{1-\rho}{\rho}} dl = (1-\rho) rU l^{\frac{1}{\rho}} \tag{4.41}$$

and the second term could also be;

$$\beta\varphi \int y^{\frac{1-\rho}{\rho}} p(\varphi) dl = \rho l^{\frac{1}{\rho}} p - \rho \int y^{\frac{1}{\rho}} \frac{\partial p}{\partial y}$$

Let the inverse demand $\frac{\partial p}{\partial y}\frac{y}{p} = \frac{-1}{\sigma} = \beta - 1$, the equality from the model construction.

$$\beta\varphi \int y^{\frac{1-\rho}{\rho}} p(\varphi) dl = \rho l^{\frac{1}{\rho}} p - \rho(\beta-1) \int y^{\frac{1}{\rho}} p dy \text{ which can be ;}$$

$$\int y^{\frac{1-\rho}{\rho}} p(\varphi) dl = \frac{\rho\beta}{1+\rho(\beta-1)} \varphi p(\varphi) \tag{4.42}$$

Substituting equation 48 and 47 in to equation 46 and using $(1-\rho)rU = (1-\rho)b + \rho c\theta$ gives the final equation of bargained wage,

$$w(\varphi) = (1-\rho)b + \rho(\varphi D A^{1-\beta}(\varphi l)^{\beta-1} + c\theta) \tag{4.43}$$

Note that the constant term $c = 0$. See Cahuc and Wasmer (2001), Cahuc et al. (2008) and Ebell and Haefke (2003) for more detail.

B. Cutoff productivities

A. Participation productivity

The Participation productivity φ_d is the level of productivity for which the firm is indifferent between entering the domestic market or staying out of the market. Thus, the value of entering and serving the domestic market has to be equals with the outside option of the firm which we assume is zero. Hence, $(r+\delta)J^d(\varphi) = 0$

[15]Integration by part rule; $\int uvdx = u\int vdx - \int u'(\int vdx)dx$

$$D(\varphi_d l)^{\beta} - (1-\rho)bl - \rho\left(\frac{\beta}{1+\rho(\beta-1)}\right)D(\varphi l)^{\beta} - \rho c\theta - f_d == 0 \tag{4.44}$$

Which could be solved to pin down the minimum productivity to enter the market

$$\varphi_d = D^{\frac{-1}{\beta}} l^{-}1\left(\frac{1+\rho(\beta-1)}{1-\rho}\right)^{\frac{-1}{\beta}}[(1-\rho)bl + \rho c\theta l + f_d]^{\frac{1}{\beta}} \tag{4.45}$$

B. Export cut-off productivity

The export threshold could be solved in the same way we did for the one worker case. From the definition, there exists the productivity for which the firm is indifferent between serving the domestic market and entering the foreign market through export. Thus, the export threshold (φ_x) is the productivity level which equates the value of serving the domestic market and foreign market; ($J^x(\varphi) = J^d(\varphi)$);
$D(\varphi l)^{\beta} - wL - f_d = D(\varphi l)^{\beta}A^{1-\beta} - wl - f_d - f_x$

$D(\varphi l)^{\beta}(A^{1-\beta}-1) = \left(\frac{\rho\beta}{1+\rho(\beta-1)}\right)D(\varphi l)^{\beta}(A^{1-\beta}-1) - f_x$

$\left(\frac{1-\rho}{1+\rho(\beta-1)}\right)(\varphi l)^{\beta}(A^{1-\beta}-1) = \frac{f_x}{D}$

Solving for φ_x;

$$\varphi_x = \left(\frac{1-\rho}{1+\rho(\beta-1)}\right)^{\frac{-1}{\beta}}\left(A^{1-\beta}-1\right)^{\frac{-1}{\beta}}\left(\frac{f_x}{DL}\right)^{\frac{1}{\beta}} \tag{4.46}$$

Note: The productivity thresholds have the same structure in both one-worker-one-firm and the multi-workers cases. The difference is both the participation threshold and the export threshold depends on the labor demand of the firm.

C. The Labor market tightness

From the job creation condition;

$$\frac{r+\delta}{q(\theta)}c = \pi_i(\varphi) \tag{4.47}$$

where;

$q(\theta) = \eta\theta^{\alpha-1}$ as given in section (1.3)

$\pi_i(\varphi) = r_i(\varphi) - w_i(\varphi) - f_d - I_x f_x$ if the profit function of the firm derived from the value function and $i \in (d, x)$ is indicating the firm type.

Inserting the above expression and rearranging, we can solve for θ

$$\theta = \left(\frac{\eta}{r+\delta}\right)^{\frac{1}{1-\alpha}} \left(D(\varphi l)^{\beta} A^{1-\beta} - w(\varphi)l - f_d - I_x f_x\right)^{\frac{1}{1-\alpha}} \tag{4.48}$$

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