ESSAYS ON INTERNATIONAL ECONOMICS

A Ph.D. Dissertation

by
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To my parents, my sister and Mehmet

ESSAYS ON INTERNATIONAL ECONOMICS

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by

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MAY 2015

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Doctor of Philosophy in Economics.

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ABSTRACT

ESSAYS ON INTERNATIONAL ECONOMICS

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This dissertation consists of three essays on international economics. In the first chapter, the long-run effects of trade liberalization and trade-induced skill-biased technological change on wages and unemployment are studied by augmenting a heterogeneous firm trade model with job search and unemployment. The model predicts that trade liberalization has asymmetric wage effects on the two types of workers: it increases wage inequality in favor of skilled workers. Also, unemployment rate in the skilled-labor market falls to a greater extent, implying a change in the skill composition of unemployment in both trade partners.

The second chapter aims to unearth the underlying causes of high levels of the current account deficit by investigating the export performance of Turkish firms. First, a cross-country analysis reveals that Turkey performs poorly compared to its competitors in generating a suitable business environment, promoting innovation and skills, and providing easier access to finance all of which are known to contribute significantly to stimulating export performance.

Using a data set from the Productivity and the Investment Climate Private Enterprise Survey in 2005 and the Business Environment and Enterprise Performance Survey in 2008/2013, it is confirmed that product innovation, foreign ownership, the use of foreign inputs, and having a better marketing strategy are associated with higher probability of exporting. Also, conditional on exporting, export sales increase with foreign ownership.

The third chapter studies the import dependency of Turkish manufacturing exports in 2000s. By using TIVA database provided by OECD-WTO, it shows that compared to its peers (such as Czech Republic, Hungary) Turkish manufacturing exports depend less on imported intermediates. However, Turkey requires more intermediate imports than its peers in order to increase its exports relative to GDP. Using data from various sources (TIVA, Comtrade and TurkStat), the second part of the chapter provides a detailed analysis of import dependency in three key industries, namely the transport equipment, textiles and food. The results show that Turkey mostly specializes in production and exports of low value added and low-tech activities within these industries. To increase its exports and domestic value added embodied in exports, Turkey needs to move towards higher value added and technologically more advanced stages of production in the global value chain.

Keywords: International Trade, Skill-Specific Unemployment, Export Performance of Firms, Trade in Value Added, Turkey

ÖZET

ULUSLARARASI İKTİSAT ÜZERİNE MAKALELER

KÖYMEN ÖZER, Seda

Doktora, İktisat Bölümü

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Mayıs 2015

Bu tez uluslararası iktisat üzerine üç makale içermektedir. İlk bölümde iş arama ve işsizliği içeren bir heterojen firma ticaret modeli kullanılarak ticaretteki serbestleşme ve ticaret kaynaklı beceri yanlı teknolojik gelişmenin ücretler ve işsizlik üzerindeki etkileri incelenmektedir. Model, ticaretteki liberalleşmenin farklı iki tip işçinin ücretleri üzerinde asimetrik etkiye neden olduğunu göstermektedir; ticaretteki liberalleşme ücret eşitsizliğini vasıflı işçiler lehine değiştirmektedir. Ayrıca, vasıflı işçi piyasasındaki işsizlik oranı daha yüksek düzeyde düşmektedir ki bu durum her iki ticaret partnerindeki işsizligin vasıflı-vasıfsız işçi kompozisyonunu da değiştirmektedir.

İkinci bölüm Türk firmalarının ihracat performanslarını inceleyerek yüksek cari işlemler açığının temel nedenlerini ortaya çıkarmayı amaçlamaktadır. İlk olarak, ülkelerarası analiz, ihracat performansına önemli derecede katkıda bulunduğu bilinen uygun bir iş ortamının yaratılması, innovasyonun ve becerilerin geliştirilmesi ve finansmana kolay erişimin sağlanması gibi hususlarda Türkiye'nin rekabet ettiği ülkelere kıyasla daha zayıf bir performans ortaya

koyduğunu göstermektedir. 2005 yılındaki Üretkenlik ve Özel Girişim Yatırım İklimi Anketi ile 2008/2013 yıllarındaki İş Ortamı ve Girişim Performansı Anketi'nden elde edilen veri seti kullanılarak, ürün yeniliği, yabancı ortaklık, yabancı girdi kullanımı ve daha iyi bir pazarlama stratejisine sahip olmanın ihracat yapma olasılığını arttırdığı teyit edilmiştir. Ayrıca, ihracat yapan bir firmanın, ihracat miktarı yabancı ortaklıkla artmaktadır.

Üçüncü bölüm, 2000'li yıllarda Türkiye'nin imalat sanayi ihracatının ithalata bağımlılığını analiz etmektedir. OECD-DTÖ tarafından sunulan TIVA veri seti kullanılarak, Türkiye'nin imalat sanayi ihracatının eşdüzey ülkelere (Çek Cumhuriyeti ve Macaristan gibi) kıyasla ithal ara mallara daha az bağımlı olduğu gösterilmektedir. Ancak, eşdüzey ülkelere kıyasla Türkiye ihracatının GSYH'ya oranını arttırmak için daha fazla ara mal ithalatına ihtiyaç duymaktadır. Bu bölümün ikinci kısmında farklı kaynaklardan elde edilen veri setleri kullanılarak (TIVA, Comtrade ve TUİK), üç temel endüstri olan ulaşım ekipmanları, tekstil ve yiyecek sektörlerinin ithalata bağımlılığına ilişkin detaylı bir analiz ortaya konmaktadır. Sonuçlar, bu üç sektörde de Türkiye'nin üretim ve ihracat açısından çoğunlukla düşük katma değerli ve düşük teknolojili aktivitelerde uzmanlaştığını göstermektedir. Türkiye'nin ihracatının ve ihracattaki milli katma değerinin artması için, küresel değer zincirlerinde üretimin daha yüksek katma değerli ve teknolojik olarak daha ileri evrelerine geçmesine ihtiyacı vardır.

Anahtar Kelimeler: Uluslararası Ticaret, Beceri Bazlı İşsizlik, Firmaların İhracat Performansları, Katma Değerde Ticaret, Türkiye

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CHAPTER 1

INTRODUCTION

Since international trade has been widely accepted as an important determinant of economic welfare, its determinants and outcomes have been at the heart of the trade policy debate. The second chapter of this thesis analyzes labor market outcomes of the trade liberalization. In the third chapter, the determinants of export performance is investigated at the firm-level. Finally, the fourth chapter discusses how firms' participation in international trade should be structured to maximize the benefits to the domestic economy.

In recent years, international trade has become more complex in nature and the production - even within a firm - has become internationally more diversified. Therefore, it is important to understand the firms' response to globalization to offer a profound discussion of gains from trade. On top of that, it is utmost important to determine labor market outcomes of firm behavior after a liberalization policy to identify who gains from trade.

Rigorous empirical work, followed by Bernard and Jensen (1995, 1999), has highlighted selection into exporting only the most productive firms are able to export. Moreover, as suggested by Aw, Chung, and Roberts (2000)

trade leads the least productive firms to exit. These findings have led to an improvement over new trade models, pioneered by Krugman (1980). This new theoretical framework incorporates heterogeneous firms into intra-industry trade models (Bernard et al. (2003), Melitz (2003)). More recently, firm-level evidence revealed the fact that liberalization stimulates skill-biased technological change (SBTC) (see Bas (2008), Bustos (2011a), Rattso & Stokke (2013), Behar (2013)). These studies suggest that liberalization not only reallocates market shares toward more productive firms and leads to the exit of least productive firms, but also it augments the profits of existing exporters and promotes technology upgrade. Therefore trade liberalization enhances the relative demand for skill within the firm. This, in turn, raises the skill premium and and relative employment of skilled labor in the industry. Taking skill supply constant, a mirror image of this finding in macro-level data would be trade causing the relative unemployment of skilled to fall. A recent study by Felbermayr et al. (2011b) supports this hypothesis. They show that liberalization is followed by a fall in aggregate unemployment and the fall in aggregate unemployment is primarily due to reductions in unemployment of skilled workers.

In the light of these findings, the aim of the second chapter is to develop a suitable model to capture these skill-specific unemployment trends in the data, which also replicates the previous theoretical findings and the stylized facts. We incorporate labor market frictions a la Diamond-Mortensen-Pissarides and skill-biased technological change to an intra-industry trade model with heterogeneous firms and workers. In the model, there are two types of workers – *skilled* and *unskilled*, and two types of technologies – *low* and *high*. First,

firms pay a free entry cost and draw their productivity from a common distribution. Not only entry but also exporting and technology adoption are costly activities. Conditional on their productivity, and hence their expected profits, they decide to enter, start exporting and which type of technology to use. Next, firms decide on optimal number of vacancy and engage in wage bargaining with workers before production takes place. A simultaneous reduction in variable trade costs in two symmetric countries lowers the marginal cost of exporting and lead some non-exporting firms to cover fixed costs of supplying for foreign market and to start exporting. Moreover, existing exporters expand their production. Of those exporter firms which are more productive and closer to the technology adoption margin, becomes eligible for covering the fixed cost of higher technology and upgrade. Also, high-tech exporting firms expand their production. All these events lead skilled and unskilled demand and wages to increase. The least productive firms that cannot cover the wages of their workers exit. The comparative statics of the model suggest that trade liberalization ultimately enhance both skill and unskilled demand and increase the number of vacancies relative to unemployed in both type of both type of workers. Accordingly, wages increase and unemployment fall in both labor markets. Thus, trade liberalization benefits each worker in terms of unemployment and wages in the long-run. Next questions is which type of workers benefit more. The results predict that the relative demand for skill increases and skill premium rises which is a consistent finding with the rest of the literature. Also, unemployment rate in the skilled worker market falls to a greater extent, implying a change in the skill composition of unemployment

in both trade partners. Therefore, trade liberalization has asymmetric effects on the two types of workers even in a symmetric country case.

In the second chapter, the observed labor market outcomes of trade liberalization are modeled. One of the outcomes of the model is a widely accepted and well-modeled fact a la Melitz (2003): More productive are more likely to export. In the third chapter, we take a closer look at the characteristics of firms that determines their export performance. We investigate these characteristics exclusively for Turkish firms to understand the underlying causes of high levels of the current account deficit in the country.

The third chapter focuses on a large developing country to investigate the determinants of exports at the firm-level. First, we provide descriptive descriptive analysis on Turkey's export performance and compare the country's characteristics with similar countries by using above defined determinants of exports. Next, we provide an empricial analysis on Turkish we show how improvements in innovative activity, higher human capital, access to credit, foreign technology transfer are associated with better export performance for Turkish firms.

Although, Turkey has improved its export performance since the Customs Union Treaty with the European Union in 1996, exports as a percentage of GDP has remained low compared to Turkey's counterparts such as Poland, Czech Republic and Mexico. Moreover, Turkey's production and exports is highly dependent on imported inputs and low- and medium-tech products are dominant in country's export basket. These characteristics of the country pose a challenge to sustainable current account deficit and economic growth.

First, by exploiting various databases, we show that Turkey performs poorly compared to its competitors in generating a suitable business environment, promoting innovation and skills and providing easier access to finance, which are the main factors that stimulate export growth. Next, we test whether improvements in these factors would stimulate exports of Turkish firms. For this purpose, we use a data set from the Productivity and the Investment Climate Private Enterprise Survey in 2005 and the Business Environment and Enterprise Performance Survey in 2008 and 2013, carried out by the European Bank for Reconstruction and Development and by the World Bank. The results of the study suggest that more-productive and larger firms are more likely to export. Also, product innovation, inward foreign direct investment, the use of foreign inputs, having a better marketing strategy boost the export probability of Turkish firms. After a successful entry, firms that are larger in size and firms with higher productivity and foreign ownership are associated with higher export sales.

Chapter 3 reveals the importance of firm-level characteristics that improve the export performance of firms which in turn increase the exports of the country. However, the increase in exports does not necessarily mean that country's domestic value added embodied in exports increases as well. In contrast, countries that depend on imported intermediates for production might realize higher import dependency as they increase their exports. In fact, the findings in Chapter 3 confirms that this might be the case for Turkey. In the first part of Chapter 3, we show that growth of imports is higher than growth of exports. Also, firm-level analysis reveals that firms that use imported inputs

are more likely to export. The fourth chapter provides a detailed assessment of intermediate import dependency of exports in Turkey.

With the spread of outsourcing practices throughout the world, firms, which compete with compete for the same customer-base in the same sector, also start to compete for providing specific tasks. The transformation of competition into a vertical one increased the competition and co-dependency between countries. The fourth chapter contributes to the literature by providing a detailed investigation of a large developing countrys, namely Turkey, dependence on imported intermediates. By using various databases (TIVA, Comtrade, TurkStat firm-level data), Chapter 4 shows that Turkish manufacturing exports depend less on imports compared to other countries' exports. However Turkey requires more intermediate imports than its peers (such as Czech Republic and Hungary) in order to increase its exports relative to GDP.

Moreover, we show that the patterns observed for total manufacturing exports are also observed for three key sectors in Turkey, namely transport equipment, textiles and apparel and food. Furthermore, Turkey mostly specializes in production and exports of low value added and low- and medium-tech activities within these industries. We suggest that to increase its exports and domestic value added embodied in exports, Turkey needs to move towards higher value added and technologically more advanced stages of production in the global value chain.

While Chapter 3 offers policy implications for increasing export performance, Chapter 4 suggests that increased exports do not necessarily imply increased domestic value added. Also, policymakers should take into account

the effects of trade liberalization on labor market outcomes while increasing export performance of the country. As it is discussed in Chapter 2, trade raises the inequality between different skill groups in terms of wages and unemployment. Therefore, policies should target higher exports with less intermediate import dependency by simultaneously reducing the inequality effects of increased openness.

CHAPTER 2

WAGE INEQUALITY, SKILL-SPECIFIC UNEMPLOYMENT AND TRADE LIBERALIZATION

Economists and policy makers advocate globalization by indicating its positive effects on welfare through increased variety of goods available for consumers and improved aggregate productivity. On the other hand, public resists to trade liberalization since they fear that it will worsen their position in the labor market in terms of wages and employment. There exists empirical evidence that justifies these fears. As some sectors close up and some firms exit after the trade liberalization, workers formerly employed by these firms/sectors join the unemployment pool. Workers who lost their jobs start searching for employment opportunities and settle for lower wages when they do find jobs.

The main aim of this chapter is to analytically investigate which type of workers gain from trade liberalization policies. Since globalization reduces the survival probability of low-productivity firms and allocate market shares towards more productive, technologically advanced and skill-intensive firms, one could expect different effects on skilled and unskilled workers. Therefore,

it is only natural to distinguish workers as skilled and unskilled to identify who benefits from trade in terms of wages and unemployment. Skill premium – the relative wage of skilled to unskilled workers – is an appropriate indicator for revealing the diverse effects of liberalization on different skill groups. Although there is a rigorous amount of work on the relationship between skill premium and trade liberalization, a little has been done to understand the effects of globalization on unemployment of different skill groups.

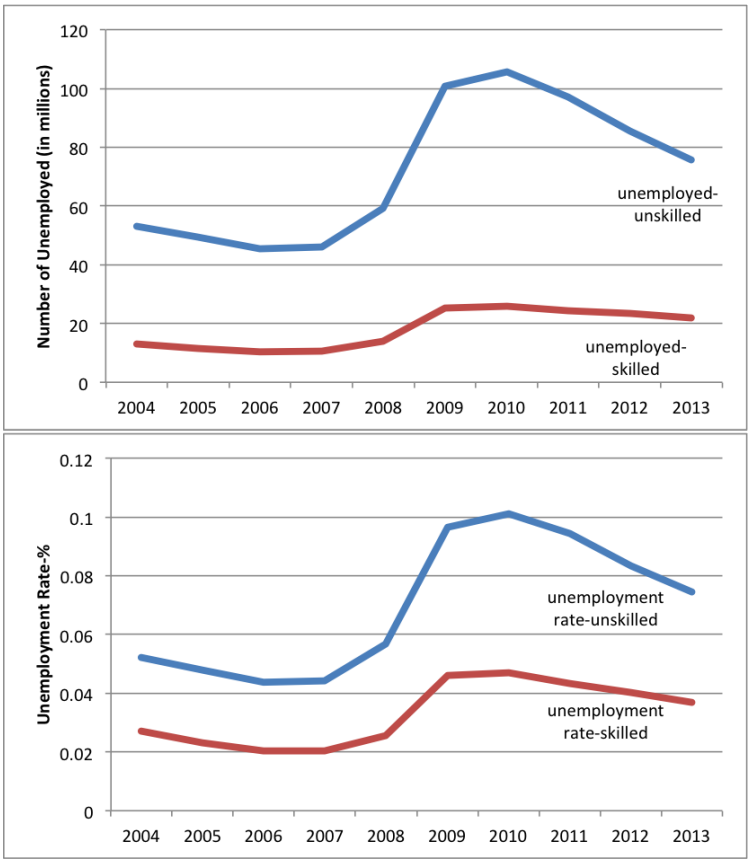
This chapter aims to improve our understanding of labor market outcomes of trade liberalization. It develops a Melitz-type trade model that (i) links globalisation and SBTC to relative wage and employment of skilled labour in the presence of labour market frictions; and (ii) offers a new mechanism through which trade liberalization affects unemployment of different skill groups differently. This chapter contributes to the new trade theory by building a model in which trade liberalization affects different type of skill groups differently. Also, the predictions of the model presented here are consistent with a number of recent stylized facts and the findings of existing well-established trade models. Therefore, the analysis offers a suitable environment to generate new predictions about labor market effects of trade liberalization.

Why should we expect liberalization to have diverse effects on unemployment of different types of workers? Analogous to wage differential between skilled and unskilled worker groups, the unemployment rates of different skills are also diversified. The upper panel of Figure 2.1 shows the number of skilled and unskilled unemployed workers in United States for the 2004-2013 period whereas lower panel is the unemployment rate for these skill groups. Here

skilled workers are those with a university/college degree. These figures highlight the following patterns. First, both the number of unemployed and the unemployment rate are structurally different for skilled and unskilled workers and unskilled unemployment rate is almost twice as high as skilled. Therefore, to understand the labor market outcomes of trade liberalization it is important to discuss its diverse effects on unemployment rate of different type of workers rather than aggregate unemployment. Second, the unemployment rate of different skill groups move in the same direction throughout the period. Finally, although skill supply increases between 2004-2013 this rise is negligible as unemployment rate and number of unemployed have similar trend. Therefore, it is the demand for skill, rather than supply of skill, which yields differences in unemployment rates of different skill groups.

Akin to skill premium, the ratio of skilled unemployment to unskilled can be used to measure who benefits from globalization in terms of unemployment. Figure 2.2 shows the correlation between openness to trade and the relative skilled unemployment for the same period. The relative skilled unemployment is on the left vertical axis which is denoted by bars in the graph. The line represents openness to trade and its values are on right vertical axis. There is a negative relationship between openness to trade and skilled to unskilled unemployment. A surge is exports and imports as a share of GDP is associated with a fall in the relative unemployment rate for skilled labor. In other words the composition of unemployment changes in favor of skilled. Figure 2.2 also includes "Great Trade Collapse" which occurred between at the end of 2008 and mid-2009. As U.S. trade fell to a great extent, openness to trade decreased

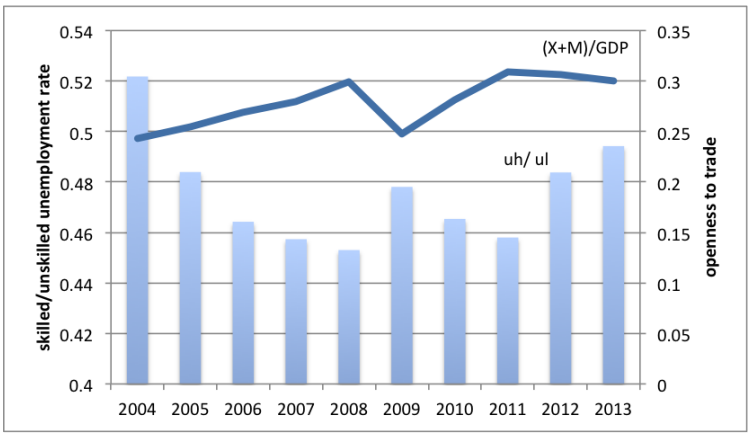
Figure 2.1: Skill-Specific Unemployment for U.S. (Source: BLS)



as well. The negative correlation between relative skilled unemployment and openness to trade still prevails in 2009 in Figure 2.2. However, due to global financial crisis, there could be other factors that ruled both indicators at the same time.

It is important to note that this graph shows correlation, not causation. However, there are several studies suggesting that globalization cause relative demand for skill to rise within a firm (see Bas (2008), Bustos (2011a), Rattsø and Stokke (2013), Behar (2013)). Controlling for skill supply, the increase in relative skilled employment reveals itself as a fall in relative skilled unemployment in macro-level data sets. A recent evidence on unemployment effect of globalization by Felbermayr et al. (2011b) shows that trade openness reduces

Figure 2.2: Skill-Specific Unemployment and Openness to Trade for U.S. (Source: BLS and OECD)



aggregate unemployment by using a panel data from 20 OECD countries. Their results also suggest that the fall in aggregate unemployment is primarily due to reductions in unemployment of skilled workers. The aim of this chapter is to develop a tractable framework to generate some new predictions for the labor market effects of globalization.

To further motivate, we discuss three lines of literature related with labor market effects of trade liberalization and argue how does the model presented here contributes to existing theoretical models. New trade theory starts with seminal papers by Krugman (1979) and Krugman (1980). Before these studies, trade models assume that trade between countries are inter-industry. However, what we see in the data is world's trade consist mostly from intra-industry exchange of goods. Krugman (1980) models this fact by building a monopolistically competitive intra-industry trade model in which international trade arises from economies of scale rather than factor endowments. As firm-level data sets become available, additional stylized facts attract the attention of economists. Firm-level analysis revealed the fact that only more productive

firms can cover costs of exporting and start producing for foreign markets. Building upon Krugman (1980), Melitz (2003) and Bernard et al. (2007) incorporate heterogeneous firms that differ in their productivity to capture firms' self-selection into export markets. In Melitz (2003), simultaneous reduction in trade costs in two symmetric countries leads more firms to start exporting and existing exporters to expand. This bids up average real wages in the industry. Least productive firms which cannot cover the cost of workers exit and hence liberalization results in an increase in aggregate productivity in the industry. Therefore, in Melitz (2003), average real wages and employment increases due to globalization. However, in Melitz (2003) workers are homogeneous since the model is not set up with a focus on diverse effects of globalization on different types of workers.

The second line of literature that we relate to focuses on globalization's effect on wages of different types of workers, and hence on wage inequality. In contrast to what Heckscher-Ohlin (H-O) predicts, what we observe in the data is an upward trend in skill premium accompanied by trade liberalization policies in both developing and developed economies. Goldberg and Pavcnik (2007) and Harrison et al. (2011) provide detailed assessments of these findings. In response to failure of H-O to explain the rise in skill premium, economists have shifted their focus on alternative explanations such as SBTC. However, as firm-level data sets become available globalization and SBTC appear as complementary explanations of rising skill premium[1]. Bas (2008) and Bustos

[1] A number of new mechanisms have been examined through which trade liberalization alters inequality. These mechanisms include trade in tasks, incomplete contracting, innovation and labor market frictions. Among these channels, we focus on intra-industry reallocation effects of liberalization through skill-biased technological change on workers with observable characteristics.

(2011a) find that increase in technology adoption due to globalization raises the relative demand for skill and the relative wage of skilled labor by using firm-level data from Chile and Argentina, respectively. By calibrating a general equilibrium model Rattsø and Stokke (2013) propose that trade-induced skill-biased technological change is an important determinant of wage inequality in South Africa.

To the best of our knowledge, the model developed by Yeaple (2005) is the first attempt to introduce technology choice to a heterogeneous firm trade-model. Yeaple (2005) shows that as trade costs decreases, the number of exporting firms as well as the number of firms utilizing more advanced technology increases. Bas (2008), Bustos (2011b) and Bustos (2011a) introduce some form of technology adoption choice into Melitz (2003). Theoretical findings of these studies suggest that as trade liberalization reallocates market shares toward more productive firms, the fixed costs of technology adoption becomes affordable for some low-tech firms who export and expand their scale due to liberalization. Consequently, the number of firms using high technology increases. This raises the skill demand and hence skill premium. Harrigan and Reshef (2011) and Burstein and Vogel (2010) show that similar results prevail when countries are asymmetric. However, these models are not set up with a focus on unemployment, and so they do not present any results for the effects of liberalization on unemployment rate. Nevertheless, as relative demand for skill is increasing throughout globalization episodes, the unemployment rates for different types of workers should be affected differently from trade liberalization. The model presented here contributes to this line of literature by

testing the whether skill premium rise due to globalization is still valid in the existence search and matching frictions in the labor market.

Existing studies that links trade and unemployment analyze the potential effects of trade on aggregate unemployment. The most common concern regarding globalization is the transitional unemployment effects of trade liberalization in developing economies. However, there is lack of evidence on how globalization affects transitional unemployment due to unavailability of appropriate data. On the other hand, annual unemployment rates are available for most of the countries. The long-run effects of liberalization on unemployment have been examined in a few empirical studies. Recent papers by Dutt et al. (2009) and Felbermayr et al. (2011b) discuss the long-run effects of trade openness on unemployment. By using a panel data from 90 developing countries for the period 1990-2000, Dutt et al. (2009) conclude that trade liberalization reduces the long-run aggregate unemployment. Felbermayr et al. (2011b) shows that a 10 percentage points increase in trade openness reduces aggregate unemployment by about 0.75 percentage points in OECD countries.

Despite the lack of sufficient evidence on the unemployment effects of globalization, there is quite a number of theoretical models linking unemployment and trade. Here, we focus on heterogeneous firm trade models where globalization leads reallocation of resources within an industry.[2] Egger and Kreickemeier (2009) incorporate fair wages into Melitz (2003) and find that trade liberalization can lead to an increase in unemployment. Davis and Harrigan (2011) merge Melitz (2003) with Shapiro and Stiglitz (1984) and suggest that

[2]Davis (1998) introduces minimum wages whereas Davidson et al. (1999) introduce search generated unemployment to Heckscher-Ohlin.

a reduction in trade costs results in destruction of "bad jobs" and creation of "good" jobs whereas the effects of globalization on aggregate unemployment is minimal. Felbermayr et al. (2011a) introduce Pissarides-type labor market frictions into Melitz (2003) and show that globalization results in an increase in industry productivity, which in turn, lowers the aggregate unemployment rate.[3] Finally, Helpman et al. (2010) examine the unemployment effects of trade liberalization by developing a model with heterogeneous firms and workers and search and matching frictions. Helpman et al. (2010) work on asymmetric country trade model and they provide mixed results for the effect of globalization on aggregate unemployment rate. The unemployment rates of different types of workers have not been at the focus of these trade models. It is important to emphasize once again that as firms upgrade their technology and become more skill-intensive after liberalization episodes, controlling for skill supply, this would decrease the relative skilled unemployment. Building on extensive theoretical work, this chapter contributes to the literature by focusing on diverse effects of trade liberalization on unemployment of different types of workers. More specifically, we assess whether globalization have diverse effects on different skill groups or whether these skill groups equally benefit from trade liberalization in terms of employment.

The theoretical model mostly related to ours is developed by Moore and Ranjan (2005). In Moore and Ranjan (2005), skill-specific unemployment coexists with a open and perfectly competitive goods market[4]. The labor market

[3]Helpman and Itskhoki (2010), on the other hand, utilize search frictions as a source of comparative advantage and find that globalization leads higher unemployment rate.

[4]Davidson et al. (2008) are first to introduce skill-specific unemployment into a trade framework. In the model, firms are homogeneous and technology adoption is a binary choice. High technology requires skilled worker whereas low-tech jobs can be either accomplished by

is characterized by search and matching model of Pissarides (2000). There is only one type of technology available to all firms and SBTC is introduced as an exogenous shock to this production technology. They discuss the effects of globalization and SBTC separately and find that both contribute to the rise in inequality. The results of their model suggest that trade liberalization leads skilled unemployment to fall whereas those of unskilled to rise. SBTC, on the other hand, results in reduction of unemployment for both skill groups if the complementarity of skilled and unskilled good is strong enough. The analysis presented here differs from Moore and Ranjan (2005) in two major dimensions. First, we allow for allocation of market shares to change due to liberalization since firms with different productivity react liberalization differently. Therefore, in this model, firms endogenously decide to enter and export. More importantly, Moore and Ranjan (2005) assume that SBTC and globalization have independent effects on labor market. The discussion above suggest that globalization have a direct effect on exporting behavior and indirect effect on SBTC through reallocation of market shares. Differently from Moore and Ranjan (2005), in this model, technology adoption is endogenous. Firms decide on which type of technology to use depending on their productivity as well. Hence, this chapter allows us to identify skill-specific effects of liberalization where globalization endogenously affects SBTC.

Main findings of the paper are as follows. Independent of the size of exporting and technology adoption costs, trade liberalization leads wages of both

skilled or unskilled labor. Consistent with other trade models, opening up to trade leads to an allocation of resources towards high-tech firms. However the focus of the analysis is within firm productivity gains from trade, and so, they do not derive results for unemployment of different types of workers.

skilled and unskilled to increase. Also, unemployment rates for skilled and unskilled falls due to globalization leading to a decrease in variable trade costs. Therefore, both type of skill groups gain from trade. However, trade liberalization affects skilled and unskilled workers differently even in a symmetric country case. As in Bustos (2011a), a reduction in variable trade costs reallocates resources toward more productive firms. However, in contrast to Bustos (2011a) this may increase or decrease the probability of technology adoption depending on initial level of liberalization and technology adoption costs. Regardless of the number of high-tech firms, skill premium rises since relative skill demand increases as the market share of existing of high-tech firms expand. Also liberalization is followed by a change in the composition of unemployment pool. The rise in relative skill demand causes unemployment rate of skilled to fall more than unskilled.

The remainder of the paper is organized as follows. Section 2.1 gives the set-up of the model. Section 2.2 describes the wage bargaining process and presents the derivation of Wage and Job Creation curves. Section 2.3 presents the entry, exporting and technology decisions of firms. In Section 2.4, the labor market equilibrium is derived for both skill groups to close the model. Section 2.5, conducts a comparative statics analysis to chapter the effect of trade liberalization on labor market outcomes and calibrates the model for U.S. economy. In Section 2.6, a different scenario which results from the alternative magnitudes of technology and exporting costs, is examined and Section 2.7 concludes.

2.1 Setup of the Model

There is a single consumption good which is a CES aggregate of intermediate inputs. Intermediate inputs are either domestically produced or imported. There are two symmetric countries. Intermediate input producers are heterogeneous in their productivity and decide whether to enter and/or export as in Melitz (2003) which are both costly activities. Also firms choose to upgrade their technology by covering technology adoption cost as in Bustos (2011b). In addition, labor market faces search and matching frictions of Diamond-Mortensen-Pissarides type. We incorporate the search and matching by following the approach of Felbermayr et al. (2011a).

Final output producers

Single final output Y, either consumed or used as an input, is produced from continuum of intermediate inputs. Denoting quantity of each intermediate input by $q(\omega)$ and we assume following production function

$$Y = \left[M^{\frac{\upsilon-1}{\sigma}} \int_{\omega \in \Omega} q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}} \tag{2.1}$$

Following Felbermayr et al. (2011a) we take $\upsilon = 0$ to avoid counter-factual relationship between autarky unemployment rate and the labor supply. Price

index dual to (1) is

$$P = \left[M^{-1} \int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega \right]^{1-\sigma} \tag{2.2}$$

where $p(\omega)$ is the price of input ω. σ is the constant elasticity of substitution, $\sigma > 1$. Therefore, the demand for intermediate input ω is

$$q(\omega) = \frac{Y}{M} p(\omega)^{-\sigma} \tag{2.3}$$

Intermediate input producers

There is a continuum of monopolistically competitive intermediate input producers each producing a different variety with constant elasticity of substitution. There are two types of technologies available to intermediate input producers. Low technology output $q_\ell(\omega) = \ell(\omega)\varphi(\omega)$ requires only unskilled worker $\ell(\omega)$ whereas high technology output $q_h(\omega) = h(\omega)\gamma\varphi(\omega)$ requires only skilled worker $h(\omega)$. Marginal product of unskilled worker is $\varphi(\omega)$ whereas marginal product skilled worker is $\gamma\varphi(\omega)(\gamma > 0)$. We use φ to index intermediate input producers for the rest of the analysis. Fixed market access cost for low technology firms is f_ℓ whereas for high technology firms it is $\eta f_\ell(\eta > 0)$. Note that high technology has lower variable cost but higher fixed cost[5]. Fixed export market cost is same for both low and high technology firms, f_X. $\tau > 1$

[5]Note that higher fixed cost of high technology can be reflective of firm's absorption capacity. Since technology adoption at the firm-level would take time, it would be more costly for the firm in terms of time spent on adoption. However, the aim of the model is to understand long-run effects of trade liberalization. As the short-run dynamics of liberalization is not inherent in the analysis, absorption capacity aspect of technology adoption cannot be discussed with this model.

is the standard iceberg transport cost. Operating revenue from exporting for both technologies is $p_i^x q_i^x/\tau$ whereas from domestic market it is $p_i^d q_i^d$ for $i \in (\ell, h)$. Equating marginal revenues for both technologies suggest that $p_i^x(\varphi) = \tau p_i^d(\varphi)$. So that $q_i^x(\varphi) = \tau^{1-\sigma} q_i^d(\varphi)$. Total revenue of a low-tech firm with productivity φ is:

$$r_\ell(\varphi) = \left[\frac{Y}{M}(1 + I(\varphi)\tau^{1-\sigma})\right]^{\frac{1}{\sigma}} (\ell\varphi)^{\frac{\sigma-1}{\sigma}} \tag{2.4}$$

and high-tech firm's revenues are

$$r_h(\varphi) = \left[\frac{Y}{M}(1 + I(\varphi)\tau^{1-\sigma})\right]^{\frac{1}{\sigma}} (h\gamma\varphi)^{\frac{\sigma-1}{\sigma}} \tag{2.5}$$

$I(\varphi)$ is an indicator function that takes value '1' if the firm is exporting and '0' if it is producing only for the domestic market.

Labor market

Each country is endowed with $\rho_s L$ units of skilled labor and $(1-\rho_s)L$ units of unskilled labor, where L is the total labor force. The labor market is defined separately for skilled and unskilled workers. Here, we present the ex-post segmentation equilibrium in which each type of worker matches with firms according to their abilities. In other words, skilled worker is hired only by high-tech firms whereas unskilled worker is employed only by low-tech firms. Therefore for the rest of the analysis, ℓ stands for the unskilled worker in labor market side of the model and it represents the low technology for the

firm level variables. Similarly, h represents skilled worker and high technology. Both skilled and unskilled labor market are subject to search frictions since job search for workers and hiring by firms are both costly and time-consuming activities. $\theta_i = \frac{v_i}{u_i}$ where u_i is the number of unemployed workers and v_i is the number of vacancies for i-type workers for $i = \ell, h$. Matching function $k(u_i, v_i)$, gives the number of mathces for a given u_i and v_i. Matching function is constant returns to scale and can can be expressed as follows

$$k(u_i, v_i) = k\left(\frac{u_i}{v_i}, 1\right) v_i = m(\theta_i) v_i \tag{2.6}$$

Note that the ratio of number of matches to vacancies gives us the firms' job filling rate. $\frac{k(u_i,v_i)}{v_i} = m(\theta_i)$ is i-type firm's job filling rate. $m(\theta_i)$ is uniquely defined by θ_i and satisfies the following properties: $m'(\theta_i) < 0$, $lim_{\theta_i \to \infty} m(\theta_i) = 0$ and $lim_{\theta_i \to 0} m(\theta_i) = \infty$. Note that $m(\theta_i)$ is a decreasing function of θ_i suggesting that when there are more vacancies around it is harder for firms to fill their jobs. On the other hand, the ratio of number of matches to unemployed produces the rate at which workers meet firms: $\frac{k(u_i,v_i)}{u_i} = m(\theta_i)\theta_i$. Note that $m(\theta_i)\theta_i$ is an increasing function of θ_i. As vacancy-to-unemployed ratio increases, workers meet firms at a higher rate. c is the cost of posting a new vacancy meaning that recruiting $\ell(\varphi)(h(\varphi))$ units of unskilled (skilled) worker requires a firm spending of $[c/m(\theta_i)]l(\varphi)([c/m(\theta_i)]l(\varphi))$. In other words, the adjustment cost of a firm is linear in number of workers.

2.2 Optimal Vacancy Posting and Wage Bargaining

In this section we derive Wage (W) and Job Creation (JC) curves for both skill groups. Wages are bargained individually. δ is the probability that producers leave the market and χ is the probability that match is broken. Then, the actual separation rate is $s = \delta + \chi - \delta\chi$ assuming that two probabilities are independent from each other. Unemployed unskilled worker earns $b\overline{w_\ell}$ and unemployed skilled worker earns $b\overline{w_h}$ where $b \in (0, 1)$ and, $\overline{w_\ell}$ and $\overline{w_h}$ are average wages of unskilled and skilled labor, respectively.

First each type of intermediate input producers choose optimal number of vacancies v_i by taking wage rates as given. Afterwards, workers and firms meet and wages are bargained before production taking place. Note that wage contracts are not enforceable. In other words, it is costless for firms to fire employees and workers to quit their jobs.

2.2.1 Number of Optimal Vacancy

Each type of firm determines the optimal number of vacancy to post. Skilled and unskilled workers search for jobs according to their abilities. We restrict our attention to the case where skilled worker would never prefer unskilled jobs.

Low-tech intermediate input producer maximizes its market value with

respect to vacancy:

$$J(\ell|\varphi) = \max_{\nu_\ell} \frac{1}{1+r}\{r_\ell(\varphi) - w_\ell(\varphi)\ell(\varphi) - c\nu_\ell - f_\ell - I(\varphi)f_X + (1-\delta)J(\ell'|\varphi)\} \tag{2.7}$$

subject to its revenues (Equation 2.4)

$$r_\ell(\varphi) = \left[\frac{Y}{M}(1 + I(\varphi)\tau^{1-\sigma})\right]^{\frac{1}{\sigma}} (\ell\varphi)^{\frac{\sigma-1}{\sigma}} \tag{2.8}$$

and to the law of motion of labor within the firm

$$\ell' = (1-\chi)\ell + m(\theta_\ell)\nu_\ell \tag{2.9}$$

The number of workers at the firm employment in the next period is the sum of existing matches that are unbroken $(1-\chi)\ell$ and newly hired workers $m(\theta_\ell)\nu_\ell$. First order condition of the optimization problem in (2.7) is

$$\frac{c}{m(\theta_\ell)} = (1-\delta)\frac{\partial J(\ell'|\varphi)}{\partial \ell'} \tag{2.10}$$

$\frac{c}{m(\theta_\ell)}$ is the expected recruitment cost and equals to shadow value of unskilled worker to firm. Taking the derivative of (2.7) with respect to ℓ, iterating one period and substituting into (2.10) yields

$$\frac{\partial J(\ell|\varphi)}{\partial \ell} = \frac{1}{1+r}\left\{\frac{\partial r_\ell(\varphi)}{\partial \ell} - w_\ell(\varphi) - \frac{\partial w_\ell(\varphi)}{\partial \ell}\ell(\varphi) + \frac{c}{m(\theta_\ell)}(1-\chi)\right\} \tag{2.11}$$

Here firms are acting like a monopsonist since they are taking into account the effect of additional hiring on the wage of employees. Low-tech firms decide on

optimal number of vacancy using first order condition (2.10). Equation (2.11) incorporates law of motion of employment and pins down the optimal level of output. The price of the intermediate input is achieved by replacing (2.10) in (2.11)

$$\frac{\partial r_\ell(\varphi)}{\partial \ell} = \frac{\sigma - 1}{\sigma} p_\ell^d(\varphi)\varphi = w_\ell(\varphi) + \frac{\partial w_\ell(\varphi)}{\partial \ell}\ell(\varphi) + \frac{c}{m(\theta_\ell)}\frac{r+s}{1-\delta} \tag{2.12}$$

Note that marginal cost of worker is equal to wage in a perfectly competitive labor market. Here, in addition to wages, hiring an unskilled worker has two additional costs. $\frac{\partial w_\ell(\varphi)}{\partial \ell}\ell(\varphi)$ represents the monopsony power of low-tech firms whereas $\frac{c}{m(\theta_\ell)}\frac{r+s}{1-\delta}$ is the expected cost of recruiting the worker.

Similarly, high-tech intermediate input producer solves

$$J(h|\varphi) = \max_{\nu_h} \frac{1}{1+r}\{r_h(\varphi) - w_h(\varphi)h(\varphi) - c\nu_h - \eta f_\ell - I(\varphi)f_X + (1-\delta)J(h'|\varphi)\} \tag{2.13}$$

subject to its revenues (Equation 2.5)

$$r_h(\varphi) = \left[\frac{Y}{M}(1 + I(\varphi)\tau^{1-\sigma})\right]^{\frac{1}{\sigma}} (h\gamma\varphi)^{\frac{\sigma-1}{\sigma}} \tag{2.14}$$

and skilled worker at the firm in the next period

$$h' = (1-\chi)h + m(\theta_h)\nu_h \tag{2.15}$$

First order condition of the optimization problem reads

$$\frac{c}{m(\theta_h)} = (1-\delta)\frac{\partial J(h'|\varphi)}{\partial h'} \tag{2.16}$$

Analogous to (2.11) and (2.12), optimal vacancy posting condition and pricing rule for firms using high technology can be written as

$$\frac{\partial J(h|\varphi)}{\partial h} = \frac{\sigma-1}{\sigma}p_h^d(\varphi)\varphi = \frac{1}{1+r}\left\{\frac{\partial r_h(\varphi)}{\partial h} - w_h(\varphi) - \frac{\partial w_h(\varphi)}{\partial h}h(\varphi) + \frac{c}{m(\theta_h)}\frac{r+s}{1-\delta}\right\} \tag{2.17}$$

$$\frac{\partial r_h(\varphi)}{\partial h} = w_h(\varphi) + \frac{\partial w_h(\varphi)}{\partial h}h(\varphi) + \frac{c}{m(\theta_h)}(1-\chi) \tag{2.18}$$

2.2.2 Wage Bargaining

In this section, Wage and Job Creation Curves for both skilled and unskilled workers will be derived. The details of the derivations can be found in Appendix A.

Once the firm and the worker successfully matched, total surplus of the match is split between the firm and the worker. $E(i,\varphi)$ is the value of being employed to the worker of type i whereas U_i is the value being unemployed. Expected value of being employed for unskilled is the sum of wage the worker receives and the value of becoming unemployed if the match is broken with probability s:

$$rE(\ell,\varphi) = w_\ell(\varphi) + s[U_\ell - E(\ell,\varphi)] \tag{2.19}$$

The discounted value of being unemployed for unskilled labor is the sum of

unemployment compensation $b\overline{w_\ell}$ and the expected returns from finding a job:

$$rU_\ell = b\overline{w_\ell} + \theta_\ell m(\theta\ell)[E(\ell,\varphi) - U_\ell] \tag{2.20}$$

On the firm side, $\frac{\partial J(i|\varphi)}{\partial i}$ is the value of one more vacancy to i-type firm. Both type of firms earns zero rent from a vacant job. Then, under Nash bargaining the wage rate satisfies

$$w_i = arg\,max(E(i,\varphi) - U_i)^\beta \left(\frac{\partial J(i|\varphi)}{\partial i}\right)^{1-\beta} \tag{2.21}$$

where β is the bargaining power of the worker and $\beta \in (0,1)$. First order condition of (2.21) satisfies

$$(1-\beta)[E(i,\varphi) - U_i] = \beta\frac{\partial J(i|\varphi)}{\partial i} \tag{2.22}$$

Inserting (2.11) and (2.17) into (2.22) yields two ordinary differential equations for both skill groups. The solution to these equations is combined with the outside option of both type of workers $rU(\theta_i)$ to obtain wage curves in both labor markets.

$$w_\ell = \frac{\beta}{1-\beta}\frac{1}{1-b}\frac{c}{1-\delta}\left[\theta_\ell + \frac{r+s}{m(\theta_\ell)}\right] \tag{2.23}$$

$$w_h = \frac{\beta}{1-\beta}\frac{1}{1-b}\frac{c}{1-\delta}\left[\theta_h + \frac{r+s}{m(\theta_h)}\right] \tag{2.24}$$

Note that wage curve is the labor supply equivalent of Walrasian models. Wage Curve posits a positive relation between wage rate and the labor market

tightness. A higher market tightness θ_i shows that jobs meet workers at higher rate than workers meet vacant jobs. Therefore, the bargaining strength of the worker becomes higher than the firm which in turn bids up the wages. Combining the solutions of the ordinary differential equations with the demand for intermediate inputs (2.3) yields the Job Creation curves for both type of markets.

$$w_\ell = \frac{\sigma - 1}{\sigma - \beta} p_\ell^d(\tilde{\varphi}_\ell)\tilde{\varphi}_\ell - \frac{c}{m(\theta_\ell)} \frac{r+s}{1-\delta} \tag{2.25}$$

$$w_h = \frac{\sigma - 1}{\sigma - \beta} p_h^d(\tilde{\varphi}_h)\tilde{\varphi}_h\gamma - \frac{c}{m(\theta_h)} \frac{r+s}{1-\delta} \tag{2.26}$$

Job creation curve is the labor demand equivalent of Walrasian models suggesting a negative relation between wage rate and the labor market tightness. At a higher wage rate w_i, it is more costly to hire an employee. This leads firms to post less vacancy, and consequently, to market tightness θ_i to fall.

Note that since $P = 1$, w_i is the real wage of i-type worker. Also the Job Creation curves suggest that w_i depends on the average productivity level of i-type firms. Therefore, within the same technology workers are paid the same wages regardless from the productivity levels of the firms which they are employed in. Wage rates only differ between technologies.

2.3 Firm Entry, Exporting and Technology Choice

Entry and exporting decisions of the firms are analogous to Melitz (2003) model. The technology adoption idea is incorporated in a similar fashion to Bustos (2011b). The aim of the analysis presented in this section is to show how the skilled and unskilled labor market tightness and entry, exporting and technology decisions of the firms interact.

Firms pay an entry cost f_e. Then, they draw their productivity from a sampling distribution $G(\varphi)$ which has a p.d.f. $g(\varphi)$ and support over $(0, \infty+)$. After the drawing, the productivity of each firm remains constant. Let's define φ_d^* as cutoff productivity for entry (or exit). Similarly, define φ_x^* and φ_h^* as cutoff productivities for exporting and technology adoption, respectively. Then the ex-ante probability of successful entry is $\rho_d = 1-G(\varphi_d^*)$. The probability of exporting is $\rho_x = \frac{1-G(\varphi_x^*)}{1-G(\varphi_d^*)}$ and the probability of adopting the high technology is $\rho_h = \frac{1-G(\varphi_h^*)}{1-G(\varphi_d^*)}$.

Without any exogenous shock, at the steady state, firms do not change their sizes: $\ell' = \ell \Longrightarrow v_\ell = \frac{\ell(\varphi)\chi}{m(\theta_\ell)}$ and $h' = h \Longrightarrow v_h = \frac{h(\varphi)\chi}{m(\theta_h)}$. At the end of the first period firms reach their optimal size since the adjustment cost function is linear in labor.

$$J(i|\varphi) = \frac{\Pi_i^j(\varphi)}{1+r} + \frac{1-\delta}{1+r} J(i'|\varphi) = \frac{\Pi_i^j(\varphi)}{r+\delta} \tag{2.27}$$

for $i \in (\ell, h)$ $j \in (d, x)$. It is profitable for a low-tech firm to start producing

when

$$\frac{\Pi_\ell^d(\varphi)}{r+\delta} = \frac{1-\delta}{r+\delta}\pi_\ell^d(\varphi) - \frac{c}{m(\theta_\ell)}l^d(\varphi) - f_x \geq 0 \tag{2.28}$$

where $\pi_\ell^d(\varphi)$ is the flow profit of low-tech firm from domestic sales:

$$\pi_\ell^d(\varphi) = \left[p_\ell^d(\varphi)\varphi\ell^d(\varphi) - w_\ell l^d(\varphi) - \frac{c\chi}{m(\theta_\ell)}l^d(\varphi) - f_\ell\right] \tag{2.29}$$

It is important to note that the last two terms in (2.28) ensure that low technology firms enter the market and post vacancies one period before production takes place. Accordingly, the firms pay the fixed market access cost and cost of posting vacancies upfront. However, in the period without any production, they can exit the market due to an exogenous shock with probability δ.

A low-tech firm's expected profits from foreign sales are

$$\frac{\Pi_\ell^x(\varphi)}{r+\delta} = \frac{1-\delta}{r+\delta}\pi_\ell^x(\varphi) - \frac{c}{m(\theta_\ell)}\ell^x(\varphi) - f_x \tag{2.30}$$

where $\pi_\ell^x(\varphi)$ is the flow profit of low-tech firms from foreign sales and it is equal to

$$\pi_\ell^x(\varphi) = [p_\ell^x(\varphi)\varphi\ell^x(\varphi)/\tau - w_\ell l^x(\varphi) - \frac{c\chi}{m(\theta_\ell)}l^x(\varphi) - f_x] \tag{2.31}$$

Analogous to (2.28), expected domestic profits of a high-tech are

$$\frac{\Pi_h^d(\varphi)}{r+\delta} = \frac{1-\delta}{r+\delta}\pi_h^d(\varphi) - \frac{c}{m(\theta_h)}h^d(\varphi) - \eta f_\ell \tag{2.32}$$

where $\pi_h^d(\varphi)$ is the flow profit of a high-tech firm and is equal to

$$\pi_h^d(\varphi) = [p_h^d(\varphi)\varphi\gamma h^d(\varphi) - w_h h^d(\varphi) - \frac{c\chi}{m(\theta_h)}h^d(\varphi) - \eta f_\ell] \tag{2.33}$$

A high-tech firm's exporting profit is

$$\frac{\Pi_h^x(\varphi)}{r+\delta} = \frac{1-\delta}{r+\delta}\pi_h^x(\varphi) - \frac{c}{m(\theta_h)}h^x(\varphi) - f_x \tag{2.34}$$

where $\pi_h^x(\varphi)$ is the foreign profit of a high-tech firm from foreign sale:

$$\pi_h^x(\varphi) = [p_h^x(\varphi)\varphi\gamma h^x(\varphi)/\tau - w_h h^x(\varphi) - \frac{c\chi}{m(\theta_h)}h^x(\varphi) - f_x] \tag{2.35}$$

First we will consider the case in which technology costs are high enough so that

$$\frac{\eta-1}{\lambda^{\sigma-1}} > \frac{f_x}{f_\ell}(1+\tau^{\sigma-1}) \tag{2.36}$$

where λ is the marginal cost advantage of high technology and $\lambda > 1$ which is derived below. Under this case, it is less costly for firms to start exporting than to upgrade technology. Consequently, the ordering of cutoff productivites is $\varphi_d^* < \varphi_x^* < \varphi_h^*$. φ_d^* is the cutoff productivity for entry (or exit). The least productive firms under this cutoff exit. φ_x^* is the cutoff productivity for exporting. The firms between entry and exporting cutoffs produce only for domestic market and use low-tech. φ_h^* is the technology adoption cutoff. Firms with productivity more than φ_x^* and less than φ_h^* operate under low technology and serve both for domestic and foreign markets. Finally, the firms above technology cutoff have higher technology and serve for both domestic and foreign

markets. In Section 2.6, we consider the case in which exporting costs are high enough so that the ordering of cutoffs is $\varphi_d^* < \varphi_h^* < \varphi_x^*$. However, a detailed discussion is provided for the first scenario since it is the most empirically supported case: In the data, there are low-tech firms which can also export.

Entry - Since low productive firms are using low-tech and serving only domestic market, the zero cutoff profit (ZCP) condition for entry is $\frac{\Pi_\ell^d(\varphi_d^*)}{r+\delta} = 0$.

$$\left[p_\ell^d(\varphi_d^*)\varphi_d^* - w_\ell - \frac{c}{m(\theta_\ell)}\frac{r+s}{1-\delta}\right]\ell^d(\varphi_d^*) = \frac{r+1}{1-\delta}f_\ell \tag{2.37}$$

Exporting - Firms with a productivity above φ_x^* earn positive profits from foreign sales. Then ZCP condition for exporting is $\frac{\Pi_\ell^x(\varphi_x^*)}{r+\delta} = 0$ which yields

$$\left[p_\ell^x(\varphi_x^*)\varphi_x^*/\tau - w_\ell - \frac{c}{m(\theta_\ell)}\frac{r+s}{1-\delta}\right]\ell^d(\varphi_x^*) = \frac{r+1}{1-\delta}f_x \tag{2.38}$$

Combining two ZCP conditions (2.37) and (2.38), one can express φ_x^* in terms of φ_d^*

$$\left(\frac{\varphi_x^*}{\varphi_d^*}\right) = \left(\frac{f_x}{f_\ell}\right)^{\frac{1}{\sigma-1}}\tau \tag{2.39}$$

Note that, as long as $\left(\frac{f_x}{f_\ell}\right)^{\frac{1}{\sigma-1}}\tau > 1$, exporting cutoff φ_x^* is higher than exit cutoff φ_d^*. This assumption ensures some firms produce only for domestic market. Moreover, a reduction in variable trade cost or fixed exporting cost results in an increase in the number of exporting firms upon survival.

For Technology Choice - Marginal firm which adopts high technology is

indifferent between two technologies. In other words, additional profit from upgrading technology for the marginal firm is equal to '0'. Therefore, ZCP condition is $\frac{\Pi_{\ell}^{d}(\varphi_{h}^{*})}{r+\delta} + \frac{\Pi_{\ell}^{x}(\varphi_{h}^{*})}{r+\delta} = \frac{\Pi_{h}^{d}(\varphi_{h}^{*})}{r+\delta} + \frac{\Pi_{h}^{x}(\varphi_{h}^{*})}{r+\delta}$. The cutoff productivity for technology adoption φ_{h}^{*} is pinned down by ZCP for technology adoption.

$$\begin{aligned} &\frac{1-\delta}{r+\delta}\left[p_{\ell}^{d}(\varphi_{h}^{*})\varphi_{h}^{*} - w_{\ell} - \frac{c}{m(\theta_{\ell})}\frac{r+s}{1-\delta}\right]\tau^{1-\sigma}\ell_{d}(\varphi_{h}^{*}) - \frac{r+1}{r+\delta}f_{L} \\ &= \frac{1-\delta}{r+\delta}\left[p_{h}^{d}(\varphi_{h}^{*})\varphi_{h}^{*}\gamma - w_{h} - \frac{c}{m(\theta_{h})}\frac{r+s}{1-\delta}\right]\tau^{1-\sigma}h_{d}(\varphi_{h}^{*}) - \frac{r+1}{r+\delta}\eta f_{L} \end{aligned} \tag{2.40}$$

Combining ZCP conditions (2.37) and (2.40) produces the relation between technology adoption and entry cutoffs

$$\left(\frac{\varphi_{h}^{*}}{\varphi_{d}^{*}}\right) = \left[\frac{\eta-1}{(\tau^{1-\sigma}+1)(\lambda^{\sigma-1}-1)}\right]^{\frac{1}{\sigma-1}} \tag{2.41}$$

where

$$\lambda = \frac{\gamma}{\frac{w_{h}+\frac{c}{m(\theta_{h})}\frac{r+s}{1-\delta}}{w_{\ell}+\frac{c}{m(\theta_{\ell})}\frac{r+s}{1-\delta}}} \tag{2.42}$$

As variable trade cost τ decreases, the marginal cost of serving for foreign market falls. Existing low-tech exporters expand and increase their profits. Marginal firms below technology cutoff start to afford the fixed cost of high technology and upgrade. Hence, $\frac{\varphi_{h}^{*}}{\varphi_{d}^{*}}$ falls or in other words, the number of firms using high technology conditional on survival increases.

λ can be interpreted as the marginal cost advantage of high technology, as in Bustos (2011b). λ is greater than '1' so that technology adoption is profitable. Note that in a perfectly competitive labor market λ would be equal to $\frac{\gamma}{\frac{w_{h}}{w_{\ell}}}$. Therefore, the labor market frictions lead skill premium perceived by

workers to be different than skill premium paid by firms. While skill premium perceived by workers is $\frac{w_h}{w_\ell}$, skill premium paid by firms is $\frac{w_h+\frac{c}{m(\theta_h)}\frac{r+s}{1-\delta}}{w_\ell+\frac{c}{m(\theta_\ell)}\frac{r+s}{1-\delta}}$. This comes from the fact that firms are paying hiring costs in addition to wages paid to workers. Hence, different than Bustos (2011b), technology cutoff depends on equilibrium labor market tightness of skilled and unskilled workers. As skill premium paid by firms increases, the marginal cost advantage of high technology falls. Consequently, lower portion of firms upgrade technology. Using Wage curves (2.23) and (2.24) and Job Creation curves (2.25) and (2.26), it can be shown that λ can be written as a function of tightness of both labor markets:

$$\lambda = \frac{\gamma}{\frac{\beta\theta_h+\frac{(1-b+b\beta)(r+s)}{m(\theta_h)}}{\beta\theta_\ell+\frac{(1-b+b\beta)(r+s)}{m(\theta_\ell)}}} \tag{2.43}$$

Since $m(\theta_i)$ is a decreasing function of θ_i, λ decreases as relative skilled tightness $(\frac{\theta_h}{\theta_i})$ goes up. In other words, if there are more vacancies around in skilled market compared to unskilled, then the competition of high-tech firms over skilled workers is more intense. This increases the skill premium paid by firms and lowers the advantage of high-tech.

Free Entry - (2.38) and (2.41) capture the relationships of entry cutoff with exporting and technology cutoffs, respectively. Still, we need to pin down the entry cutoff. Free Entry (FE) condition will allow us to define entry decisions of firms.

Firms pay a free entry cost f_e before drawing their productivity. Firms bare the sunk cost for entry only if they expect positive profits. Therefore, FE

condition can be written as follows

$$f_e = [1 - G(\varphi_d^*)]\frac{\overline{\Pi}}{r+\delta} \tag{2.44}$$

where

$$\frac{\overline{\Pi}}{r+\delta} = \frac{\overline{\Pi}_\ell^d}{r+\delta} + \rho_x \frac{\overline{\Pi}_\ell^x}{r+\delta} + \rho_h \frac{\overline{\Pi}_h}{r+\delta} \tag{2.45}$$

ρ_e, ρ_x and ρ_h are probabilities of entry, exporting and technology adoption, respectively. $\overline{\Pi}$ is the average expected profit of the industry where as $\overline{\Pi}_i^j$ is the average expected profit of i-type firms from j market for $i \in (\ell, h)$ $j \in (d, x)$. Interpretation of FE condition is as follows. A firm which enters the industry will start to produce with probability of $1-G(\varphi_d^*)$ and earn an average expected profit of $\overline{\Pi}$.

Note that for the rest of the analysis, a Pareto distribution is assumed for the productivity of firms since it is empirically supported and analytically tractable. Pareto distribution has the cumulative distribution function $G(\varphi) = 1 - \varphi^{-k}$ and the probability distribution function $g(\varphi) = k\varphi^{-(k+1)}$ where $k > \sigma - 1$. Accordingly, the probabilities of entry, exporting and adopting higher technology can be written as

$$\rho_e = 1 - G(\varphi_d^*) = (\varphi_d^*)^{-k} \tag{2.46}$$

$$\rho_x = \frac{1 - G(\varphi_x^*)}{1 - G(\varphi_d^*)} = \left(\frac{\varphi_x^*}{\varphi_d^*}\right)^{-k} = \left(\frac{f_x}{f_\ell}\right)^{\frac{-k}{\sigma-1}} \tau^{-k} \tag{2.47}$$

$$\rho_h = \frac{1 - G(\varphi_h^*)}{1 - G(\varphi_d^*)} = \left(\frac{\varphi_h^*}{\varphi_d^*}\right)^{-k} = \left[\frac{\eta - 1}{(\tau^{1-\sigma}+1)(\lambda^{\sigma-1}-1)}\right]^{\frac{-k}{\sigma-1}} \tag{2.48}$$

Inserting (2.45)-(2.48) into (2.44) and solving for expected profits yield[6]

$$(\varphi_d^*) = \Psi^{\frac{1}{k}}[f_\ell + \rho_x f_x + (\eta - 1)\rho_h f_\ell]^{\frac{1}{k}} \tag{2.49}$$

where $\Psi = \left[\frac{r+1}{r+\delta}\frac{\sigma-1}{k-\sigma+1}\frac{1}{f_e}\right]$.

Note that ρ_x depends only on exogenous fixed costs of production and exporting (f_ℓ f_x) and on variable cost (τ). ρ_h, on the other hand, endogenously determined by $\frac{\theta_h}{\theta_\ell}$. Therefore, entry cutoff which is also a function of ρ_h is pinned down by labor market tightness of both skill groups.

2.4 Equilibrium

2.4.1 Unemployment

$k(\theta_i)$ is the number of matches given the search frictions $\theta_i = \frac{v_i}{u_i}$ in the labor market for i type workers. The matching function is assumed to have the following Cobb-Douglas form for analytical tractability: $k(\theta_i) = m_0 u_i^\alpha v_i^{1-\alpha}$ where $0 < \alpha < 1$. Then, the rate at which firms fill their jobs can be expressed as $m(\theta_i) = m_0\theta_i^{-\alpha}$ whereas the rate at which workers find jobs becomes $m(\theta_i) = m_0\theta_i^{1-\alpha}$. At the steady state, flow out of unemployment should be equal to flow into unemployment for both type of workers:

$$m_0\theta_i^{1-\alpha}u_i = s(1 - u_i) \tag{2.50}$$

[6]Details of the derivation are provided in Appendix B.

Left-hand side of the equality is the measure of i-type unemployed workers who are newly matched with jobs whereas right-hand side represents the separation of i-type workers from their existing jobs. Therefore, the fraction of i-type workers who are unemployed can be written as

$$u_i = \frac{s}{s + m_0\theta_i^{1-\alpha}} \tag{2.51}$$

This is the standard Beveridge Curve that links unemployment to the level of labor market tightness. Unemployment is a decreasing function of labor market tightness suggesting that if vacancy to unemployment ratio (θ_i) is lower, it is less likely for workers to find jobs, unemployment increases.

2.4.2 Labor Market Equilibrium

To close the model, labor market equilibrium will be defined. At equilibrium, for both skilled and unskilled workers, the number of workers who find jobs should be equal to the number of workers who are hired by firms. Unskilled workers who match with low-tech jobs (which is denoted as Labor Supply (LS)) can be derived as

$$LS_\ell(\theta_\ell) = (1 - u_\ell)(1 - \rho_s)L = \frac{m_0\theta_\ell^{1-\alpha}}{s + m_0\theta_\ell^{1-\alpha}}(1 - \rho_s)L \tag{2.52}$$

Note that LS_ℓ is only a function of the tightness in unskilled labor market. Higher vacancy-to-unemployed ratio corresponds to a higher wage, and so, labor supply increases. Analogous to (2.52), LS_h equation is expressed as follows

$$LS_h(\theta_h) = (1-u_h)\rho_s L = \frac{m_0\theta_h^{1-\alpha}}{s+m_0\theta_h^{1-\alpha}}\rho_s L \tag{2.53}$$

On the firm side, aggregating the unskilled workers who are hired by low-tech firms produces the following equation (which is denoted as Labor Demand (LD)):

$$LD_\ell(\theta_\ell,\theta_h) = \int_{\varphi_d^*}^{\varphi_x^*} \ell_d(\varphi)\frac{g(\varphi)}{1-G(\varphi_d^*)}d\varphi + \rho_x\int_{\varphi_x^*}^{\varphi_h^*}(1+\tau^{1-\sigma})\ell_d(\varphi)\frac{g(\varphi)}{1-G(\varphi_x^*)}d\varphi$$

$$= A\frac{1+\frac{\rho_x f_X}{f_L}-\frac{\rho_h(\eta-1)}{\lambda^{\sigma-1}-1}}{\beta\theta_\ell+\frac{(1-b+b\beta)(r+s)}{m_0\theta_\ell^{-\alpha}}} \tag{2.54}$$

Note that probability of adopting high technology (ρ_h) depends on marginal cost advantage of high technology (λ). In turn, the marginal cost of advantage of high technology is a function of tightness measures of both skill groups (θ_ℓ, θ_h). Since other parameters in LD_ℓ are exogenous, this function can be expressed solely in terms of two endogenous labor market tightness measures.

Similarly, the labor demand condition of skilled workers can be expressed as follows

$$LD_h(\theta_\ell,\theta_h) = \rho_h\int_{\varphi_h^*}^{\infty}(1+\tau^{1-\sigma})h_d(\varphi)\frac{g(\varphi)}{1-G(\varphi_h^*)}d\varphi$$

$$= A\frac{\frac{\rho_h(\eta-1)\lambda^{\sigma-1}}{\lambda^{\sigma-1}-1}}{\beta\theta_h+\frac{(1-b+b\beta)(r+s)}{m_0\theta_h^{-\alpha}}} \tag{2.55}$$

Again, the labor demand for skilled workers endogenously determined only by labor market tightness for both skill groups.

At equilibrium, $LD_i = LS_i$ for each type of workers. Labor market clearing

condition for skilled workers is

$$A\frac{1+\frac{\rho_x f_X}{f_L}-\frac{\rho_h(\eta-1)}{\lambda^{\sigma-1}-1}}{\beta\theta_\ell+\frac{(1-b+b\beta)(r+s)}{m_0\theta_\ell^{-\alpha}}}=\frac{m_0\theta_\ell^{1-\alpha}}{s+m_0\theta_\ell^{1-\alpha}}(1-\rho_s)L \tag{2.56}$$

and skilled labor market equilibrium is

$$A\frac{\frac{\rho_h(\eta-1)\lambda^{\sigma-1}}{\lambda^{\sigma-1}-1}}{\beta\theta_h+\frac{(1-b+b\beta)(r+s)}{m_0\theta_h^{-\alpha}}}=\frac{m_0\theta_h^{1-\alpha}}{s+m_0\theta_h^{1-\alpha}}\rho_s L \tag{2.57}$$

where

$$A=\frac{(r+1)(\sigma-1)(1-b)kf_L}{(k-\sigma+1)c} \tag{2.58}$$

Hereby, we are left with two equations with two endogenous indeterminate variables. In the next section, we provide comparative statics results by using these two equations.

2.5 Results of the Analysis

In this section, the effects of trade liberalization on wages and unemployment of both skilled and unskilled workers are investigated. Trade liberalization is defined as the reduction in variable trade cost (τ). In the first part we provide comparative statics for net effects of liberalization on tightness, wages and unemployment for different labor markets. Although the net effect of liberalization on labor market outcomes can be fully characterized analytically, globalization's effect on technology adoption is potentially ambiguous. Therefore, we provide a numerical illustration to discuss the technology adoption aspect of the model

2.5.1 Comparative Statics

Proposition 1: A simultaneous reduction in variable trade cost τ in two symmetric countries leads

1. labor market tightness ($\theta_i = \frac{v_i}{u_i}$) to rise in both type of labor markets $\left(\frac{d\theta_i}{d\tau} < 0\right)$.

2. to an increase in wages of both skilled and unskilled worker $\left(\frac{dw_i}{d\tau} < 0\right)$.

3. unemployment to fall in both type of labor markets $\left(\frac{du_i}{d\tau} > 0\right)$.

4. wages of skilled rise more than unskilled, hence skill premium to increase $\left(\frac{\frac{w_h}{w_\ell}}{d\tau} < 0\right)$.

5. unemployment of skilled fall more than unskilled, hence relative skilled unemployment to fall $\left(\frac{\frac{u_h}{u_\ell}}{d\tau} > 0\right)$.

Proof: see Appendix C.

These are the net results of trade liberalization on unskilled labor market. As variable trade cost falls, the ratio of vacancies to unemployed goes up in both labor markets. It becomes easier for workers to find jobs and more difficult for firms to fill their vacancies. Consequently, wages rise and unemployment rates decline.

Equilibrium skill premium can be written as a function of θ_ℓ and θ_h:

$$\frac{w_h}{w_\ell} = \frac{[\theta_h + \frac{(r+s)}{m(\theta_h)}]}{[\theta_\ell + \frac{(r+s)}{m(\theta_\ell)}]}$$

Note that skill premium is an increasing function of $\frac{\theta_h}{\theta_\ell}$. We show that liberalization increases the labor market tightness of skilled labor market more than unskilled: $|\frac{d\theta_\ell}{d\tau}| < |\frac{d\theta_h}{d\tau}|$. Therefore, a reduction in τ bids up both type of wages, increasing wage of skilled more than unskilled.

Expressing the relative unemployment rates in terms of skilled and unskilled labor market tightness yields

$$\frac{u_\ell}{u_h} = \frac{s + m(\theta_h)}{s + m(\theta_\ell)}$$

Since the ratio is an increasing function of relative labor market frictions, given that $|\frac{d\theta_\ell}{d\tau}| < |\frac{d\theta_h}{d\tau}|$, the relative unemployment rate of unskilled workers increases. In other words, trade liberalization changes the composition of unemployment and unskilled workers start to constitute a larger portion of unemployment pool. Overall, both skilled and unskilled worker benefit from trade liberalization. However, the distribution of gains is not symmetric. As stated above, the impact of trade on skilled labor market is greater than unskilled. Now we discuss the direct and indirect effects operating behind these results. Table 2.1 presents a summary of these findings.

First direct effect comes from the fact that a reduction in variable trade cost is accompanied by an increase in the fraction of surviving firms which export (to put it differently $\frac{\partial \frac{\varphi_x^*}{\varphi_d^*}}{\partial \tau} > 0$). Consequently, the probability of exporting, $\rho_x = (\frac{\varphi_x^*}{\varphi_d^*})^{-k}$ rises. Therefore, higher share of low-tech firms start to serve for both domestic and foreign markets and expand their production. In addition, low-tech firms, which are already exporting, realize a decrease in their marginal

cost of serving for foreign market, hence increase their scale. Both of these events contribute to an increase in demand for unskilled labor, driving up the unskilled vacancy number and unskilled labor market tightness.

Secondly, liberalization leads probability of entry ($\rho_{in} = (\varphi_d^*)^{-k}$) to decrease. In other words, entry cutoff increases and least productive firms exit: $\frac{\partial \varphi_d^*}{\partial \tau} > 0$. As wages of unskilled rise least productive firms cannot cover the variable cost of producing. Since least productive firms are operating with low-technology, exit of these firms breaks up the existing matches between low-tech firms and unskilled labor. Accordingly, demand for unskilled falls leading to a reduction in unskilled vacancies. Moreover, some unskilled workers join to unemployment pool. Vacancy to unemployed ratio (θ_ℓ) falls in unskilled labor market.

Finally, liberalization endogenously induces a skilled-biased technological change. As τ falls, the fraction of surviving firms that adopt higher technology increases ($\frac{\partial \frac{\varphi_h^*}{\varphi_d^*}}{\partial \tau} > 0$). Accordingly, the probability of technology adoption $\rho_h = \left(\frac{\varphi_h^*}{\varphi_d^*}\right)^{-k}$ rises. In other words, more productive and exporting low-tech firms expand their higher production and marginal firms closer to φ_d^* start to cover fixed costs of high technology. As more firms upgrade, the demand for unskilled falls. Accordingly, the number of unskilled vacancies fall. Such a decrease in demand for unskilled causes vacancy to unemployed ratio (θ_ℓ) to fall.

Note that the exit of least productive firms and endogenous skill-biased technological change pushes unskilled labor market tightness down whereas expansion of low-tech exporters increases the tightness. In contrast, there are two direct effects of liberalization both working in same direction in skilled

labor market. As the share of firms operating with high technology increases skill demand rises. Moreover, due to a reduction in τ, the high-tech firms expand their share in foreign market which further augment the skilled labor demand. Therefore, liberalization stir up the demand for skill and skilled labor market tightness (θ_h) goes up accordingly.

Yet there is an indirect channel through which liberalization affect the skilled and unskilled labor market tightness. This channel works through marginal cost advantage of high technology (λ). As stated above, λ is a function of relative labor market tightness (See Equation (2.43)). If skilled tightness relative to unskilled goes up, marginal cost advantage falls and less firms adopt higher technology. Hence the probability of technology adoption falls($\frac{\partial \rho_h}{\partial \lambda} > 0$). As a result, the relative demand for skill falls.

In order to identify the liberalization's impact on labor market through λ, we use the effect of τ on $\frac{\theta_h}{\theta_\ell}$. As stated above, comparative statics results suggest that $|\frac{d\theta_\ell}{d\tau}| < |\frac{d\theta_h}{d\tau}|$. In other words, the impact of trade on skilled labor market is higher than its impact on unskilled labor market in absolute value. Therefore, λ falls due to a fall in τ. Consequently, the indirect effect of liberalization reduces the relative demand for skill.

Table 2.1: The Effects of Trade Liberalization

Direct Effect		Indirect Effect		Net Effect	
Δ in Prob.	Δ in θ	Δ in Prob.	Δ in θ	Δ in Prob.	Δ in θ
$\rho_e \downarrow$	$\theta_\ell \downarrow$	$\rho_e \uparrow$	$\theta_\ell \uparrow$	ρ_e*	$\theta_\ell*$
$\rho_x \uparrow$	$\theta_\ell \uparrow, \theta_h \uparrow$	$\rho_x -$	$-$	$\rho_x \uparrow$	$\theta_\ell \uparrow, \theta_h \uparrow$
$\rho_h \uparrow$	$\theta_\ell \downarrow, \theta_h \uparrow$	$\rho_h \downarrow$	$\theta_\ell \uparrow, \theta_h \downarrow$	ρ_h*	$\theta_\ell*, \theta_h*$

**The net effects of trade liberalization is ambigious for these variables and will be discussed in "Numerical Illustration" part.*

Although the labor market outcomes of trade liberalization are unambiguous, probability of entry and technology move in different directions due to direct and indirect effects and which effect dominates still not clear. To discuss this issue we provide numerical exercise in the next section.

2.5.2 Numerical Illustration

The aim of this section is to provide numerical illustration of what we have found so far by comparative statics. Moreover, we pin down the net effect of trade liberalization on probability of technology adoption and entry with the help of this exercise. First, we choose our parameters to set up a benchmark case. Then, the effect of a reduction in τ is investigated to quantify the effects of globalization.

Our parameters are chosen as follows. Following Felbermayr et al. (2011a) and Bernard et al. (2007), we assume Pareto distribution for productivities of firms with a shape parameter $k > \sigma - 1$. We set $k = 3.4$ as in Bernard et al. (2007) and choose $\sigma = 2.7$. Number of workers is normalized to 1 ($L = 1$). The variable trade cost (τ) equals 1.3 for the benchmark case following Ghironi and Melitz (2005). Bernard et al. (2007) suggest that the share of firms that export equals 0.21. This ratio lets us pin down $\frac{f_x}{f_\ell}$ at 1.4. We calibrate $f_\ell = 1.1$ such that aggregate labor market tightness is equal to 0.5 as in Hall (2005)[7]. We set monthly exit rate of the firm as $\delta = 0.0097$ (Bartelsman et al. (2004)), monthly job destruction rate as $s = 0.034$ (Shimer (2005)) and monthly discount rate as $r = 0.0033$ (for 4 percent annual interest rate).

[7]Aggregate labor market is defined as $\theta = \frac{v_h + v_\ell}{u_h + u_\ell}$

We assume Cobb-Douglas matching function for both type of labor markets; $m(\theta_i) = m_0\theta_i^{-\alpha}$. (Shimer (2005)) estimates job finding rate to be 0.45. We calculate job finding rate for aggregate labor market and set m_0 to 0.72 so that job finding rate for aggregate labor market is equal to 0.45. Following (Shimer (2005)) value of non-market activity (b) is set equal to 0.4. We calculate average wage of industry and set cost of posting vacancy to 1.1 times the monthly wage following Ebell and Haefke (2009a). As in Abowd and Allain (1996) bargaining power of workers (β) is set equal to 0.5. Finally we choose $\eta = 1.5$ and $\gamma = 3.4$ to target observed college premium differential of 0.5 and relative unemployment of skilled to unskilled close to 2 in U.S. data.

Next we investigate the effect of trade liberalization. Trade liberalization is defined as 10 percent fall in variable trade cost τ. Figure 2.3 presents the wage and unemployment effects of trade liberalization for skilled and unskilled labor market. Figure 2.3 is a numerical illustration of what we have found in comparative statics. As τ falls from 1.3 to 1.18, unskilled unemployment falls by 3.7 percent whereas skilled unemployment falls by 3.9 percent. Skilled wages increases by 8.3 percent while unskilled wages rise by 7.9 percent.

Figure 2.3: Wages and unemployment rates of skilled and unskilled

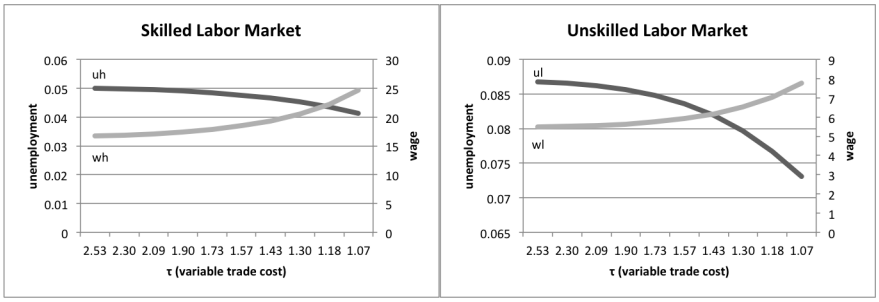
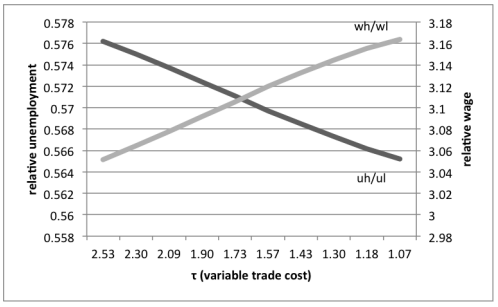


Figure 2.4 again presents quantitative results of what we have found with

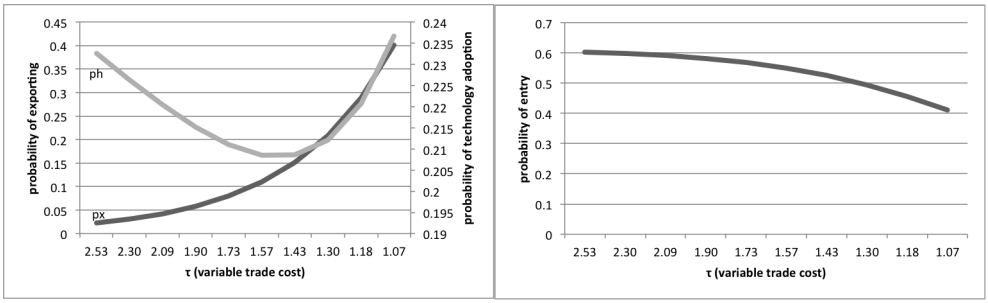
comparative statics. After a fall in τ from 1.3 to 1.18, the relative unemployment of skilled falls by 0.2 percent. On the other hand, wage inequality rises by 0.34 percent.

Figure 2.4: Relative wages and unemployment rates



Finally, Figure 2.5 presents the changes in probabilities of entry, exporting and technology adoption due to globalization. As τ falls probability of exporting rises and probability of entry falls. A fall in τ from 1.3 to 1.18 results in an increase in probability of exporting by 8 percentage-points. Same reduction in variable trade cost leads probability of entry to fall by 3.8 percentage-points. However, the change probability of technology adoption due to liberalization depends on initial level of liberalization. For example, a fall in τ from 1.73 to 1.57, results in 0.2 percentage-point decrease in probability of technology adoption whereas as τ falls from 1.3 to 1.18, this probability increases by 1.6 percentage-points. This finding can be interpreted as follows. If variable trade costs are high enough, the amount of liberalization is not sufficient for low-tech firms to cover fixed cost of high technology. As variable trade cost gets lower, trade liberalization makes it profitable for firms to adopt high technology.

Figure 2.5: Probability of entry, exporting and technology adoption



2.6 Alternative Case

In this section, we investigate the case where the exporting costs are high enough so that

$$\frac{\eta - 1}{\lambda^{\sigma-1}} < \frac{f_x}{f_\ell}(1 + \tau^{\sigma-1}) \tag{2.59}$$

then, the following ordering of cutoff productivities arises $\varphi_d^* < \varphi_h^* < \varphi_x^*$. In this case, again least productive firms exit. Firms with productivity between φ_d^* and φ_h^* produce only for domestic market and use low technology. Firms that operates with a productivity level over φ_h^* and below φ_x^* produce high-tech products and serve for the domestic market. Finally, firms with a productivity level over φ_x^*, use high technology and produce for both domestic and foreign markets. Under this alternative scenario, all exporters are operating with high technology. The labor market outcomes of trade liberalization are exactly the same with the main scenario. However, the mechanisms driving these results are different.

Difference of this case from the previous one is, a reduction in variable trade cost does not have a direct effect on technology adoption. Trade liberalization affects technology cutoff only indirectly through marginal cost advantage of

high technology. As liberalization enhance the skill premium paid by firms, the marginal cost advantage of high technology falls leading less firms to upgrade their technology. However, overall effects of trade liberalization on wages, unemployment, wage inequality and relative unemployment rates remain the same.

2.7 Discussion of the Assumptions

In this section, we discuss the assumptions of the model that are deriving the results.Note that, relaxing these assumptions would change quantitative predictions of the model, leaving qualitative results similar.

The model assumes that trading partners are symmetric. First of all, trade between similar countries constitutes a large portion of global trade. According to United Nations' "World Economic Situation and Prospects 2014" report, North-North and South-South trade accounts for 40 and 25 percent of world trade, respectively[8]. Therefore, the model's predictions are relevant for a significant share of world trade. However, trade volume between asymmetric countries is still an important part of world trade volume (35 percent). Hence, it is important to discuss the model's predictions for South-North or North-South trade. Asymmetries between countries may arise from various factors. The most important asymmetry that can be introduced to the model is to drop the assumption that relative supply of skilled labor is the same across the trade partners so that HO predictions will apply. The outcomes of this chapter suggest that trade liberalization results in an increase in skill premium

[8]South-North and North-South each constitute 17-18 percent of the total trade.

and a fall in skilled unemployment relative to unskilled even in a symmetric country case. Assuming asymmetric factor abundance would strengthen our results in the skilled-labor abundant country and weaken them in the unskilled-labor abundant one. In other words, introducing asymmetry in terms of skill abundancy would increase the skill premium and decrease the relative skilled unemployment in skill-abundant country more than skill-scarce country.

The second assumption that is important for quantitative predictions of the model is the definition of low- and high- technologies. In the model, skilled worker is only employed by high-tech firms and unskilled worker is only hired by low-tech firms. This assumption is stronger compared to the case where both type of workers are employed by both type of firms and high-tech firm is more skill intensive. The latter technology definition leaves the analysis of this paper analytically intractable and does not add additional information on labor market effects of liberalization. As long as high-tech firms are more skill intensive, firms' entry, exporting and technology adoption choices are not affected by intensity level of skill in different technologies. We should note that relaxing this assumption would only dampen the effects of liberalization on skill premium and relative skill unemployment while qualitative findings remain unchanged.

Another assumption regarding matching process is the chapter focuses on ex-post segmentation equilibrium rather than cross-skill matching equilibrium. In cross-skill matching, skilled workers can be hired by low-tech firms. Under this case, skilled workers are paid a lower wage when employed by a low-tech firm. Moreover, skilled workers earn more than unskilled in a low-tech

firm since skilled worker is more productive. It is clear that the model would increase skilled employment more than unskilled in cross-skill matching compared to ex-post segmentation. However, skill premium definition becomes complex when there exists three types of wages in the economy. Under cross-skill matching, depending on productivity of skilled worker in a low-tech job, a medium-level wage should be defined. Therefore, only more productive low-tech firms would cover the medium wage. As trade liberalization reallocates market shares toward more productive firms, we would expect medium-wage compared to low and high-wage compared to medium to increase. Therefore, analyzing cross-skill matching equilibrium would not change the outcomes of the model but would complicate the solution to a great extent.

Finally, we discuss the welfare implications of the model. As liberalization increases both types' wages and decreases their unemployment, we conclude that welfare increases for both skilled and unskilled. However, the model does not introduce welfare preferences of the workers. If utility function was modified so that agents get disutility form inequality, we would expect that as skill premium increases due to liberalization, this would reduce the welfare of unskilled workers.

2.8 Conclusion

In this model, we chapter the effects of trade liberalization on wages and unemployment rates of skilled and unskilled. The results of the analysis suggests that independent of the size of exporting and technology adoption costs, globalization, in the long run, increases the wages of both skilled and unskilled.

Hence, overall wages increase in the economy. Also, unemployment rates for skilled and unskilled decrease due to a reduction in variable trade costs, such as tariffs and transportation costs, leading aggregate unemployment to fall. Liberalization affects skilled and unskilled workers asymmetrically when countries have identical characteristics. Since reductions in trade costs increases wage of skilled more than unskilled, increasing the wage inequality. Finally, trade liberalization results in a change in the composition of unemployment pool. Both skilled and unskilled unemployment rates fall whereas unemployment rate of skilled falls more than unskilled.

The model can be developed by applying different extensions. The incorporation of on-the-job search and on-the-job training can enrich the implications of the analysis and change the effect of liberalization on labor market. Although we have discussed above that symmetric country assumption is reasonable to understand labor market outcomes of trade liberalization, introducing asymmetries between countries would bring useful insight. Asymmetries between countries regarding labor market or industry characteristics prosper the model's predictions. Finally, the model presented here focuses on long-run effects of trade liberalization and leave out transitional dynamics between steady states. However, it would be beneficial to analyze the differences between short-run and long-run effects of trade liberalization to have a better understanding of outcomes of globalization. These points are left for future research.

CHAPTER 3

THE EXPORT PERFORMANCE OF TURKEY (1996-2013)

The Turkish economy has been hailed internally and externally for delivering strong outcomes since the early 2000s. Synchronously, however, the Turkish economy has also been included in the "Fragile Five" with Brazil, Indonesia, India and South Africa. High inflation and slow growth rates in these countries have led to breakdown of competition and loss of foreign investors' confidence. Therefore, high current account deficits have been financed through fixed income inflows, which have left these countries currencies vulnerable to exchange rate risk. In 2014, with an inflation rate of 8-9 percent, a growth rate of 2.9 percent and increasing current account deficits financed mainly by the indebtedness of banks and the private sector to foreign countries, the Turkish economy maintains its risky-country status. This conundrum begets a detailed and multidimensional evaluation of the trade deficit of the Turkish economy. Rather than focusing solely on export performance, a full picture requires a detailed evaluation of imports and the overall current account dynamics. As such, in this paper, we provide an investigation of not only exports but also

imports and current account figures. Moreover, we take a deeper investigative step into understanding export performance.

Turkish exports have increased significantly since the change in Turkey's trade regime in the 1980s from import substitution to export-oriented growth. To a great extent, the Customs Union agreement with the European Union (EU) contributed to trade figures. From the beginning of the 2000s until the global financial crisis, the growth rate of exports remained high. As exports recover from the crisis, export growth rate falls to pre-crisis levels. However, export recovery has not come from structural changes that Turkey requires but from improvements in the economies of the country's trade partners. Berument et al. (2014) show that export recovery from the global financial crisis highly depends on an income upturn in countries that imports Turkish products. Saygılı and Saygılı (2011) compute not only the income elasticity but also the import and exchange rate elasticity of Turkish exports and show that both high income elasticity and high import elasticity accompanied by decreasing exchange rate elasticity have raised the import content of Turkey's export basket. Therefore, as Turkish exports recover from the financial crisis, a rise in imports has occurred, which has also contributed to a rise in the trade deficit.

Moreover, exports as a percentage of GDP in Turkey have remained low relative to comparable countries, which suggests that exports have not been the driving force of GDP growth in Turkey. The vulnerability to trade partners' income and dependence on imports, combined with low levels of export-to-GDP ratio, pose a high risk to the current account and deserve a deliberate

discussion about the underlying reasons of poor trade performance. Therefore, this chapter aims to provide a comprehensive analysis of Turkey's trade performance over the recent two decades and to contribute to the ongoing discussion of the country's export structure by exploiting a new data set.

The reasons behind the underperformance of exports have been investigated by several studies in the literature. An economy's export performance is found to be negatively affected by (i) lack of appropriate innovation activities to produce and export technologically advanced and high value-added products, (ii) lack of adequate skills for more-efficient production and better management and marketing, (iii) lack of an efficient business environment and (iv) lower export participation of small- and medium-sized enterprises (SMEs). Next, we discuss the importance of these structural factors for an economy's export performance.

First and most importantly, all factors that lead firms to become competitive in foreign markets are also factors that make a firm more productive. Micro data from developing and developed countries often show that larger and more-productive firms export more. The direct implication of Melitz (2003) model is that larger firms with higher productivity self-select into the export market and also export more after a successful entry. Among others, Bernard and Jensen (1999) and Bernard et al. (2003) for the US, Clerides et al. (1998) for Colombia, Mexico and Morocco and Aw et al. (2000) for Taiwan provide empirical support for this hypothesis. Next, we discuss factors that enhance firm productivity and competitiveness in global markets.

Innovative activities increase firm competitiveness and enable them to over-

come trade barriers. Alvarez (2007) for Chile and Harris and Moffat (2011) for the UK show that innovating firms are more likely to export. Moreover, innovation increases the turnover of existing exporters and leads to higher export intensity. Lachenmaier and Wössmann (2006) suggest that innovation increases the export share of German manufacturing firms. Basile (2001) shows that both the export propensity and intensity of Italian firms are positively related to innovative activity.

Not only the existence of innovative activity but also the type of innovation matters for firms' exporting behavior. Caldera (2010) for Spain and Becker and Egger (2013) for Germany decompose innovation into two modes: product and process innovation. These studies find that product innovation has a larger effect on exporting. Becker and Egger (2013) interpret this finding by emphasizing the importance of an extensive margin in product space. For Belgian firms, Beveren and Vandenbussche (2009) show that it is the combination of both product and process that matters. For Turkey, Turco and Maggioni (2015) find that it is product rather than process innovation that is important. We show that this last finding prevails when using a survey data from a more recent period.

Innovation is not the only mechanism to raise the technological composition of export products; by using high-tech intermediate inputs, a firm may also increase its products' technological intensity. For developing economies like Turkey, where advanced intermediate inputs are more likely to be imported rather than produced, foreign inputs may proxy the technological content of its exported goods. Goldberg et al. (2010) report substantial gains from imported

inputs on domestic output growth. They show that input tariff liberalization in India reduced the technological constraints of domestic firms. A recent study by Feng et al. (2012) shows that technology embedded in intermediate inputs helps Chinese firms improve their export performance. Correa et al. (2011) also provide empirical support for the positive relationship between export propensity and intensity with imported inputs in Ecuador.

Firms with higher human capital and/or higher investment in training become more competitive and are more likely to overcome trade barriers. Alvarez (2007) suggests that higher human capital is associated with a higher probability of exporting in the Chilean manufacturing industry. Harris and Moffat (2011) take a different point of view and show that higher human capital increases the probability of exporting via its complementarity with innovative activities.

Easier access to credit is essential for a trade-friendly business environment. Caggese and Cunat (2013) show that eliminating financial constraints significantly improves firms' export performance in Spain. Access to credit is particularly important for SMEs' export behavior. The literature shows that smaller firms that cannot overcome trade costs are more likely to export indirectly through trade intermediaries. Intermediary firms have well established distribution networks and better knowledge regarding foreign markets and regulatory framework. However, intermediaries acquire commissions from their customers (producers) proportional to export sales intermediated. Building upon these facts and developing the model of Melitz (2003), Ahn et al. (2011) builds a model that produces a positive relationship between direct exports

and size. In the model, exporting indirectly via intermediaries has lower fixed cost but higher marginal cost compared direct exporting. Therefore, smaller firms which cannot cover the high fixed cost of exporting rely on trade intermediaries to be able to export. Although marginal cost of exporting becomes higher with the use of intermediaries, smaller firms prefer indirect exports to expand their scale. Abel-Koch (2013) test the theoretical findings of Ahn et al. (2011) using the 2005 "Productivity and the Investment Climate Private Enterprise Survey" for Turkey and find that firms that are larger, have more university graduates in their labor force and have a internationally recognized quality certification, have a lower indirect export intensity. Moreover, firms that develops a new product rely on trade intermediaries to export their products. We expand their analysis by using data from the same survey for 2005, 2008 and 2013 and including additional variables that are of importance (access to finance and productivity) to evaluate indirect export intensity of Turkish firms.

In developing economies, improvements in legal and regulatory framework is essential for creating an efficient business environment. These improvements not only enhance exports but also play a major role in attracting foreign direct investment (FDI) inflows. It is well known that multinationals have better foreign market knowledge and more advanced technology. Hence, they are more likely to become exporters and to realize higher export sales. Therefore, inward FDI promotes exports of the host country. Girma et al. (2005) shows that this is the case for the UK manufacturing industry, and many other studies provide similar results for other countries.

In this chapter, first we show that Turkey lags behind its competitors in these areas by exploiting macro-level data. The firm-level survey data used in the chapter allows us to investigate how improvements in these fields would enhance the export performance of Turkish firms. The contribution of the analysis to existing literature on Turkey's trade performance is to provide a comprehensive discussion of determinants of export performance at the firm level in Turkey. The main findings of the firm-level analysis are as follows: More productive and larger firms are more likely to export. Also, product innovation, inward FDI, foreign input use, having an internationally recognized certification and having a website boost the probability of Turkish firms exporting. After a successful entry, firms that are larger in size and with higher productivity and foreign ownership have higher export sales. Moreover the results show that the export performance is associated with different factors for firms different in size. Finally, we investigate the role of trade intermediaries for Turkish exporting firms and the results show that smaller and less-productive firms require these intermediary firms in order to start exporting.

In Section 3.1 we provide descriptive statistics for Turkey's trade performance and current account deficit and compare Turkey's trade figures and infrastructure of with its global counterparts. The aim of the section is to discuss the shortcomings of Turkey's infrastructural capacity that limit the country's trade performance. In Section 3.2, we explain the data and methodology used for the firm-level analysis. In Section 3.3, we discuss how eliminating these limitations improve the export performance of Turkish firms. We conclude with policy suggestions in Section 3.4.

3.1 Turkey's Trade Performance

The period of Turkish economy after 2000 cannot be evaluated as monolithic, neither in the evaluation of economic performance nor in the extent of the economic reforms undertaken. As detailed in Gürkaynak and Sayek-Böke (2013), 2002 through 2006 was a period of strong economic reforms and outcomes mostly due to an internalized IMF program. While the IMF program ended on paper in 2008, the reform checklist actually ended in 2006, and more important, was never replaced with a new set of internally consistent economic reform programs. This fact motivates the need to analyze the 2000s in two episodes: 2002 through 2006 and 2007 onwards.

Any analysis of the Turkish economy's trade performance necessitates taking into account the relationship with the EU. The 1996 Turkey-EU customs union has been a significant factor influencing the trade performance of the Turkish economy[1]. The same period was also marked by significant global events that played a prominent role in the evolution of trade patterns in Turkey. A break in the willingness of local authorities to undertake economic reforms in 2007 also coincided with the changing global conditions. While the average world GDP growth rate of above 3 percent and the average world import growth rate of almost 7.5 percent experienced in the early 2000s contributed positively to the trade figures of many countries, including Turkey, the slowdown following the 2008 global financial crisis brought about a new challenge for Turkish exporters.

[1]Another landmark date is 2004, when Turkey started EU membership negotiations. However, this date has been more influential on capital flows rather than on trade patterns per se.

As such, any trade performance of the Turkish economy should be evaluated across these four periods: 1990-1996, 1997-2001, 2002-2006 and 2007-2013. Several trade indicators over these episodes are summarized in Table 3.1. The share of exported goods in GDP has risen steadily throughout the 1990s and 2000s. From a level of 10.8 percent on average in the early 1990s, the share increased to 12.2 in the second half of the 1990s, to 15.8 percent in the early 2000s and up to 17.4 percent since 2007. While the share in GDP shows a steady increase, export growth performance is reflective of the change in intensity of economic reforms undertaken by the public authorities. Up until the customs union, exports grew at an annual rate of 8.7 percent, which then dropped to 3.6 percent during the latter half of the 1990s a period marked by several consecutive domestically grown economic crises. The period of stellar export growth coincides, not surprisingly, with the period of domestic reforms and steady global growth. The annual export growth rate rose to 18.9 percent during the first half of the 2000s. The abrupt break in economic reforms, accompanied by a slowdown in world markets led to a halting drop in the export growth rate, down to five percent per annum. This slowdown has led to public authorities recently revising their 2023 targets from 500 billion USD worth of exports to a mere 200 billion USD.

Imports have had slightly higher growth rates than exports but have followed a similar trend, which is consistent with the argument that Turkish exports have a high import content. Imports as a share of GDP increased by four percent in the 2002-2006 period and by 7.5 percent in the 2007-2013 period, a change from 20 percent between 1990 and 2001. The compounded

Table 3.1: Trade Figures 1990-2013

	1990-2013	1990-1996	1997-2001	2002-2006	2007-2013
Trade Balance (billion $)	-36.38	-11.24	-18.42	-33.86	-76.15
Exports/GDP	14.04	10.76	12.2	15.77	17.39
Imports/GDP	22.43	17.61	20.14	24.17	27.64
Exports/Imports	62.74	61.54	60.97	65.41	63.3
X-M/GDP	-8.39	-6.85	-7.94	-8.41	-10.25
X+M/GDP	36.46	28.37	32.34	39.94	45.03
Exports (CAGR)	10.8	8.69	3.6	18.86	5.09
Imports (CAGR)	10.62	10.06	-3.14	22.04	5.76
Real GDP growth (CAGR)	3.74	3.33	-0.09	5.93	2.75

Source: TurkStat database and authors' own calculations.

annual growth rate of the change in imports was below 10 percent between 1990 and 2001. This growth rate increased to almost 19 percent in the 2002-2006 period, and came back to five percent after 2007. Since there have been no structural reforms undertaken to decrease the import dependency of production, this slowdown in imports is reflective of a slow recovery from the global financial crisis.

As a result of growing exports and imports, openness to trade in Turkey increased steadily from 1996 to 2013. However, import coverage of exports remained below 65 percent throughout this period, which has led to an accumulation of a trade deficit over the years. The average trade deficit was around 36 billion USD between 1990 and 2013. Between 2007 and 2013, Turkey realized the highest average trade deficit (76 billion dollars). The trade-deficit-to-GDP ratio remained below 10 percent before 2007, however, on average, it increased to 10.25 percent between 2007 and 2013.

To suggest policies that would enhance exports and restrain growing the current account deficit, we need to conduct a deeper investigation of Turkish trade performance. We start with discovering the technological capacity of

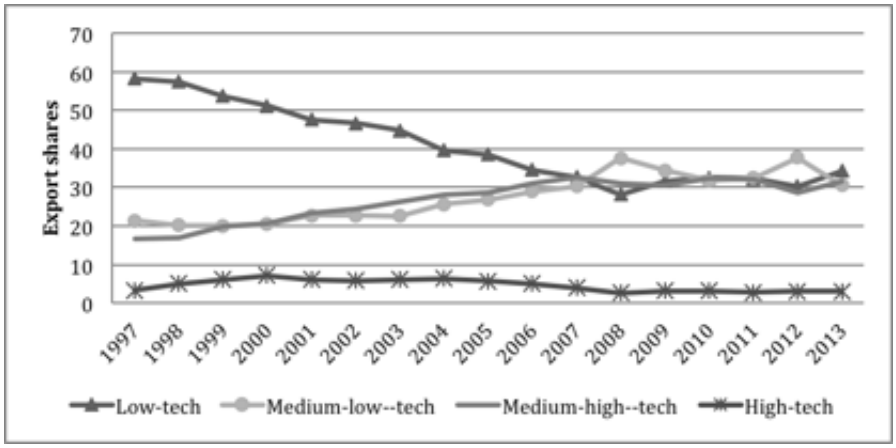
Turkish exports and imports. We group both export and import products according to the OECD's technological intensity classification, presented in Table 3.2[2]. Figure 3.1 shows that the technological intensity of Turkish exports has gone through a structural transformation since 1996. While low-tech exports' share in total exports fell from 60 percent in 1997 to 30 percent in 2013, the share of medium-tech exports rose from 40 percent to almost 65 percent in the same period. Although Turkey has upgraded its export basket toward more technological products, high-tech exports still constitute a smaller fraction of total exports, with a share lower than 10 percent throughout the period. It is also worthwhile to note that this small fraction of high-tech exports dropped even below that share in 1997. This picture suggests that Turkey lacks structural reforms and the capacity to change the technological content of its exports toward high-tech products.

Table 3.2: OECD Technological Intensity Classification by ISIC Rev.3

ISIC, Rev.3	Technological Intensity	Industry name
15	Low-tech	Food products and beverages
16	Low-tech	Tobacco products
17	Low-tech	Textiles
18	Low-tech	Wearing apparel
19	Low-tech	Luggage, saddlery and footwear
20	Low-tech	Wood and cork products
21	Low-tech	Paper and paper products
22	Low-tech	Printing and publishing
36	Low-tech	Furniture
23	Medium-low-tech	Coke, petroleum products and nuclear fuel
25	Medium-low-tech	Rubber and plastic products
26	Medium-low-tech	Other non-metallic minerals
27	Medium-low-tech	Manufacture of basic metals
28	Medium-low-tech	Manufacture of fabricated metal products
351	Medium-low-tech	Ships, boats and floating structures
24 (except 2423)	Medium-high-tech	Chemicals and chemical products
35 (except 351 and 353)	Medium-high-tech	Other transport
29	Medium-high-tech	Manufacture of machinery and equipment
31	Medium-high-tech	Electrical machinery and apparatus
34	Medium-high-tech	Motor vehicles and trailers
2423	High-tech	Pharmaceutical products
353	High-tech	Aircraft and parts thereof
30	High-tech	Office, accounting and computing machinery
32	High-tech	Communication and apparatus
33	High-tech	Medical, precision and optical instruments, watches

[2]Technology classification of (OECD) based both on direct R&D intensity and R&D embodied in intermediate and investment goods produced. There are four categories: high-, medium-high, medium-low and low technology. One should note that this definition technological intensity is prone to mismeasurement since it ignores the fact that some firms are more R&D intensive than the others within the same sector. For example, in a low-tech industry, firms can produce a variety of products ranging between low-tech and high-tech. However, it the best available measure due to above mentioned aggregation issues.

Figure 3.1: Exports by Technological Intensity

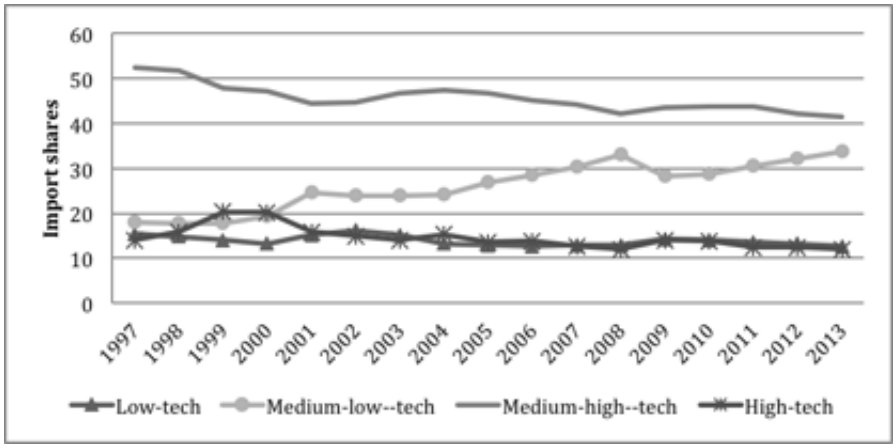


Source: TurkStat database and authors' own calculations.

In Figure 3.2, we repeated the same analysis to understand the technological structure of Turkish imports. While medium-tech products dominated the import basket, both high- and low-technology exports constituted between 10 and 20 percent of total imports. In 1997, medium-high–tech imports constituted almost half of total imports. While the share of medium-high–tech imports decreased to 40 percent in 2013, it was replaced by medium-low–tech imports. This picture suggests that the technological intensity of Turkish imports has deteriorated since 1997. On the other hand, low-tech and high-tech product groups each constitute 10-15 percent of total imports.

Since intermediate imports constituted on average 70 percent of total imports between 1997 and 2013, these findings may reflect the technological intensity of intermediate imports. Since Turkish economy does not rely on production of sophisticated and technologically advanced production and exports, the demand for high-tech imports is lower compared to other types of imports. On the other hand, the lower share of low-tech products in import basket may result from the fact that the country produces the low-tech intermediate inputs

Figure 3.2: Imports by Technological Intensity



Source: TurkStat database and authors' own calculations.

domestically.

A potential explanation for the dominance of medium-tech inputs and the increasing share of medium-low–tech inputs would be that the sophistication of production determine the demand for inputs at various levels of technology. For instance, basic metal imports - iron and steel - in 2013 is 4 times larger than what it is in 2003 and compounded annual growth rate of basic metal imports between 2003-2013 is 15 per cent. Since construction industry has started to constitute larger share of GDP, the increase in imports of basic metals (classified as medium-low–tech) is not surprising. Another explanation for increasing share of medium-low–tech imports comes from dependence of energy on imports of coke and petroleum products. Between 2003-2013, imports of coke and petroleum products have almost 20 per cent compounded annual growth rate.

Next, we analyze the growth of exports and average trade-balance-to-GDP ratio for different technology groups in different sub-periods. The first column of Table 3.3 shows that total exports expanded by 11.2 percent throughout the

1997-2013 period and that medium-tech exports were the engine of this growth. On the other hand, as medium-high–tech products accounted for a large proportion of imports, this technological category forms the major component of the trade deficit. The primary sources of the trade deficit in medium-high–tech are chemicals and chemical products. In the medium-high–tech category, the imports of basic metals and petroleum products contribute to trade deficit to a great extent. These results suggest that imported products are used in manufacturing goods that are in demand in the domestic market rather than foreign. Hence, Turkey needs reforms to increase its competitiveness and become eligible for providing these goods to foreign markets as well.

Table 3.3: Technological Structure of Trade in Turkey

	1997-2013	1997-2001	2002-2006	2007-2013
Exports				
Low-tech (CAGR)	7.79	0.22	12.02	5.7
Medium-low-tech (CAGR)	13.57	5.62	24.84	5.07
Medium-high-tech (CAGR)	15.41	11.39	24.74	4.37
High-tech (CAGR)	10.69	17.6	15.89	1.12
Total (CAGR)	11.18	5.82	18.95	6.94
Trade Balance				
Low-tech/GDP	2.96	3.48	3.33	2.33
Medium-low-tech/GDP	-1.09	-0.91	-1.23	-1.13
Medium-high-tech/GDP	-4.8	-5.86	-4.85	-4.01
High-tech/GDP	-2.09	-2.18	-1.92	-2.17
Total/GDP	-5.03	-5.46	-4.68	-4.98

Source: TurkStat database and authors' own calculations.

In Table 3.3, a time decomposition of export growth suggests that almost all technology categories had the highest export growth rates between the years 2002 and 2006, and realized a sharp decrease between 2007 and 2013. Also, the deterioration in technological capacity reveals itself in Table 3.3 as well. The growth of high-tech exports was over 15 percent before 2006, whereas high–tech products realized a dramatic fall in export growth rate since then,

increasing by only 1.1 percent. In addition, low-tech export growth was below one percent between 1997 and 2001, but there was a sharp increase in this category's exports in the 2002-2006 period. In the aftermath of 2007, low-tech products realized the largest growth rate compared to other technology sub-groups.

Again, the reforms undertaken between 2002 and 2006 manifested themselves in a lower trade-deficit-to-GDP ratio. It is also important to note that low-tech is the only technology category that realizes a surplus, which primarily comes from textiles and wearing apparel products. Therefore, the Turkish economy mainly specializes in low value-added and low–tech products, and all the other technological categories contribute to the current account deficit.

For a better view of trade figures, we compare Turkey's performance with its competitors. In Table 3.4, exports as a percentage of GDP, current account deficit to GDP and high-tech exports in manufacturing exports of BRICS, MIST, Czech Republic, Poland and Hungary are presented for the latest year available[3]. Turkey's export-to-GDP ratio is higher than or close to Brazil's, South Africa's, India's and Indonesia's, which are the other four economies of the Fragile Five. Especially compared to South Korea, Czech Republic, Hungary and Poland, Turkey's export performance is quite poor. Moreover, Turkey has the highest current account deficit-to-GDP ratio among all selected countries. These findings suggest that economic growth in Turkey is not driven mainly by exports. On top of that, a dependency on imports for production together with a low import coverage of exports contribute negatively to

[3]BRICS countries are Brazil, Russia, India, China and South Africa and MIST countries are Mexico, Indonesia, South Korea and Turkey.

growth figures. We have presented above that Turkey performs poorly in exporting high-tech manufacturing goods. The failures of high-tech production and exporting emerge once again in a comparison with the selected economies. Turkey has the lowest share of high-tech exports in manufactured exports.

Table 3.4: Comparison of Trade Performance with Selected Economies

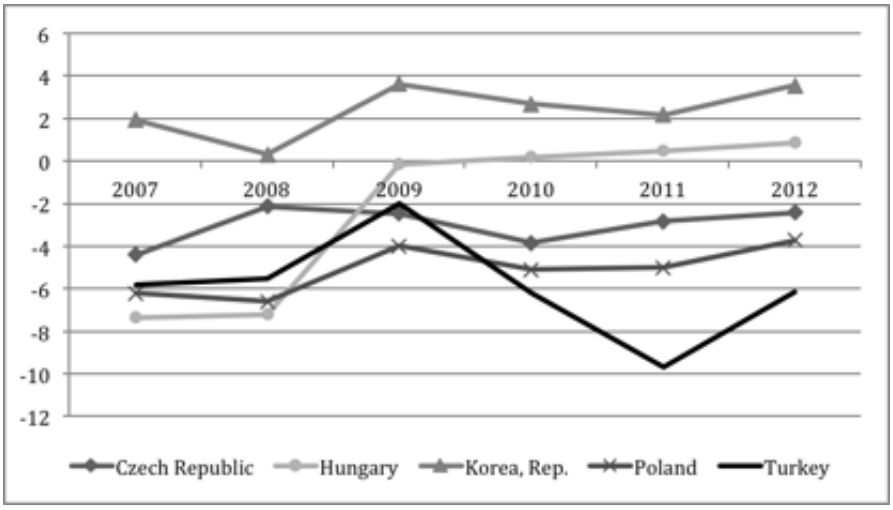
	Country Name Country Name	Exports (% of GDP) (2013)	CA balance (% of GDP) (2012)	High-tech exports (% of manufac.exports) (2012)
BRICS	Brazil	12.59	-2.41	10.49
	Russia	29.59	3.57	8.38
	India	24.00	-4.92	6.63
	China	27.32	2.35	26.27
	South Africa	29.92	-5.24	5.53
MIST	Mexico	32.64	-1.23	16.33
	Indonesia	24.29	-2.75	7.30
	Korea, Rep.	56.34	3.54	26.17
	Turkey	26.30	-6.15	1.83
OTHER	Hungary	94.00	0.90	18.09
	Poland	46.65	-3.73	6.95
	Czech Rep.	78.03	-2.41	16.08

Source: World Bank database.

Among these economies, South Korea, Hungary, Poland and Czech Republic have the highest export-to-GDP ratio. Therefore, to understand the shortcomings of Turkey's trade performance, we provide a detailed comparison of these countries' infrastructural capacities and trade figures. In Figure 3.3 we report the countries' current account-balance-to-GDP ratio between 2007 and 2012. The Korean Republic ran a current account surplus throughout the period. While Turkey had a similar current-account-deficit-to-GDP ratio as other countries before 2010, it now seems like the only economy that has not recovered from the crisis in terms of current account deficit.

Moreover, Turkey had the lowest high-tech manufacturing export share among the listed economies throughout that period (see Figure 3.4). Although South Korea had slightly transformed its export basket from high-tech to low-tech products during this period, that economy still had the highest share for high-tech exports. Although Poland and Turkey had similar shares in 2007,

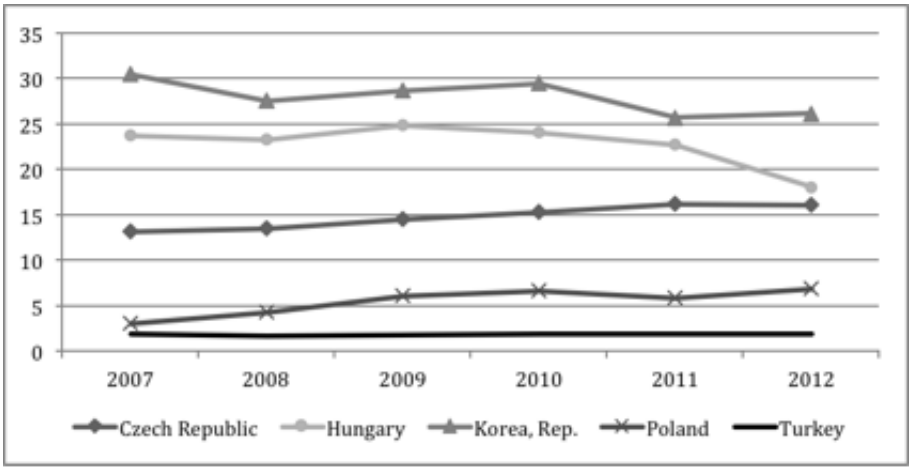
Figure 3.3: CA to GDP (%)



Source: World Bank database.

Poland increased its share of high-tech exports above five percent, whereas Turkey remained at 2007 levels.

Figure 3.4: High-tech export in manufacturing exports (%)



Source: World Bank database.

Therefore, Turkey is trapped in medium- and low-tech exports. Relative to its global counterparts, the technological composition of Turkey's export basket has put a downward pressure on export growth. To understand the lack of comparative advantage in high-tech exports, we present the structural differences between Turkey and the selected economies in Table 3.5. We use

development indicators from the International Institute for Management Development's (IMD) World Competitiveness Data and the World Bank's Doing Business Rankings. Table 3.5 reveals Turkey's weaknesses relative to its comparator countries in terms of human capital. In terms of the illiteracy ratio, pupil-to-teacher ratio in primary education, the Human Development Index and life expectancy at birth, Turkey performs similar to the BRICs average and worse than other selected countries. Although Turkish firms give importance to employee training more than their peers, the ratio of people with higher education as a percentage of the 25-to-34-aged population is the lowest in Turkey. However, the share of population with higher education is prone to mismeasurement. University graduates of one country not necessarily have equal amount of human capital with university graduates of another country. Therefore, in 3.5, the comparison of PISA scores in math, science and reading of the countries is provided. The scores reveal that Turkey's education system is unable to generate even the basic skills of the students which are at the age of 15.

Table 3.5: Comparison of infrastructural capacity with selected economies

Variable/Country	BRICS	South Korea	Turkey	Hungary	Poland	Czech Rep.
Human Capital						
PISA-math (2012)	477*	554	448	477	518	499
PISA-science (2012)	471*	538	463	494	526	508
PISA-read (2012)	469*	536	475	488	518	493
Illiteracy ratio (%, 2011)	9.7	1.7	5.9	1	1	1
Pupil/teacher (primay,2011)	24.9	19.6	21.3	10.5	11	18.8
Higher education (% of 25-34 age pop., 2011)	26.5	64	19	28	39	25
Employee training index (1-10, 2013)	5.5	6.1	5.7	4.6	3.8	5.5
HDI (2012)	0.7	0.9	0.7	0.8	0.8	0.9
Life expectancy at birth (2012)	67.2	80.7	74.2	74.6	76.3	77.8
Technology and Innovation						
Computer (per 1000 people, 2013)	242.4	915.5	157.2	620.9	483.8	643.8
Internet user (per 1000 people, 2013)	352.6	857.5	420.2	735.5	692	817.7
Business R&D to GDP (%, 2010)	0.7	2.9	0.4	0.8	0.2	0.9
Business Environment						
IPR enforcement index (1-10, 2013)	4.9	5.2	4.6	6.2	6.8	6.7
Doing Business Ranking (2013)	95.8	7	69	54	45	75
Access to credit index (1-10, 2013)	4.8	5	6.7	3.5	6.2	6.4

Source: IMD World Competitiveness Database and World Bank Doing Business Rankings.
*Due to data availability, the average includes only Brazil, Russia and Chinese Taipei.

The picture is similar on the innovation side of the story. Business R&D as a percentage of GDP in Turkey lags behind South Korea, Hungary, Czech Republic and Poland. Relatively low intellectual property rights (IPR) protection index of Turkey can be underlying reason of low levels of R&D. Also, both the number of computers and Internet users are lower in Turkey as well.

As it is discussed above, efficient business environment stimulates exports. Moreover, multinational companies prefer destinations where the business environment is more favorable. This issue is important if we consider how the current account deficit is financed. Izmen and Yilmaz (2009) investigate Turkey's trade and FDI performance up to 2008, and suggest that high current account deficits are accompanied by low FDI inflows in Turkey, which puts the country in a risky position. According to the Doing Business Rankings, Turkey ranks lower than South Korea, Hungary and Poland. Therefore, Turkey is not a favorable destination for multinationals relative to its competitors. Overall, the less-preferable business environment in Turkey leads multinationals to invest in other countries rather than in Turkey. On the other hand, Turkey has an advantage over its competitors in terms of access to credit.

Herewith, Turkey requires structural reforms to enhance firms' competitiveness and lead them to participate in global markets more efficiently. In Section 3.3, we discuss how reforms that target higher technological capacity and quality, better skills, easier access to finance and higher FDI inflows would transform Turkey's countenance of global competitiveness. Next, we explain the data set and methodology used for this analysis.

3.2 Data and Methodology

3.2.1 Data

We conduct an analysis of the 2005 "Productivity and the Investment Climate Private Enterprise Survey" carried by the World Bank in Turkey and of the 2008 and 2013 "Business Environment and Enterprise Performance Survey" provided by the European Bank for Reconstruction and Development and the World Bank. The data and questionnaires are freely available to users[4]. The data set includes a stratified random sample of firms at three levels: industry, establishment size and region. There are 3819 observations for 3263 firms, from which only 48 firms had information for all three years; 377 firms had information for 2005 and 2008 whereas 83 firms had information for 2005 and 2013. Given that the panel analysis would suffer from observation issues, we conducted a cross-section analysis for the three years.

To ensure that the results were not driven by outliers, we excluded the largest and smallest firms (the top and bottom five percent) from the sample. The sectors with only a few observations were also excluded (wood, publishing, printing and recorded media, precision instruments, information technology, hotels and restaurants and transportation services). Finally, firms that did not answer questions truthfully or reported unreliable numbers according to the interviewer's perception were not included in the analysis. The final data set of interest includes 2093 observations.

Measurement of variables

[4]http://www.enterprisesurveys.org

1. Dependent variables: Export propensity, export sales and indirect export intensity Export propensity is measured by a dummy variable that takes the value '1' if the firm is exporting and '0' otherwise. Export sales are measured by the natural logarithm of the firm's total export sales. Indirect export intensity is the ratio of indirect exports to total exports.

2. Independent variables:

   (a) Firm size and productivity: Firm size is measured by the number of permanent employees, whereas firm productivity is the ratio of sales to employees. While we expect these two variables to have positive impacts on export performance, we also expect them to contribute negatively to indirect export intensity. Since direct exporting is more costly, it is expected that less-productive and smaller firms are less likely to export directly and have a higher indirect export intensity.

   (b) Human capital: Training is a dummy variable that takes the value '1' if the firm states that they have a formal training program for permanent employees and '0' otherwise. The training indicator captures firms' on-the-job training activities as well as a flow indicator for human capital; in other words, it is a measure of human capital investment. University share is the ratio of employees with a university degree to total employees. University share is a stock measure; it captures the existing qualifications of the firm's employees.

   (c) Innovation: Product innovation is a dummy variable that takes the

value '1' if the firm has introduced a new or significantly improved product(s) during the last three years. Process innovation is also a dummy variable, and takes the value '1' if the firm has introduced a new or significantly improved method(s) for production in the last three years.

(d) Foreign technology transfer: Foreign ownership is a measure of foreign affiliation and is reported directly by firms. Since multinationals are superior to their domestic counterparts in terms of productivity, investment in innovation and human capital, it is expected that higher foreign ownership is positively associated with the firm's export performance. Foreign input is the share of inputs of foreign origin in total inputs. Foreign input use may capture the relaxation of technological constraints through using technologically advanced intermediate inputs.

(e) Access to credit: Loan is a dummy variable that takes the value '1' if the firm has a line of credit or a loan from financial institution. Loan share is the ratio of the value of the loan to total sales of the firm. With this measure we aim to capture a firm's access to financing.

(f) Other variables: Quality certification is a dummy variable that takes the value '1' if the firm has an internationally recognized quality certification and '0' otherwise. This measure is another indicator of a firm's competitiveness in global markets. Website is a dummy variable that takes the value '1' if the firm has a website and '0'

otherwise. It is a variable that captures a firm's ability to promote its products through online marketing.

Table 3.6 reports descriptive statistics for flow variables and Table 3.7 provides information on dummy variables. Out of 2093 firms, 1217 firms report exporting activity. Exporters are more productive and larger in size. Moreover, exporting firms report higher foreign ownership and use more foreign inputs. They also borrow more money relative to their revenues. Thirty-four percent of firms are involved in product innovation, whereas almost half of firms are working on improving an existing product line. Almost 50 percent of firms provide training for their employees and have a quality certification. Most firms report that they have websites and more than 50 percent of them have access to credit. Also, correlation of independent variables used in the below regressions are reported in 3.8 and correlations are all below 0.35.

3.2.2 Methodology

We prefer to use Heckman's sample selection model (two-step) since not only it allows us to distinguish firm characteristics relevant for export propensity and export intensity but also deals with possible selection bias that may arise in the second stage. In the first stage of the procedure, firm characteristics important for export status are analyzed by using Probit:

Table 3.6: Descriptive statistics on flow variables

Variable	N	Mean	Std.
All firms			
Ln (Labor)	2093	3.772458	1.151169
Ln (Sales/Labor)	2093	11.2971	1.18337
Ln (Export)	1217	14.31676	1.861821
University Share	2043	0.1237716	0.1535358
Foreign Ownership	2083	0.0139558	0.0979629
Foreign Input (% of Total Inputs)	1742	0.1986592	0.2799712
Loan/Sales	1916	0.3019302	5.395103
Indirect Exports (% of Total Exports)	1217	0.3104453	0.4045497
Exporters			
Ln (Labor)	1219	4.149495	1.068554
Ln (Sales/Labor)	1219	11.32277	1.159176
University Share	1191	0.1245973	0.14268
Foreign Ownership	1209	0.020397	0.1176185
Foreign Input (% of Total Inputs)	1117	0.249413	0.2925209
Loan/Sales	1123	0.4303278	7.024402
Non-Exporters			
Ln (Labor)	876	3.24779	1.052777
Ln (Sales/Labor)	876	11.26137	1.216002
University Share	852	0.1226174	0.1676164
Foreign Ownership	874	0.0050458	0.0600615
Foreign Input (% of Total Inputs)	625	0.107952	0.2297999
Loan/Sales	793	0.1201009	0.6488867

Table 3.7: Descriptive statistics for dummy variables

	Yes (%)	No Yes (%)
Exporting	58.19	41.81
Training	46.56	53.44
Product Innovation	34.04	65.96
Process Innovation	48.48	51.52
Access to credit	57.73	42.27
Certification	45.89	54.11
Has a website	77.91	22.09

Table 3.8: Correlation between independent variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Ln(size)	1											
2. Ln(prod.)	-0.13*	1										
3. Training	0.33*	0.03	1									
4. University	0.00	0.20*	0.15*	1								
5. Product in.	0.06*	0.06*	0.14*	0.10*	1							
6. Process in.	0.11*	0.00	0.17*	0.08*	0.45*	1						
7. For. own.	0.08*	0.02	0.04	0.07*	0.02	0.01	1					
8. For. inp.	0.13*	0.10*	0.10*	0.15*	0.15*	0.17*	0.09*	1				
9. Loan	0.08*	0.12*	0.08*	0.06*	0.12*	0.14*	-0.01	0.09*	1			
10. $\frac{Loan}{Sales}$	0.01	-0.08*	0.01	0.01	0.01	0.01	-0.01	-0.01	0.05*	1		
11. Quality	0.32*	0.06*	0.31*	0.09*	0.14*	0.05*	0.06*	0.12*	0.07*	0.04*	1	
12. Website	0.22*	0.12*	0.11*	0.11*	0.13*	0.11*	0.03	0.15*	0.10*	0.02	0.25*	1

* Significant at 10% level.

$$Export\,dummy = 1\;if\;\alpha_0 + \alpha_1 Ln(Firm\,size) + \alpha_2 Ln(Firm\,productivity) + \alpha_3 Training$$

$$+\alpha_4 University + \alpha_5 Product\,innovation + \alpha_6 Process\,Innovation + \alpha_7 Foreign\,ownership$$

$$+\alpha_8 Foreign\,input + \alpha_9 Loan + \alpha_{10} Loan\,share + \alpha_{11} Quality\,certification + \alpha_{12} Website$$

where ε_{it} is sector-year fixed effect, δ_r is region fixed effect and ξ_{irt} is the error term. The inverse Mill's ratio (IMR) is calculated from the errors of the first stage and this ratio is included as an independent variable in the second stage:

$$Ln(Export\,sales) = \beta_0 + \beta_1 Ln(Firm\,size) + \beta_2 Ln(Firm\,productivity) + \beta_3 Training$$
$$+\beta_4 University + \beta_5 Product\,innovation + \beta_6 Process\,Innovation + \beta_7 Foreign\,ownership$$
$$+\beta_8 Foreign\,input + \beta_9 Loan + \beta_{10} Loan\,share + \beta_{11} Quality\,certification + \beta_{12} Website$$
$$+\varepsilon_{it} + \delta_r + \xi_{irt}\,if\ export\,propensity = 1$$

If the errors from both stages are correlated then we conclude that there is a selection bias in the second stage and hence Heckman's selection model is more appropriate for deriving unbiased results. To account for nonlinearities driven by firm size, we repeat the same analysis for small and large firms.

Note that we include same independent variables in both stages. Heckman selection two-stage model allows us to run the regression without exclusion restriction. However, this application of the model may lead identification of the model to be questionable. IMR derived from first-stage probit is a nonlinear function of the variables. The second-stage equation is identified because of this nonlinearity even if same independent variables are included in both stages. The nonlinearity of the IMR relies on the assumption that the residuals of the first-stage is normally distributed. Accordingly, we test the normality of the residuals in the first-stage for each regression presented below

and we cannot reject the null hypothesis that standard errors are normally distributed[5].

Finally, to capture the importance of intermediary use in exporting, we conduct an investigation on firm-level characteristics that are related to indirect export intensity and estimate the following regression using ordinary least squares (OLS) with fixed effects:

$$\begin{aligned} Indirect\,exports/Total\,exports = \gamma_0 + \gamma_1 Ln(Firm\,size) + \gamma_2 Ln(Firm\,productivity) \\ +\gamma_3 Training + \gamma_4 University + \gamma_5 Product\,innovation + \gamma_6 Process\,Innovation \\ +\gamma_7 Foreign\,ownership + \gamma_8 Foreign\,input + \gamma_9 Loan + \gamma_{10} Loan\,share \\ +\gamma_{11} Quality\,certification + \gamma_{12} Website + \varepsilon_{it} + \delta_r + \xi_{irt} \geq 0 \end{aligned}$$

One should note that the cross-sectional nature of our data set renders the identification of a causal relationship between export performance and firm-level characteristics. Therefore, we should bear in mind that strict causality cannot be established in the following analysis.

3.3 Empirical Results

In Section 3.3.1, by using the Heckman selection method, we analyze firm characteristics that are important for export propensity and those that lead firms to export more after a successful entry. Moreover, we present additional

[5]For example, normality test of the specification where we include all independent variables in both stages suggest that we cannot reject the null hypothesis that standard errors are normally distributed at 10 % significance level ($Chi2(2) = 2.4839$ and $Prob > chi2 = 0.2888$)

results for different size groups. In Section 3.3.2, we investigate the role of intermediaries in firms' export performance.

3.3.1 Results for export sales and export propensity

The Heckman's two-step procedure results are available in Table 3.8.a. The first panel presents the first-stage results on the probability of exporting, whereas the second panel shows the results of export sales. Column (1) is the benchmark model, where the most important firm characteristics found to be correlated with export behavior in the literature are included in the analysis: firm size and firm productivity. We show that larger and more-productive firms are more likely to export.

Table 3.8.a: Heckman selection estimation results for all firms

First stage-Dependent variable: Exporter dummy									
	1	2	3	4	5	6	7	8	9
Ln(size)	0.46***	0.42***	0.42***	0.43***	0.40***	0.41***	0.33***	0.36***	0.36***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(prod.)	0.16***							0.17***	0.17***
	(0.00)							(0.00)	(0.00)
Training		0.16**	0.12*	0.12*	0.07	0.06	0.01	0.00	0.01
		(0.02)	(0.09)	(0.09)	(0.33)	(0.48)	(0.88)	(0.99)	(0.90)
University		0.41	0.31	0.36	0.18	0.01	-0.15	-0.29	-0.28
		(0.12)	(0.24)	(0.18)	(0.53)	(0.99)	(0.63)	(0.35)	(0.37)
Product in.			0.36***		0.29***	0.33***	0.28***	0.28***	
			(0.00)		(0.00)	(0.00)	(0.00)	(0.00)	
Process in.				0.24***					0.13
				(0.00)					(0.14)
For. own.					0.41	1.13**	1.11**	1.21**	1.20**
					(0.32)	(0.04)	(0.04)	(0.03)	(0.03)
For. inp.					0.96***	0.96***	0.90***	0.88***	0.90***
					(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Loan						0.09	0.10	0.06	0.06
						(0.23)	(0.18)	(0.46)	(0.43)
$\frac{Loan}{Sales}$						0.02	0.01	0.04	0.04
						(0.49)	(0.54)	(0.55)	(0.55)
Quality							0.37***	0.34***	0.36***
							(0.00)	(0.000)	(0.000)
Website							0.29***	0.26***	0.27***
							(0.00)	(0.01)	(0.00)
Constant	-3.73***	-1.93***	-2.02***	-2.06***	-1.91***	-2.00***	-2.05***	-3.97***	-3.96***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.000)
N	2093	1855	1851	1848	1681	1566	1497	1497	1495
Wald chi2	1380.6	295.9	303.2	353.8	376.1	377.0	379.8	1428.2	1392.7
Prob>chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ind.*year fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The numbers in parenthesis denote p-values. $***$, $**$ and $*$ indicates the statistical significance at the 1%, 5% and 10%, respectively.

Column (1) implicitly assumes that other firm characteristics such as human capital indicators, innovation and foreign technology transfer indicators

all have indirect relations with exports through their direct relations with firm productivity. However, all of these factors can also have a direct relation with exports beyond their indirect relation with productivity enhancement. With the results in columns (2) to (6), we argue that these firm characteristics do not play a role through firm productivity, but rather have actual direct relationship with export behavior.

We first add human capital in column (2). The university share of employees does not have a robust significant relationship with the probability of exporting. On the other hand, if a firm that trains its workers, it has higher probability of exporting. However, this result is not robust to the inclusion of more control variables.

The innovative activities of a firm that targets product and process innovations are found to be positively associated with export propensity (columns (3) and (4)). A firm that develops a new product is 10.5 percent more likely to export. The marginal effect of new product on exporting probability ranges between 7.7-9.4 percent across specifications. A firm that upgrades a product line is 7.2 percent more likely to export. However, process innovation becomes insignificant once we control for labor productivity in column (9). We thus conclude that it is product rather than process innovation that matters in the probability of exporting[6]. This finding is consistent with Caldera (2010) and Turco and Maggioni (2015).

In column (5) we add the foreign technology transfer indicators: foreign ownership and foreign input. Although the coefficient of the foreign ownership

[6]Therefore, in the rest of the analysis we present results with product innovation.

is insignificant in Column (5), it becomes significant as we control for more variables. A 10 percent increase in foreign affiliation is associated with 0.03 higher probability of exporting. This finding is in line with our expectations, following Girma et al. (2005). Also, the use of foreign inputs is positively related with the probability of exporting. These results together emphasize the importance of participating in global value chains (GVCs) to compete in foreign markets.

In column (6) we add financial market access indicators. Although the signs of access to credit variables are consistent with the expectations, the results suggest an insignificant relation between easier access to credit and export propensity. Finally, having an internationally recognized quality certification and a website are positively associated with firm's export probability, as can be seen from columns (7)-(9).

In Table 3.8.b, second stage results of Heckman selection are presented. The usual suspects contribute both to export propensity and export sales: larger and more-productive firms are more likely to export, and once they export they are more likely to have higher export sales. An increase in university graduates within a firm is negatively related to export sales once we control for productivity. This result may suggest that it is skills rather than a university degree that matters. In developing countries like Turkey, where skill mismatch is highly present, university share is not a good proxy for human capital. Köymen-Özer and Sayek-Böke (2014) show that skilled job positions capture human capital better than employee education level[7]. Therefore, pay-

[7]However, we cannot test this hypothesis here since detailed job characteristics are not available in our data set.

ing a higher wage to university graduates who may not fulfill job requirements may bring lower export sales. Moreover, we show that production innovation only matters for export market participation since the second stage results imply that innovation does not have a relation with export sales. This finding is consistent with Ganotakis and Love (2011) who also suggests product innovators are more likely to export, but conditional on entry, innovation does not increase export intensity. Finally, foreign ownership is found to be positively related with both export propensity and export intensity.

Table 3.8.b: Heckman selection estimation results for all firms

Second stage-Dependent variable: Ln(total exports)									
	1	2	3	4	5	6	7	8	9
Ln(size)	1.29***	1.39***	1.39***	1.35***	1.29***	1.28***	1.18***	1.20***	1.20***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(prod.)	1.01***							1.02***	1.02***
	(0.00)							(0.00)	(0.00)
Training		0.27*	0.24*	0.22*	0.19	0.19	0.07	-0.03	-0.02
		(0.07)	(0.09)	(0.08)	(0.12)	(0.11)	(0.58)	(0.69)	(0.77)
University		0.80*	0.74	0.71*	0.46	0.28	0.11	-0.79***	-0.82***
		(0.09)	(0.12)	(0.09)	(0.27)	(0.51)	(0.80)	(0.00)	(0.00)
Product in.			0.21		0.14	0.18	0.09	-0.10	
			(0.24)		(0.33)	(0.24)	(0.53)	(0.25)	
Process in.				0.17					-0.09
				(0.27)					(0.30)
For. own.					0.78	1.20**	1.13**	0.63*	0.63*
					(0.11)	(0.02)	(0.03)	(0.05)	(0.05)
For. inp.					0.75**	0.69**	0.56**	0.16	0.15
					(0.01)	(0.02)	(0.05)	(0.36)	(0.40)
Loan						0.23**	0.29**	0.043	0.051
						(0.04)	(0.01)	(0.56)	(0.49)
$\frac{Loan}{Sales}$						-0.01	-0.01	0.00	0.00
						(0.25)	(0.13)	(0.47)	(0.49)
Quality							0.52***	0.09	0.07
							(0.00)	(0.38)	(0.51)
Website							0.44**	0.18	0.17
							(0.01)	(0.12)	(0.15)
Constant	-2.98**	7.12***	7.11***	7.44***	7.78***	7.68***	7.71***	-2.62**	-2.52**
	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.02)
N	1217	1129	1127	1123	1075	1007	969	969	966
Wald chi2	1380.6	295.9	303.2	353.8	376.1	377.0	379.8	1428.2	1392.7
$Prob > chi2$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ind.*year fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The numbers in parenthesis denote p-values. $***$, $**$ and $*$ indicates the statistical significance at the 1%, 5% and 10%, respectively.

Therefore, several of the infrastructure reforms that will push domestic firms to become exporters are also those that will push them to export more, such as those that will contribute to making the firm productive and those that will increase foreign partnerships. The participation in GVCs through involvement in foreign partnerships is significantly important to elevate the

technological capacity of domestic firms. In-house innovation that would lead developing new products is essential for better export performance. It is of utmost importance to note that all of these are the issues that have to be tackled through structural reforms[8].

We decompose the Heckman selection estimation results for SMEs and large firms in Table 3.9. In the first panel we present the results of the first-stage regression for both types of firms and present the second stage in the second panel. The probability of becoming an exporter is associated with different factors for small and large firms. Firm productivity and size are more important for small- and medium-sized firms. As firms grow, initially size and productivity matters for export performance, but after a certain threshold other firm characteristics become more important.

Table 3.9: Heckman selection estimation results by size

	First Stage				Second Stage			
	Employment≤100		Employment>100		Employment≤100		Employment>100	
Ln(size)	0.532***	0.440***	-0.0449	-0.287	1.364***	1.240***	0.924***	1.089***
	(0.000)	(0.000)	(0.777)	(0.164)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(prod.)	0.149***	0.181***	0.165***	0.0955	0.983***	0.966***	1.124***	1.042***
	(0.000)	(0.000)	(0.009)	(0.243)	(0.000)	(0.000)	(0.000)	(0.000)
Training		-0.0315		0.234		-0.0810		0.0547
		(0.746)		(0.266)		(0.411)		(0.676)
University		-0.487		0.358		-0.680*		-0.695
		(0.183)		(0.644)		(0.063)		(0.109)
Product in.		0.250**		0.377*		-0.179		-0.187
		(0.013)		(0.076)		(0.132)		(0.134)
For. own.		1.378**		1,164		0.889*		0.220
		(0.049)		(0.257)		(0.059)		(0.606)
For. inp.		0.834***		1.457***		0.118		-0.0730
		(0.000)		(0.001)		(0.629)		(0.761)
Loan		-0.00857		0.0551		0.0535		-0.0825
		(0.925)		(0.792)		(0.554)		(0.513)
$\frac{Loan}{Sales}$		0.0111		1.968**		0.00116		0.00505
		(0.591)		(0.019)		(0.876)		(0.409)
Quality		0.436***		-0.0322		-0.0423		0.190
		(0.000)		(0.882)		(0.782)		(0.169)
Website		0.282***		0.0433		0.292**		-0.229
		(0.009)		(0.864)		(0.047)		(0.190)
Constant	-3.777***	-4.239***	-1,351	-0.0919	-2,869	-1,911	-3,077	-1,485
	(0.000)	(0.000)	(0.258)	(0.952)	(0.202)	(0.231)	(0.392)	(0.158)
N	1560	1069	533	428	783	613	434	356
Wald chi2	910.5	871.4	118.5	551.3	910.5	871.4	118.5	551.3
$Prob > chi2$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ind.*year fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The numbers in parenthesis denote p-values. $***$, $**$ and $*$ indicates the statistical significance at the 1%, 5% and 10%, respectively.

[8]We also decompose these results for different years in Appendix D and show variables that matter continue to be important in different years as well.

In-house innovation activities and foreign inputs continue to be important factors for all firms in becoming exporters. We also show that the higher the value of the loan, the higher the probability of exporting for large firms. This finding may suggest that to benefit from access to credit, a firm needs to become more productive and larger. Foreign partnership is more important for smaller firms' export propensity. Moreover, for smaller firms, forming partnerships (FDI) is important as much as becoming part of GVCs through only input purchases. However, for larger firms, partnerships are not necessary. Quality certification and marketing are relevant factors for the probability of exporting for smaller firms rather than larger firms. Hence, better marketing is essential for small- and medium-size firms to start exporting.

The extent of exporting is also associated with different factors across different-sized firms. Firm size and productivity are positively correlated with export sales for all firms. Therefore, structural reforms that enhance productivity are much needed; if reforms had been developed and implemented, more firms would be exporting and those that already export would be doing more of it. There is a negative relation between the share of university graduates and export sales, which is consistent with our explanation above: since university graduates are more costly, hiring more university graduates may have a negative impact on the export sales of small- and medium-sized firms.

3.3.2 Results for indirect export intensity

Ahn et al. (2011) theoretical model suggests that smaller and less productive firms that cannot overcome trade costs are more likely to export indirectly via

trade intermediaries. Therefore, trade intermediaries increase the likelihood of exporting for small and less productive firms. In this section, we test whether these results are valid for Turkish firms. In other words, we analyze the role of firm-level characteristics that lead them to use trade intermediaries to be able to export their products. The results from OLS with fixed effects model are presented in Table 3.10. Column (1) is again the benchmark model. A 10 percent increase in productivity is associated with a decrease indirect exports' share by 0.27. Similarly, a 10 percent increase in firm size via employment is associated with 0.65 fall in indirect exports' share. These results are consistent with the model developed by Ahn et al. (2011); less productive and smaller firms are not able to cover higher fixed cost of direct exporting. Therefore, combining these results with findings of previous section reveals that as firms become more productive and larger in size, not only their export performance improve but also they start to export directly.

The share of university graduates and training activity provided by the firm measure the abilities of the firm's employees. The firms that provide training or firms with more university graduates have less indirect export intensity. This finding may result from the fact that firms able to employ more educated workers are more likely to be producing technologically advanced and competitive products (Abel-Koch (2013)). Hence, these firms are more likely to cover direct export costs and do not rely on trade intermediaries to export.

The sign of product innovation is consistent with the previous findings in the literature. Firms that develop a new product sell higher proportion of its products through trade intermediaries. The intuition behind this finding may

Table 3.10: Export Mode - Dependent variable: indirect exports/total exports

First stage-Dependent variable: Exporter dummy									
	1	2	3	4	5	6	7	8	9
Ln(size)	-0.06***	-0.05***	-0.06***	-0.06***	-0.05***	-0.06***	-0.03**	-0.04***	-0.04***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.012)	(0.00)	(0.00)
Ln(prod.)	-0.03**							-0.02**	-0.02*
	(0.01)							(0.04)	(0.05)
Training		-0.04*	-0.05*	-0.04*	-0.06**	-0.06**	-0.04	-0.04	-0.03
		(0.09)	(0.06)	(0.08)	(0.02)	(0.03)	(0.15)	(0.17)	(0.25)
University		-0.28***	-0.29***	-0.28***	-0.27***	-0.30***	-0.24***	-0.22**	-0.21**
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.02)	(0.02)
Product in.			0.05*		0.04*	0.04	0.04	0.04	
			(0.06)		(0.09)	(0.15)	(0.12)	(0.11)	
Process in.				-0.01					-0.03
				(0.62)					(0.30)
For. own.					0.04	0.06	0.08	0.08	0.08
					(0.72)	(0.56)	(0.49)	(0.47)	(0.48)
For. inp.					-0.04	-0.06	-0.05	-0.05	-0.04
					(0.30)	(0.20)	(0.31)	(0.31)	(0.33)
Loan						0.01	0.01	0.02	0.02
						(0.79)	(0.56)	(0.44)	(0.34)
$\frac{Loan}{Sales}$						-0.00**	-0.00**	-0.00***	-0.00***
						(0.04)	(0.02)	(0.00)	(0.00)
Quality							-0.08***	-0.07**	-0.07**
							(0.01)	(0.02)	(0.02)
Website							-0.13***	-0.13***	-0.13***
							(0.00)	(0.00)	(0.00)
Constant	0.78***	0.48***	0.47***	0.50***	0.47***	0.48***	0.54***	0.84***	0.87***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
N	1217	1129	1127	1123	1075	1007	969	969	966
R-sq	0.090	0.102	0.104	0.103	0.101	0.110	0.132	0.136	0.138
Ind*y fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The numbers in parenthesis denote p-values. $***$, $**$ and $*$ indicates the statistical significance at the 1%, 5% and 10%, respectively.

be as follows: A firm that produces a new product should spend more time and resources to identify its new customers. Since trade intermediaries have better networks, they can introduce the new product at a lower cost than firm itself (Ahn et al. (2011)). However, firms that upgrade an existing product do not require any search for new customers. The negative coefficient of process innovation may reflect this fact, however, the coefficient of this variable is insignificant across all specification.

Foreign technology transfer measures do not seem to matter for the export mode. Firms with higher amounts of loan compared to its sales have higher direct export intensity. A potential explanation of this finding would be that firms with better access to finance are able to cover higher cost of direct exporting. However, the coefficient is not economically significant. Finally, firms that have quality certification for their products and a website for marketing

purposes have the flexibility of directly selling their own products. Therefore, firms have better marketing practices do not require trade intermediaries to export their products.

3.4 Conclusion

In this chapter, we aim to provide a comprehensive investigation of Turkey's trade performance between 1996-2013. First, we present trade figures from selected countries and discuss the structural factors that lead Turkey to lag behind its global competitors. Turkey's technological incompetency becomes prominent in a cross-country descriptive analysis. The Turkish economy specializes in mostly low- and medium-tech products and has been unable to add high-tech products to its export basket. Upgrading to a high value-added and technologically advanced export basket is key to increasing the country's global competitiveness. In our firm-level analysis, we show that productivity-enhancing micro-level policies pay off and increase the likelihood of Turkish firms becoming exporters. We show that innovative activity, particularly product innovation, participation in GVCs and better marketing are the key drivers of successful export performance.

Also, the findings suggest that since trade intermediaries allow smaller and less productive firms to export and increase their scale, intermediary firms increase the export performance of the country[9].

[9]However, trade intermediaries in Turkey is not responsible for identifying markets and clients abroad and establishing networks. Second biggest trade intermediary firm in Turkey, Pergamon, posts this information about the their responsibilities on their website: http://www.psdisticaret.com.tr/icerik-ayrinti.php?id=7. Therefore, policies that encourage trade intermediaries to connect exporters with their appropriate clients would benefit smaller firms to a great extent.

From a policy point of view, given the crucial role of innovation in determining a firm's productivity and export behavior, it is important for government to take these interactions into account and implement productivity-enhancing policies. Also other productivity-enhancing and export-friendly structural reforms should include those that attract FDI, ease access to technologically advanced inputs and improve marketing performance. Finally, promoting trade intermediaries' role in helping small- and medium- size exporters to find their customers abroad would increase the participation of these firms to exporting.

CHAPTER 4

EXPORTING BY IMPORTING: MEASURING TRADE IN VALUE ADDED TERMS

Global value chains (GVCs) have changed the structure of international trade, increased competition and co-dependency between countries. With the dramatic growth of outsourcing practices, the competition between companies has transformed into a vertical one, i.e. firms in the same value chain competing to provide specific and specialized tasks, from being horizontal, i.e. firms in the same sector competing for the same customer-base. Technological advances (particularly in information and communication technologies [ICTs]), political developments (including the integration into the world economy of formerly closed countries as well as multilateral and bilateral trade agreements), and business strategies (in particular the focus on core competence and on increased flexibility) all allowed companies to leverage countries' differences in endowments and input costs. As a result, competition between countries has become vertical, consistent with the vertical competition between firms.

The vertical competition between countries is driven by several forces: the

interaction between traditional cost advantages, institutional factors, and proximity to the final consumer. On the one hand, cost advantages lead firms to operate in the location that has the lowest production costs. On the other hand, institutional factors in host countries may offset cost-based advantages (such as political instability or an unfriendly business environment). There may also be benefits of locating close to other adjacent value chain stages and/or to final demand (agglomeration advantages) which would reduce transport costs, increases the timeliness of delivery and generates fewer coordination problems. Therefore, within a GVC, countries tend to specialize in different stages of production. Costinot et al. (2012) define this as the division of operations "all performed by distinct hands" envisioned by Adam Smith in 1776. This phenomenon is defined as vertical specialization by Balassa and Findlay, slicing up of the value chain by Krugman, and in many other ways by other economists, including fragmentation, production sharing, or global production networks. This production structure in which tasks are fulfilled by globally or regionally dispersed companies suggest that it is "Tasks" rather than sectors define the specialization of countries in the value chains (Grossman and Rossi-Hansberg (2008)).

Therefore, as countries compete with each other to attract jobs and investment, they also depend on each others demand, capital and production. Koopman et al. (2011) suggest that there are two dimensions of vertical integration between countries and build a country-specific measure for GVC participation. The higher the foreign value added embodied in gross domestic exports and the domestic value added embodied in foreign countries gross

exports, the higher the GVC participation of a country. In other words, participation index measures to what extent domestic economy's exports depend on other countries' production and how much other countries depend on domestic country's exports. Since the focus of this chapter is growing trade deficit of Turkey, we analyze the former dimension. In other words, we examine the vertical integration of Turkish economy to production networks by analyzing the dependency of the country's exports on other countries' production.

For a developing country like Turkey, the import content of production and exports is a critical aspect of the economy that needs to be analyzed since it has been accepted as an important driver of trade deficit. From 2002 to 2013, the ratio of trade deficit to GDP almost doubled from 6.7% to 12.2%. In the same period, imports as a percentage of GDP rose by 8.2 percentage-points (from 22.4% to 30.6%) whereas exports to GDP ratio increased only by 2.9 percentage points (from 15.6% to 18.5%). Accordingly, exports coverage of imports fell from 70% to 60%[1]. Although, these facts implicitly point to import dependency of Turkish exports, a more detailed investigation of export structure is needed to understand the extent of import dependency.

There are several studies that investigate the import dependency of production and/or exports of Turkey. Saygılı and Saygılı (2011) compute income, import and exchange rate elasticity of Turkish exports. The study concludes that as the dependency of Turkish exports to global conditions and other countries' production increase, the dependency has been deepened by decreasing exchange rate elasticity of exports. Türkan and Yükseler (2006) use input-

[1] All percentages are calculated by using TurkStat data. The numbers provide information on trade excluding services.

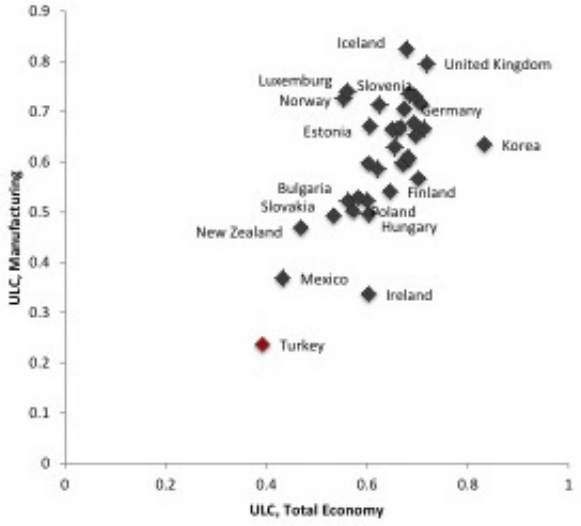
output table of 1998 provided by Turkstat and compute the extent of intermediate import use in manufacturing by sub-industries. Their results suggest that the industries that are more import dependent in 1998 present higher growth rates between 1998-2005. Therefore, the authors conclude that import dependency of manufacturing production increased in this period. Saygili et al. (2010) compute the import dependency by using 1998 and 2002 input-output tables and find that production in all manufacturing industries, except food and chemical products, has become more import dependent.

This chapter contributes to the ongoing discussion by providing a detailed investigation of manufacturing exports' dependency on intermediate imports. First, foreign and domestic value added embodied in Turkish manufacturing exports are analyzed and compared with similar countries by using Trade In value added (TIVA) database provided by OECD-WTO. TIVA provides useful measures that contain information on co-dependency between countries which are calculated from the OECD Input-Output Tables Bilateral Trade in goods by Industry and End-use (BTDIxE), International Trade in Services (TIS) and Structural Analysis (STAN) industry databases.

Since the domestic value added of exports highly depends on which stages of the production a country specializes in, in the second part of the analysis we aim to identify production stages of an industry which Turkey concentrates in. A country's domestic value added of exports differs between industries depending on country-specific characteristics such as skill supply, technological development etc. Moreover, these characteristics lead firms to concentrate on higher or lower value added activities within an industry. Turkey is a de-

veloping country with important labor cost advantages, in particular when compared to regional trade partners. Figure 4.1 shows that its exchange rate-adjusted unit labor costs (UCL) are the lowest in the region and across OECD countries. Does Turkey exploit its comparative advantage of low unit labor costs by specializing in labor-intensive manufacturing and assembly activities? Or is Turkey following the example of emerging countries and gradually entering into more capital- and knowledge-intensive activities? By using Comtrade database and firm-level data from Turkstat, we examine these questions in detail for three key industries of Turkey: food, textiles and motor vehicles.

Figure 4.1: Unit labor costs in OECD countries and selected non-OECD countries, exchange rate adjusted (2006)



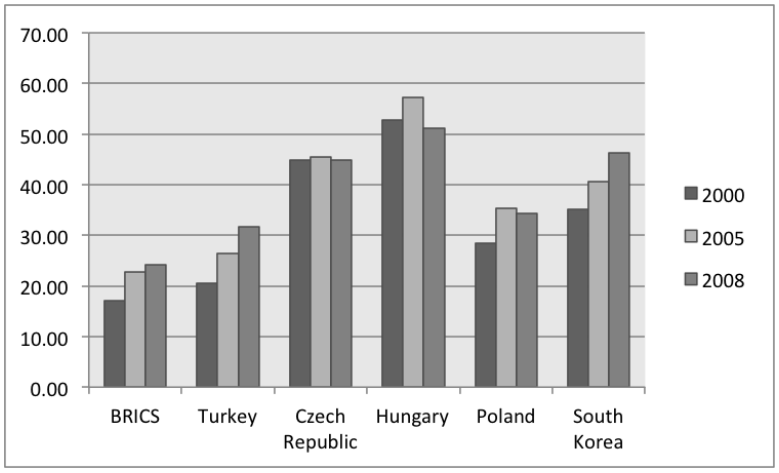
Source: OECD. 2006 is the latest year for which ULC data for Turkey are available.

In the following section, we discuss domestic and foreign value added components of Turkish manufacturing exports and compare the country's structure with its peers. In Section 4.2, we delve into details of domestic value added creation in three key industries and we conclude in Section 4.3.

4.1 Trade in value added

This section presents value added decomposition of Turkish manufacturing exports and compares the structure of manufacturing trade with selected economies. Figure 4.2 reports foreign value added embodied in manufacturing exports as a percentage of total manufacturing exports of Turkey and compares import dependency of Turkish exports with BRICS[2], Czech Republic, Hungary and Poland countries, in 2000, 2005 and 2008. Among these countries, Turkey has the largest current account deficit to GDP ratio (See Chapter 3)[3]. Hence, it is important to compare Turkey's export structure with these economies in order to build a link between import dependency of exports and current account deficit.

Figure 4.2: Foreign value added in manufacturing exports to manufacturing exports (%)



Source: Author's own calculations from TIVA provided by OECD-WTO.

In all years, foreign value added share of Turkish manufacturing exports is slightly higher than BRICS average and lower than the rest of the selected

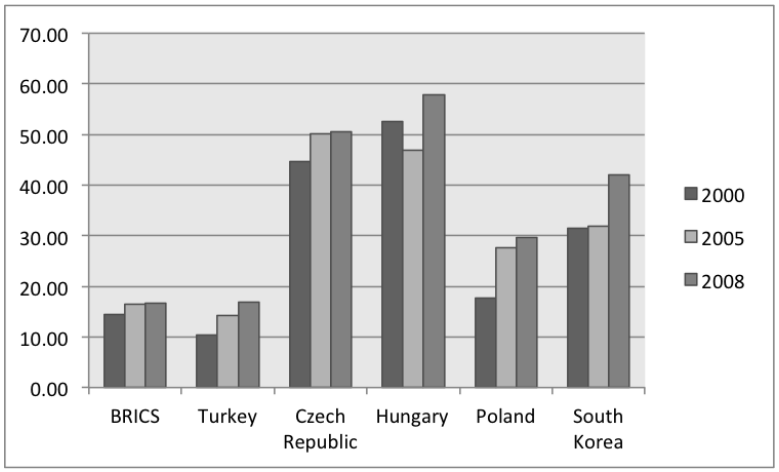
[2]BRICS countries are Brazil, Russia, India, China and South Africa.
[3]In 2012, Russia, China and South Korea have current account surplus

economies. This result may seem somewhat surprising since Turkey is accepted as one of the countries that depend on intermediate imports for production. However, there are at least two reasons to read this results carefully. First, OECD calculates the domestic value added of exports under the assumption that there is no difference in the input-output coefficients of a country's production for goods absorbed at home versus its production for exports. Koopman et al. (2012) allow processing exports to take different input-output coefficients for different markets and find that foreign content in Chinese exports is almost twice as high as that calculated under non-varying input-output coefficients. Therefore we should keep in mind that among the economies in Figure 4.2, those with higher processing exports might also have higher foreign content in their exports than what is reported. Second, these countries not only differ in foreign content of their exports but also in their export performance. Hence, the evaluation of foreign content together with export performance throughout time would provide more accurate information.

A comparison of same countries according to their manufacturing export-to-GDP ratio is presented in Figure 4.3. Together with BRICS, Turkey has the lowest manufacturing exports relative to its GDP. Therefore, although other countries have higher foreign value added embodied in their manufacturing exports, they are able export higher portion of their GDP.

Although foreign content of manufacturing exports has remained constant in Czech Republic and Hungary between 2000 and 2008, their manufacturing export-to-GDP ratio increased by over 5 percentage points. Therefore, these countries have managed to increase their exports without increasing the foreign

Figure 4.3: Manufacturing exports to GDP (%)



Source: Author's own calculations from TIVA provided by OECD-WTO.

content of their exports. Although, foreign content of Polish manufacturing exports have increased in the same period, this is accompanied by an increase in export-to-GDP ratio to a greater extent. In South Korea, both foreign value added in exports and export-to-GDP ratio increased by 10-11 percentage points. In Turkey, 6.5 percentage point increase in manufacturing export-to-GDP is accompanied by 11 percentage point increase in foreign value added share. As Turkey increases its exports relative to its GDP, the rise in exports comes with a cost; import dependency of exports has increased more than the rise in export-to-GDP. This is also the case BRICS countries.

To provide different aspects of import dependency, Table 4.1 reports import structure in these selected economies for the year 2005. BRICS countries and Turkey presents similar import structure and have a import-to-GDP ratio around 25%. In Poland and South Korea this ratio is around 35% whereas in Czech Republic and Hungary it is close to 60%.

The second and the third rows of Table 4.1 suggest that in all of these economies intermediate imports constitute the largest component of total im-

Table 4.1: Intermediate Imports - 2005

	BRICS	Turkey	Czech Rep.	Hungary	Poland	S. Korea
$\frac{Imports}{GDP}$	23.5	24.2	58.9	61.0	36.1	35.3
$\frac{Intermediate\ imp.}{Imports}$	64.8	62.4	66.3	71.9	63.0	74.6
$\frac{Intermediate\ imp.\ used\ in\ manuf.}{Intermediate\ imp.}$	67.8	68.5	71.2	75.0	67.0	77.7
$\frac{Intermediate\ imp.\ used\ in\ manuf.\ exp.}{Intermediate\ imp.\ used\ in\ manuf.}$	32.1	26.8	60.6	60.7	52.0	49.3

Source: Author's own calculations from TIVA provided by OECD-WTO.

ports (varying between 62% to 75%) and these intermediate imports are mostly used in manufacturing sector (percentage varying between 67% to 75%).

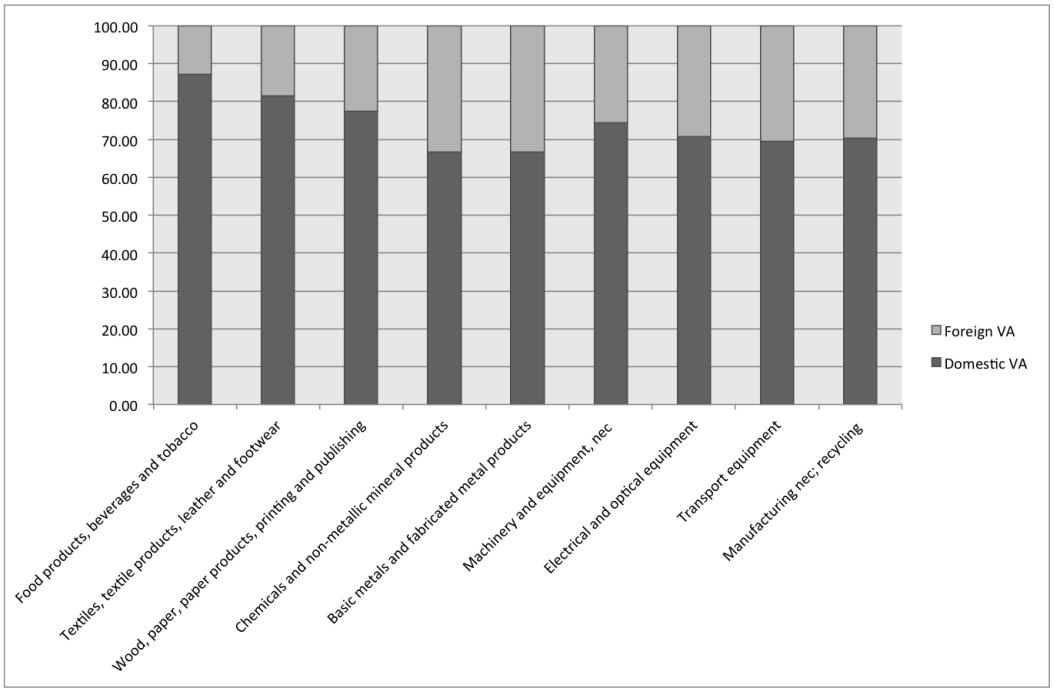
The last row reports the share of intermediate imports used in exports as a percentage of total intermediate imports in manufacturing sector. In Czech Republic and Hungary, 40% of intermediate imports used in manufacturing sector are re-exported which is not surprising since these countries export higher proportion of their production. In South Korea and Poland, almost half of the intermediate imports are used in exports whereas in BRICS economies and Turkey the shares are 32.1% and 26.8%, respectively.

Turkey and BRICS economies depend on intermediate imports for production. However, intermediate imports used in manufacturing end up being sold domestically rather than being exported. These results can be interpreted as follows. Since Turkey and BRICS economies' export performance is relatively poor, these countries are able to sell smaller fraction of their goods that use imported intermediates.

Next, we analyze value added structure of Turkish manufacturing sector by sub-industries. Foreign value added embodied in exports may differ between industries for each country depending on country's technological capacity, skill scarcity, natural resources, political and geographical characteristics, etc. For

example, in a labor-abundant country, labor-intensive industries such as food, textiles and wood have higher domestic value added in exports while capital-intensive industries have higher foreign value added in exports. Figure 4.4 presents value added decomposition of Turkish exports by each manufacturing industry in 2005. Among these industries, food and textiles exports have the highest domestic value added whereas chemicals, basic metals and transport equipment exports have the highest foreign value added.

Figure 4.4: Domestic and foreign value added by industry-2005

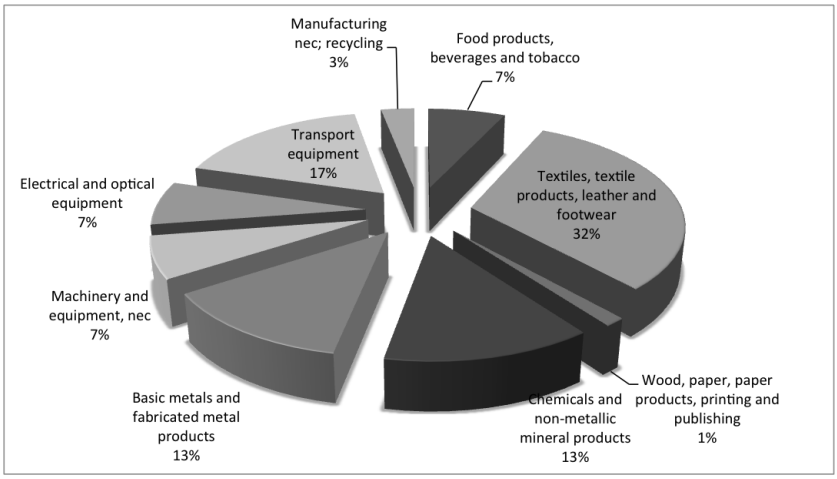


Source: Author's own calculations from TIVA provided by OECD-WTO.

Figure 4.5 reports each industry's contribution to total domestic value added embodied in manufacturing exports. Besides having the highest domestic value added, textiles industry also constitutes the largest component of total domestic value added in exports. Food industry, on the other hand, is one of the least intermediate import dependent industry but it constitutes only 7% of total domestic value added. Although, chemicals, basic metals

and transport equipment industries are the most import dependent industries within Turkey, each contribute to domestic value added to a great extent; they constitute 13%, 13% and 17% of total domestic value added of Turkish exports, respectively.

Figure 4.5: Contribution of industries to exports' domestic value added - 2005



Source: Author's own calculations from TIVA provided by OECD-WTO.

Table 4.2 reports Turkey's revealed comparative advantages (RCA) in these industries and compares to its peers. RCA basically measures the share of an industry's exports in a countrys total exports relative to its share in world exports. However, RCA in Table 4.2 is based on domestic value added embodied in total exports rather than total exports. Therefore, this adjusted measure reflects country's revealed comparative advantage more accurately. If $RCA > 1$, the industry has revealed comparative advantage and if $RCA < 1$ it has revealed comparative disadvantage in domestic value added embodied in exports.

Among all industries and all countries Turkish textiles industry by far has the highest revealed comparative advantage. India and China are other countries with comparative advantage in textiles. Turkey has revealed comparative

Table 4.2: Revealed Comparative Advantage (RCA) based on Domestic Value Added - 2005

	Brazil	Russia	India	China	S.Africa	Turkey	Czech R.	Hungary	Poland	S.Korea
Food	2.98	0.26	0.96	0.41	1.42	0.95	0.67	0.87	1.64	0.39
Textiles	0.71	0.09	3.22	2.92	0.30	4.37	0.77	0.54	0.75	0.86
Wood	1.25	1.26	0.30	0.43	1.29	0.23	1.05	0.51	1.44	0.27
Chemicals	0.86	1.87	0.99	0.57	1.15	0.65	0.90	0.92	0.96	0.85
Metals	1.50	3.47	1.15	0.95	3.28	1.25	1.52	0.85	1.28	0.86
Machinery	0.65	0.85	0.40	0.94	N/A	0.62	1.08	0.80	0.77	0.75
Electrical	0.29	0.14	0.32	1.51	0.14	0.37	0.66	1.69	0.49	1.73
Transport	1.19	0.24	0.32	0.32	0.88	1.13	1.36	1.10	1.05	1.37
Other	0.41	0.10	5.57	2.26	1.65	0.80	1.20	0.42	1.98	0.31

Source: TIVA provided by OECD-WTO.

disadvantage in food sector in 2005 though RCA is close to 1[4]. In food industry, only Brazil, South Africa and Poland have comparative advantage. The countries that have comparative advantage in chemicals industry are Russia and South Africa. Czech Republic is the only country with $RCA > 1$ in machinery and equipment industry. South Korea and China are the only countries with $RCA > 1$ in electrical equipment. In transportation equipment industry, all countries except BRICS (but including only Brazil) have revealed comparative advantage.

Results of this section can be summarized as follows:

1. Although foreign value added embodied in exports are low in Turkey compared to its counterparts, the country requires more intermediate imports than its competitors to increase its exports relative to GDP. Therefore, to lower its trade deficit, Turkey needs to increase its exports relative to GDP by simultaneously increasing its domestic value added embodied in exports.

2. Similar to other countries, intermediate imports constitute largest portion of Turkey's imports and these imported intermediates are mostly

[4]In 2000, Turkey has revealed comparative advantage in food sector. Therefore, country lost its comparative advantage in mid-2000s

used in manufacturing sector. However, in contrast to other countries, the goods that are produced out of these intermediate imports end up being sold domestically rather than being exported. (This result is related to export performance of Turkey which is the focus of Chapter 3.)

3. Turkish textiles exports are less import dependent compared to other industries' exports. Moreover, domestic value added embodied in textiles exports constitute the highest portion of total domestic value added embodied in Turkish manufacturing exports. High domestic value added generated by Turkish textiles exports reveals itself in the comparison of countries in terms of RCA. Among all industries and all selected countries Turkish textiles exports has the highest revealed comparative advantage.

4. Although transport equipment exports are most import dependent exports of Turkish manufacturing industry, the industry constitutes the second highest portion of total domestic value added embodied in manufacturing exports. Moreover, Turkey has revealed comparative advantage in transport equipment industry.

5. Although food exports are the least import dependent exports of Turkish manufacturing industry, industry's contribution to total domestic value added in exports is relatively low. In 2005, Turkey lost its revealed comparative advantage in food industry that it had in 2000.

4.2 Key Industries

In Section 4.1, we conclude that it is important to increase exports relative to GDP by simultaneously increasing the domestic value added embodied in exports. Domestic value added embodied in exports depends on stages of production within an industry and technological content of goods in which Turkey specializes. For the sake of providing a general assessment of value added decomposition of Turkish manufacturing production and exports while also reflecting the heterogeneity of Turkish industries, we investigate overall production and trade patterns and firm-level demographics in three representative sectors: motor vehicles, textiles and apparel, and food. The selection of sectors is driven by two motivations. First, these are industries with relatively long value chains (Fally (2011)). Longer value chains offer countries more opportunities for upgrading to a higher value added activity through changing substantially the structure of their trade and output. Second, these industries are important export sectors for the Turkish economy and they become prominent in above analysis.

The performance of Turkey in these industries is assessed according to the following parameters:

1. Foreign value added embodied in industry's exports in 2000s and its comparison with country's peers.

2. Production stage of industry's value chain in which Turkey specializes.

3. Technological content exported products within each stage of production.

To distinguish stages of production within an industry, we adopt the classification by Taymaz et al. (2011) which assigns exports (categorized at the 4-digit ISIC code) to one of five stages of production based on engineering considerations, namely: final products; main inputs/parts; standard inputs; raw materials; machinery and equipment. Table 4.3 shows the classification for three key Turkish industries (motor vehicles, food and textiles and apparel). However, we should note that there are at least two downsides to this classification. Covering only goods exports, it does not identify the services segments of value chains, such as R&D, design, commercialization, distribution, marketing/branding, logistics, and after-sales services, precisely the segments with higher value added. Second, it does not account for the domestic dimension of value chains, thereby providing only a partial overview of the situation.

Table 4.3: Production chain and product groups in three main sectors

	Motor Vehicles	Food	
Final Products	111 Auto 112 Truck 113 Autobus 114 Tractor	411 Meat/fish 412 Confectionery 413 Chocolate 414 Flour products	415 Canned Food 416 Other food 417 Drinks 418 Waste products
Main input/parts	120 Motor	422 Sugar 423 Cocoa 424 Milk powder 425 Frozen Foods	426 Tea 427 Alcohol 428 Pulp, waste
Standard input/parts	131 Auto parts 132 Other		.
Raw Material	140 Steel Plates	441 Meat/fish 442 Sugar beet 443 Cocoa Powder 444 Milk, wheat	
Machinery/Equipment	151 Machined parts 152 Other	450 Food mach.	

	Textiles and Apparel			
	Cotton	Wool	Synthetic	Other
Final Products	311.1 Apparel 311.2 Pajama, t-shirt 311.3 Sheets	312.1 Apparel 312.2 Pajama, t-shirt 312.3 Sheets 312.4 Carpets	313.1 Apparel 313.2 Pajama, t-shirt 313.3 Sheets 313.4 Carpets	314.1 Apparel 314.2 Pajama, t-shirt 314.3 Sheets 314.4 Carpets
Main input/parts	321 Fabric	322 Fabric	323 Fabric	324 Fabric
Standard input/parts	331 Yarn	332 Yarn	333 Yarn	334 Yarn
Raw Material	341 Cotton	342 Wool	343 Polyester	344 Other
Machinery/Equipment	350 Textile machinery	350 Textile machinery	350 Textile machinery	350 Textile machinery

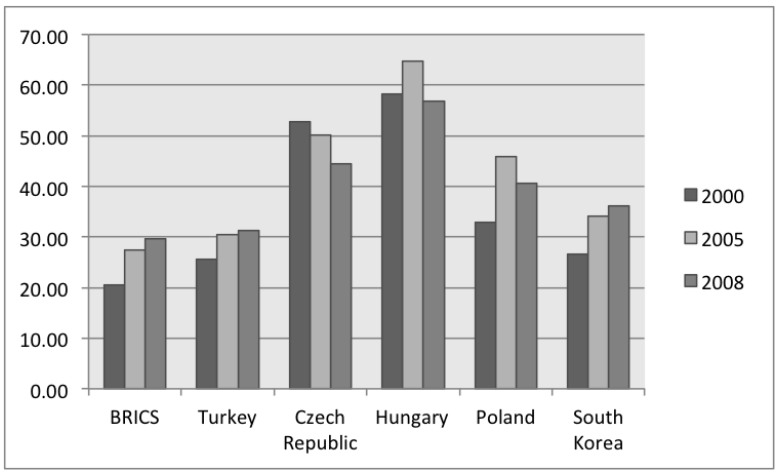
Source: Taymaz et al. (2011).

4.2.1 Motor Vehicles

As it is discussed above, domestic value added in transport equipment exports constitute 17% of Turkey's domestic value added embodied in manufacturing exports. Therefore, the industry contributes to value added creation to a great extent. Moreover, Turkey's RCA based on exports' domestic value added is equal to 1.13 suggesting that country has revealed comparative advantage in transport equipment industry.

Figure 4.6 provides comparison of the foreign value added in transport equipment exports as a percentage of total transport equipment exports of Turkey with the same selected economies in Section 4.1. Although Turkish transport equipment exports have highest foreign value added compared to other Turkish industries, import dependency of the industry's exports are lower than other countries except BRICS.

Figure 4.6: Foreign value added in transport equipment exports to transport exports (%)

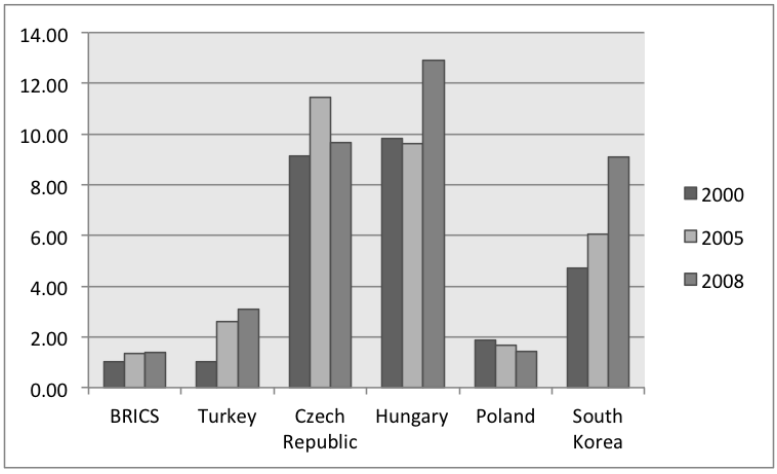


Source: Author's own calculations from TIVA provided by OECD-WTO.

Figure 4.7 compares countries' transport equipment exports-to-GDP ratio. Although foreign content of transport equipment exports has diminished in

Czech Republic and Hungary until 2008 (Figure 4.6), the ratio of transport equipment export to GDP has increased in these countries. Therefore, these countries have increased exports of transport equipment while increasing domestic content of their exports as well. In contrast, from 2000 to 2008, Poland transport equipment exports have become more import dependent while the share of transport equipment exports in GDP has fallen. In South Korea, 9.5 percentage-point increase in import dependency is accompanied by 4.3 percentage-point rise in transport equipment export-to-GDP. Turkey performs better than Poland and BRICS economies where industry's share in GDP in these countries is below 2% throughout the period. Between 2000 and 2008, Turkish transport equipment exports' import dependency and the industry's export-to-GDP have increased by 5.7 and 2 percentage points, respectively. In other words, as the importance of transport equipment exports increases, domestic value added in industry's total exports has fallen.

Figure 4.7: Transport equipment exports to GDP (%)



Source: Author's own calculations from TIVA provided by OECD-WTO.

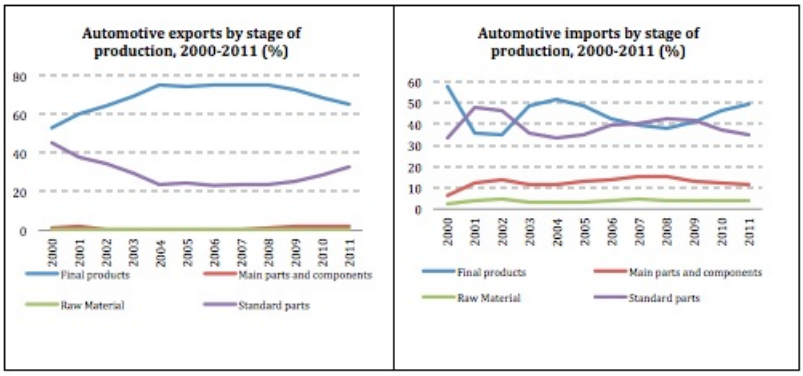
The value added generation differs between production stages of an industry. Motor vehicles are highly complex machines typically composed of over

20,000 separate parts sourced from a number of countries. Technological accumulation and value added are generated by the design building and operation of complex production systems and products. Hence, high value added activities carried out in the pre- or post- production stages and low value added activities carried out in the production, especially in assembly phase. Typically, pre-production design and marketing activities take place in large developed countries while developing countries participate to value chains in the automotive sector by leveraging on low labor costs, proximity to large consumer markets and bilateral and regional agreements which facilitate the production process across borders.

Due to data limitations, we are not able to discuss Turkey's performance in pre- and post-production stages where value added generation is highest for motor vehicles industry. Figure 4.8 decomposes motor vehicles exports and imports of Turkey to industry's production stages. Turkey's reputation as an assembly location for the automotive sector is confirmed by the large share of assembled vehicles (final products), i.e. assembly of cars, trucks, autobus and tractors, in total automotive exports (over 60%) and by the importance of parts and components on the imports side (around 50% combining main and other components).

Table 4.4 further decomposes exports of motor vehicles by stages (left panel of Figure 4.8) into subgroups according to firm size. Exports of larger firms with more than 200 employees constitute more than 90% of total exports in 2003. In addition, these large firms mostly specialize in the final stage of the value chain. More than 70% of the sector's exports consist of final products of

Figure 4.8: Exports and imports in the Turkish automotive industry, 2000-2011



Source: Author's calculations based on data from Comtrade.

motor vehicles. The second most important stage of the Turkish automotive value chain in terms of export value is standard input production, i.e. auto-parts and other components. Exports of standard inputs absorb 20% of total exports and, again, this segment of the value chain is dominated by large firms. The dominance of final goods and standard parts exports in 2003 prevails in 2010. While the export share of main parts and components increased over the period 2003-2010, this segment still made up less than 3% of total exports in 2010.

Table 4.4: Share of exports (%) of Turkish firms in the automotive sector, by firm size and stage of activity, 2003 vs. 2010

	Motor (2003)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	0.52	0	0.24	0	0.04	0.81
20-50	0.08	0	0.81	0.04	0.11	1.04
50-200	0.16	0.03	3.32	0.13	0.15	3.8
more than 200	72.76	0.41	20.43	0.01	0.75	94.36
	Motor (2010)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	0.04	0	0.52	0	0.03	0.6
20-50	2.28	0.02	1.02	0.04	0.22	3.57
50-200	0.24	0.12	3.08	0.25	0.12	3.81
more than 200	69.79	2.21	19.25	0.01	0.78	92.03

Source: Author's calculations based on firm-level data from TurkStat.

Table 4.5 reports the value added contribution of Turkish firms in the auto-

motive sector as percentage of total value added by production stages. Again, larger firms with more than 200 employees contribute the largest share, namely more than 80% of the sector's value added. Among larger firms, the majority of value added is created in the final goods and standard input production stages.

Table 4.5: Share of value added (%) of Turkish firms in the automotive sector, by size and GVC stage of activity, 2003 vs. 2010

	Motor (2003)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	0.25	0	0.26	0	0.06	0.58
20-50	0.42	0.04	2.02	0.09	0.25	2.82
50-200	2.63	0.49	7.68	0.09	0.41	11.31
more than 200	44.72	2.18	36.95	0.03	1.42	85.29
	Motor (2009)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	0.08	0.01	0.66	0.01	0.07	0.83
20-50	0.39	0.03	3.3	0.11	0.31	4.14
50-200	1.95	0.13	9.06	0.48	0.97	12.6
more than 200	36.01	0.97	40.25	0.08	5.11	82.43

Source: Author's calculations based on firm-level data from TurkStat. Note: Value added data are only available until 2009.

In 2003, 48% of the sector's value added comes from the final stage, while 47% stems from standard input production. Furthermore, between 2003 and 2009, the value added share of standard input production increased to 53%, thus exceeding the final goods stage which fell to 38%. Note that while the export share of main parts and components had increased (Table 4.4), the value added share of this category decreased from 3% to 1% between 2003 and 2009. In addition, the value added share of production of machinery which is used in motor vehicle manufacturing increased slightly from 3% to 6% over the period.

Table 4.6 takes a closer look at the top export products by stage of the value chain. Engines, in particular diesel engines, dominate the exports of main parts of the automotive sector. They also represent the main import

products, accounting for over 84% of imports in the segment (see Table 4.7). Generally, both imports and exports in each stage of the Turkish automotive value chain are very concentrated. The top five types of final products make up almost 85% of total final products. Diesel powered trucks with a low GVW alone account for 31% of final product exports in the automotive industry, and four different types of cars for a share between 16% and 9%. Using the Lall (2000) classification by technology level of exports, Table 4.6 and Table 4.7 suggest that the Turkish automotive sector tends to specialize in low and medium-tech products. High tech exports are limited to some specialized parts and components, covering less than 1% of total exports from the automotive sector.

Table 4.6: Top 5 exported products in the Turkish automotive value chain, by stage of production (2011)

Type	HS6	HS6 name	value	% share	rank	tech.
Final	870421	Diesel powered trucks not exceeding 5 tonnes	3656257	30.8	1	med.
Final	870322	Automobiles with reciprocating piston engine < 1000 cc	1913878	16.1	2	med.
Final	870323	Automobiles with reciprocating piston engine 1000-1500 cc	1807414	15.2	3	med.
Final	870331	Automobiles with diesel engine of < 1500 cc	1602076	13.5	4	med.
Final	870332	Automobiles with diesel engine of 1500-2500 cc	1068808	9	5	med.
Main	840820	Engines, diesel, for motor vehicles	225268.9	68.1	1	med.
Main	840734	Engines, spark-ignition reciprocating, > 1000 cc	50060.32	15.1	2	med.
Main	870790	Bodies for tractors, buses, trucks etc.	47248.61	14.3	3	med.
Main	870710	Bodies for passenger carrying vehicles	5709.429	1.7	4	med.
Main	840731	Engines, spark-ignition reciprocating, < 50 cc	1206.311	0.4	5	med.
Raw	721934	Flat rolled prod, stainless steel, of a width $\geq$ 600mm	25061.33	33	1	low
Raw	721933	Flat rolled prod, stainless steel, of a width $\geq$ 600mm	18323.43	24.2	2	low
Raw	721932	Flat rolled prod, stainless steel, of a width $\geq$ 600mm	8369.149	11	3	low
Raw	721922	Flat rolled prod, stainless steel, of a width $\geq$ 600mm	6541.871	8.6	4	low
Raw	721935	Flat rolled prod, stainless steel, of a width $\geq$ 600mm	5347.105	7.1	5	low
Stand.	870899	Motor vehicle parts nes.	1020974	17.2	1	med.
Stand.	870829	Parts and accessories of bodies nes. for motor vehicles	691417.3	11.7	2	med.
Stand.	401120	New pneumatic tyres, of rubber	682880.3	11.5	3	low
Stand.	870870	Wheels including parts and accessories for motor	632272.5	10.7	4	med.
Stand.	401110	New pneumatic tyres, of rubber	455660.9	7.7	5	low

Source: Author's calculations based on Comtrade data.

In conclusion, the key features emerging from the analysis of the automotive value chain are the following:

1. While transport equipment exports gain importance in Turkey, foreign value added content of industry's exports has steadily risen throughout 2000s.

Table 4.7: Top 5 imported products in the Turkish automotive value chain, by stage of production (2011)

type	HS6	HS6 name	value	% share	rank	tech.
Final	870332	Automobiles with diesel engine of 1500-2500 cc	3466842	30.8	1	med.
Final	870331	Automobiles with diesel engine of < 1500 cc	1736919	15.4	2	med.
Final	870323	Automobiles with reciprocating piston engine 1000-1500 cc	1508197	13.4	3	med.
Final	870322	Automobiles with reciprocating piston engine < 1000 cc	1125260	10	4	med.
Final	870120	Road tractors for semi-trailers	870697.9	7.7	5	med.
Main	840820	Engines, diesel, for motor vehicles	2242157	82.9	1	med.
Main	840734	Engines, spark-ignition reciprocating, > 1000 cc	382054	14.1	2	med.
Main	840732	Engines, spark-ignition reciprocating, 50-250 cc	44482.54	1.6	3	med.
Main	870790	Bodies for tractors, buses, trucks and special	23732.15	0.9	4	med.
Main	840790	Engines, spark-ignition type nes.	10050.04	0.4	5	med.
Raw	721934	Flat rolled prod, stainless steel, of a width $\geq$ 600mm	413742.3	44.7	1	low
Raw	721933	Flat rolled prod, stainless steel, of a width $\geq$ 600mm	215099.8	23.3	2	low
Raw	721935	Flat rolled prod, stainless steel, of a width $\geq$ 600mm	94344.49	10.2	3	low
Raw	721932	Flat rolled prod, stainless steel, of a width $\geq$ 600mm	68936.07	7.5	4	low
Raw	721912	Flat rolled prod, stainless steel, of a width $\geq$ 600mm	35512.6	3.8	5	low
Stand.	870840	Tansmissions for motor vehicles	1092583	13.6	1	med.
Stand.	870899	Motor vehicle parts nes.	972582.7	12.1	2	med.
Stand.	870829	Parts and accessories of bodies nes. for motor vehicles	808094.7	10.1	3	med.
Stand.	870850	Drive axles with differential for motor vehicles	624583	7.8	4	med.
Stand.	870839	Brake system parts nes. for motor vehicles	564597.8	7	5	med.

Source: Author's calculations based on Comtrade data.

2. Turkey's automotive sector has the reputation to be an assembly location. This is supported by the dominance of assembled vehicles (final products) in Turkey's automotive exports (over 60% of total automotive exports) and by the importance of imported parts and components (50% of total automotive imports combining main and other components).

3. Final good and standard part and components exports constitute most of industry's exports and domestic value added whereas high value added segment of automotive production such as machinery production constitute less than 1% of exports and around 6% of domestic value added.

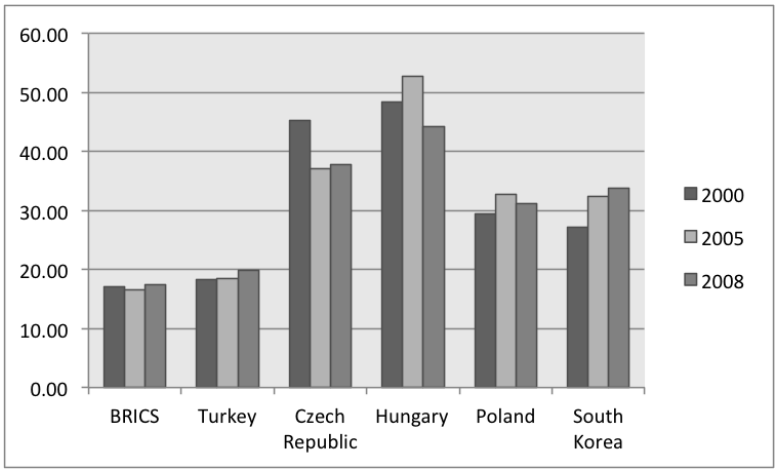
4. Firms with more than 200 generate more than 80% of the domestic value added and export more than 90% of industry's products.

5. Imports and exports of automotive industry are composed of low- and medium-tech products.

4.2.2 Textiles and Apparel

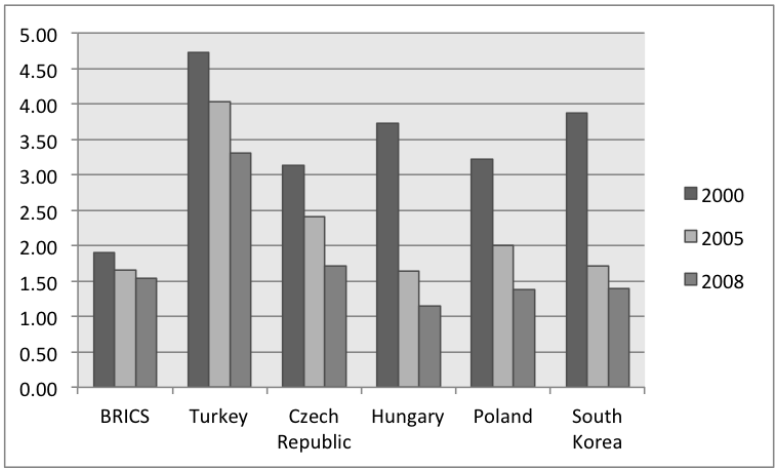
Textile and apparel industry is an important industry for Turkey as it constitutes highest portion of domestic value added embodied in exports and it has the highest revealed comparative advantage among all competitor countries and among all exporting products. In this section, we provide a detailed investigation of textiles industry. Figure 4.9 and 4.10 provides comparison of the foreign value added in Turkish textiles exports as a percentage of total textiles exports and Turkish textile export-to-GDP ratio with its peers. Except Czech Republic and Hungary, all countries realized an increase in their foreign-value added content in textiles exports between 2000 and 2008. Moreover, textiles exports-to-GDP ratio decreased in all selected economies. In Turkey, 1.4 percentage-point increase in foreign content is accompanied by 1.4 percentage-point decrease in industry's exports relative to GDP. Therefore, different than transport equipment industry, in textiles both domestic value added embodied in exports and exports to GDP have diminished in 2000s.

Figure 4.9: Foreign value added in textile exports to textile exports (%)



Source: Author's own calculations from TIVA provided by OECD-WTO.

Figure 4.10: Textile exports to GDP (%)



Source: Author's own calculations from TIVA provided by OECD-WTO.

Within textiles and apparel, value added stems from the combination of research, design, sales, marketing, and financial services. In these sectors, the retailers, designers and marketers act as strategic brokers who links overseas production bases and traders with their consumers (Gereffi and Memedovic (2003)). Broadly speaking, one can distinguish the following distinct value-adding activities within the textiles sector:

- R&D: includes companies that conduct R&D and other related to develop better physical products or process and reach of market or consumers.

- Design: includes companies that offer design services for products and components throughout the value chain that attract attention of customers, improve product performance, lower production costs, which in turn, make the product more competitive in the market.

- Purchasing/Sourcing (Inbound): involves inbound purchase and transportation of textile products and includes physical transportation of products, providing supply chain coordination, both domestic and over-

seas, by providing technology and equipment.

- Production/Assembly/Cut, Make, Trim (CMT): Textiles manufacturers prepare the fabric, using conventional and non-conventional textiles processing. Apparel manufacturers knit apparel from this fabric or from yarn. An apparel manufacturer cuts or sews materials owned by others as a subcontractor or manufactures custom garments for individual clients as a jobber and tailors. Firms either purchase their textiles from other establishments or produce the components of the textile within the firm.

- Distribution (Outbound): involves distribution and sale of manufactured apparel via a network of wholesalers, agents, logistics firms, and other companies outside of production.

- Marketing and Sales: includes pricing, selling and distribution activities of a product, including branding or advertising.

- Services: includes any activity to distinguish the firm from its competitors provided to a firm's suppliers, buyers, or employees (e.g., providing software to support the activities in the value chain, etc.).

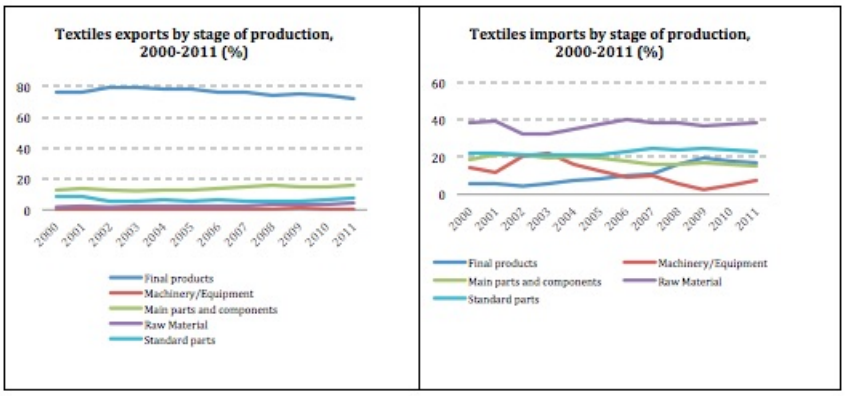
In textiles and apparel, Turkey has successfully pioneered its own design and brand manufacturing also fostered by supportive public policies. These policies granted various incentives for firms in the sector and fostered workforce development in pre- and post- production activities, such as design, specialized photography, product development, marketing, brand management, etc. Building on the traditional strength (since the 1980s) of Turkey's textiles and

apparel manufacturers as "full package suppliers" to global brands, Turkish manufacturers of textiles and apparel have more recently succeeded in transitioning and upgrading toward product design and product brand activities. However, we cannot investigate value added generation in pre- and post- production stages in textiles industry due to data limitations.

Within production stages, innovation in the apparel and textiles value chain comes either through new machinery that allows to develop new techniques or from the chemical industry. Accordingly, value added and profits are greater in these upstream sectors. Export and value added growth generated by the production of machinery and equipment is particularly important. As a matter of fact, the next frontier for upgrading in the Turkish textiles sector is product and process upgrading. Process upgrading, in particular, offers possibilities to increase the share of local value added. This is the case because by improving machinery, firms increase productivity (new capital investment). Modern machinery is also likely to have more ICT and logistics technology embedded in it. If this is the case, the benefits are not only absorbed by the firm that makes the investment, but also by the entire value chain because modern machinery reduces the total time and cost needed for the production process and increases the flexibility of the supply chain process. Figure 4.11 suggests that Turkey is specialized in the final textile good exports while machinery and raw materials exports together constitute less than 4% of industry's exports throughout the period. Moreover, machinery and raw materials imports constitute almost 50% of total imports in 2011.

Table 4.8 presents export share of each production stage whereas Table 4.9

Figure 4.11: Exports and imports in the textiles and apparel sector, 2000-2011



Source: Author's calculations based on Comtrade data.

reports the domestic value added created by each stage. Clearly, exporters with 20 to 200 employees are the largest cohort, in terms of export and value added share large firms dominate. Large firms' share in exports and value added increased noticeably between 2003 and 2009/2010 across all segments of the value chain. Large firms accounted for 36% of total exports in 2003 and 44% in 2010 while they generated 66% of the value added in 2003 and 71% in 2009.

Table 4.8: Share of exports (%) of Turkish firms in textiles and apparel sector, by size and stage of activity, 2003 vs. 2010

	Textiles and Apparel (2003)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	3.99	0.53	0.09	0.08	0.03	4.72
20-50	37.89	1.83	0.6	0.31	0.04	40.67
50-200	13.88	2.69	0.83	0.73	0.05	18.19
more than 200	23.01	6.82	5.8	0.58	0.21	36.42
	Textiles and Apparel (2010)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	2.89	0.38	0.2	0.16	0.1	3.73
20-50	19.1	2.61	0.51	1.41	0.14	23.77
50-200	21.66	3.47	1.97	1.18	0.24	28.51
more than 200	26.39	8.57	5.88	2.92	0.22	43.99

Source: Author's calculations based on firm-level data from TurkStat.

Meanwhile, in 2003, textile and apparel firms with 20-50 employees exported 41% of total exports in the sector, and most of them specialized in

Table 4.9: Share of value added (%) of Turkish firms in textiles and apparel sector, by size and GVC stage of activity, 2003 vs. 2010

	Textiles and Apparel (2003)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	0.99	0.48	0.07	0.21	0.01	1.75
20-50	6.15	1.58	0.53	0.74	0.31	9.31
50-200	13.77	3.45	2.03	3.25	0.31	22.8
more than 200	34.59	13.64	10.83	5	2.08	66.13
	Textiles and Apparel (2009)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	0.51	0.21	0.05	0.01	0.01	0.78
20-50	4.8	1.67	0.55	0.95	0.22	8.18
50-200	11.02	3.61	1.85	3.3	0.43	20.2
more than 200	39.66	11.55	10.74	7.51	1.37	70.84

Source: Author's calculations based on firm-level data from TurkStat. Note: Value added data are only available until 2009.

exports of final goods. By 2010, these low to medium-sized firms lost a large share to firms with 50 or more employees. Firms with 50-200 employees increased their export share from 18 to 20% whereas larger firms (with 200 or more employees) increased their export share from 36 to 44%.

Again, almost 90% of total exports in the textiles and apparel sector come from the final stage. The value added contributions of each segment of the value chain are equally skewed toward final goods, but less so than exports. The final goods account for only 56% of the sector's value added, compared to almost 71% of export value. Main parts and components are the second most important segment of the textiles and apparel value chain, absorbing 17% of the total exports and 15% of total value added.

Table 4.10 and Table 4.11 suggest that exports and imports of textiles and apparel industry are not as concentrated as motor vehicles. The most concentrated segment of the textiles and apparel value chain in Turkey is the production of raw materials both for export and import markets. The top 5 products account for 60% of total raw material exports and for 85% of total raw material imports. While exported and imported textiles and apparel products

are generally low and medium-tech, Turkish exports and imports of textile machinery and equipment tend to be medium-tech.

Table 4.10: Top 5 exported products in the Turkish textiles and apparel value chain, by stage of production (2011)

Type	HS6	HS6 name	value	% share	rank	tech.
Final	610910	T-shirts, singlets and other vests, of cotton	1949271	11.6	1	low
Final	570242	Pile floor coverings of man-made textiles	1208336	7.2	2	low
Final	620462	Women or girls' trousers, breeches, etc.	1194846	7.1	3	low
Final	610990	T-shirts, singlets, etc, of other textiles, nes.	1100521	6.5	4	low
Final	620342	Men or boys' trousers, breeches, etc, of cotton	1033222	6.1	5	low
Mach.	845140	Washing, bleaching or dyeing machines	21266.9	15	1	med.
Mach.	845180	Mach for wring/dress/finishing/coating or impregnating	18059.22	12.7	2	med.
Mach.	844520	Textile spinning machines	13504.37	9.5	3	med.
Mach.	844630	Machines for weaving fabrics	11880.45	8.4	4	med.
Mach.	844511	Textile carding machines	9216.862	6.5	5	med.
Main	600292	Weft knits or crocheted fabrics of cotton	561537.1	15.4	1	low
Main	520942	Denim, with $\leq$ 85% cotton	316738.7	8.7	2	low
Main	600293	Weft knits or crocheted fabrics of man-made fibres	272980.8	7.5	3	low
Main	540760	Other woven fabrics of synthetic yarn, $\geq$ 85%	269551.8	7.4	4	med.
Main	551511	Woven fabrics,<< 85% polyester staple fibres	154897	4.3	5	med.
Raw	390690	Acrylic polymers prepared,in primary forms, nes.	179483.4	17.6	1	med.
Raw	520100	Cotton, not carded or combed	146264.3	14.3	2	low
Raw	390110	Polyethylene having a specific gravity $<$ 0.94	128363.9	12.6	3	med.
Raw	390799	Polyesters, in primary forms, nes.	108670.8	10.6	4	med.
Raw	520299	Cotton waste, nes.	78838.68	7.7	5	low
Stand.	540269	Multiple or cabled yarn, nes.	172094.3	10	1	low
Stand.	550932	Multiple or cabled yarn, $\geq$ 85% acrylic	141379.2	8.2	2	low
Stand.	520512	Uncombed single cotton yarn, with $\geq$ 85% cotton	136682.2	7.9	3	low
Stand.	540210	High tenacity yarn of nylon or other polyamides	96129.59	5.6	4	low
Stand.	540249	Single synthetic yarn, nes.	89200.89	5.2	5	low

Source: Author's calculations based on Comtrade data.

Table 4.11: Top 5 imported products in the Turkish textiles and apparel value chain, by stage of production (2011)

Type	HS6	HS6 name	value	% share	rank	tech.
Final	620342	Men or boys' trousers, breeches, etc.	254130.2	8	1	low
Final	620462	Women or girls' trousers, breeches, etc.	208740.6	6.6	2	low
Final	611030	Jerseys, pullovers, etc, of man-made fibres	191668.1	6.1	3	low
Final	611020	Jerseys, pullovers, etc, of cotton	167988.1	5.3	4	low
Final	610910	T-shirts, singlets and other vests, of cotton	149899.5	4.7	5	low
Mach.	844630	Machines for weaving fabrics	259081.4	19	1	med.
Mach.	844520	Textile spinning machines	226076.1	16.6	2	med.
Mach.	844720	Flat knitting machines; stitch-bonding machines	148184.3	10.9	3	med.
Mach.	845180	Mach for wring/dress/finishing/coating or impregnating	85399.42	6.3	4	med.
Mach.	844540	Textile winding (including weft-winding)	78182.08	5.7	5	med.
Main	520942	Denim, with $\geq$ 85% cotton	330335.8	11.5	1	low
Main	540760	Other woven fabrics of synthetic yarn, $\geq$ 85%	245257.7	8.5	2	med.
Main	600192	Pile fabrics of man-made fibres, nes.	135730.4	4.7	3	low
Main	520812	Unbleached plain cotton weave, with $\geq$ 85% cotton	132243.6	4.6	4	low
Main	600293	Weft knits or crocheted fabrics of man-made fibres	112714.1	3.9	5	low
Raw	390210	Polypropylene, in primary forms	1869027	25.8	1	med.
Raw	520100	Cotton, not carded or combed	1849973	25.6	2	low
Raw	390120	Polyethylene having a specific gravity	1038334	14.3	3	med.
Raw	390110	Polyethylene having a specific gravity	910938.7	12.6	4	med.
Raw	390690	Acrylic polymers prepared,in primary forms, nes.	340604.3	4.7	5	med.
Stand.	550410	Artificial staple fibres, of viscose rayon	630912.3	14.7	1	med.
Stand.	540233	Textured yarn of polyesters	496398.9	11.6	2	low
Stand.	540243	Single yarn of polyesters, nes.	236836.8	5.5	3	low
Stand.	551011	Single yarn, with $\geq$ 85% artificial staple fibre	212565.4	4.9	4	low
Stand.	550320	Synthetic staple fibres, of polyesters	194204.9	4.5	5	med.

Source: Author's calculations based on Comtrade data.

The key features of Turkish involvement in textiles and apparel value chains are the following:

1. Although textiles industry is the highest contributor to domestic value

added embodied exports, foreign content of exports has increased and industry's exports relative to GDP has diminished in 2000s.

2. Exports of finished products dominate the sector, accounting for 80% of market share. Yet, there is an increasing number of exporters of machinery and equipment (from 4.2% of total exporters in 2003-2004 to 7.9% in 2009-2010). This is encouraging since the next step of upgrading in textiles can only come from product or process development, stages in which innovative machinery and equipment are fundamental.

3. Among stages of production, final stage contributes the most to total domestic value added of industry. Main and standard components also contribute to domestic value added to a great extent.

4. Different than automotive industry, exporters are of different size. Firms with more than 20 employees contribute both to export sales and domestic value added to a great extent.

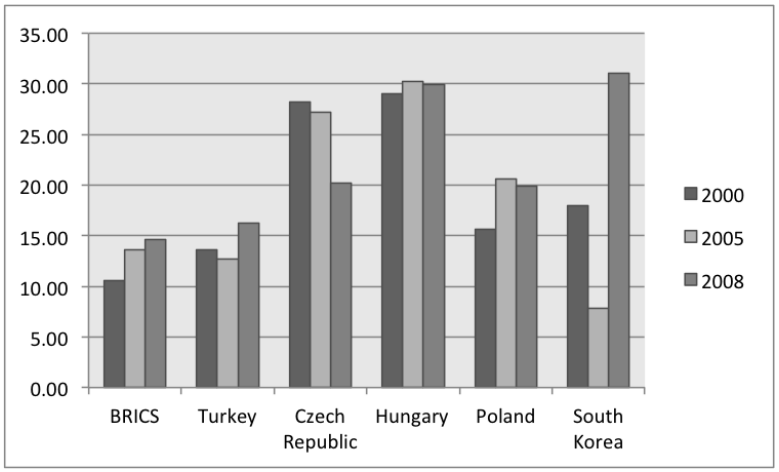
5. Exports and imports of each segment except textiles machinery are generally low-tech.

4.2.3 Food

After textiles industry, food is second least intermediate import dependent industry in Turkey. However, the contribution of industry's domestic value added to total domestic value added embodied in manufacturing exports is limited. Figure 4.12 reports the comparison of the foreign value added in food exports as a percentage of total food exports of Turkey with its peers. Simi-

lar to transport equipment and textiles, import dependency of the industry's exports in Turkey is lower than other countries except BRICS.

Figure 4.12: Foreign value added in food exports to food exports (%)



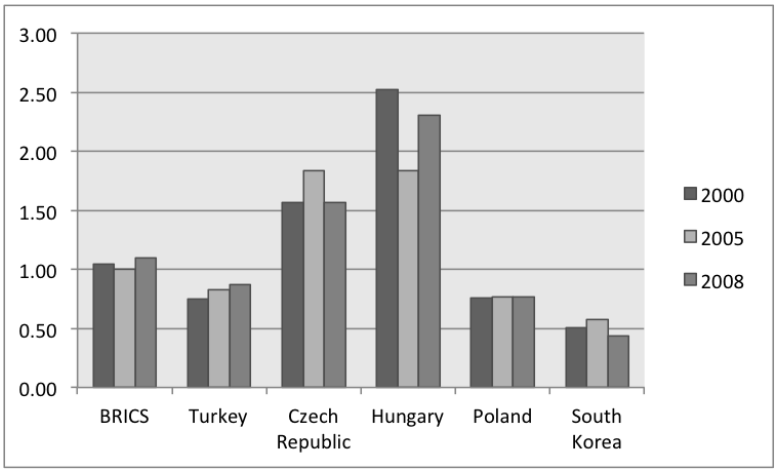
Source: Author's own calculations from TIVA provided by OECD-WTO.

A comparison of countries' food exports-to-GDP ratio is presented in Figure 4.13. In Turkey, food exports constitute around 0.8% of GDP throughout the period which is a little bit above Poland and South Korea. Between 2000 and 2008, Hungary's foreign value added share in food exports has remained almost constant while, Czech Republic's and South Korea's decreasing to a great extent. In these countries, food exports relative to GDP have stayed constant. Therefore, there is no structural transformation in food industry in Czech Republic, South Korea and Hungary.

Also for the rest of the countries, food exports as a percentage of GDP remained same or slightly decreased. However, foreign content of food exports in these countries has accrued between 2000 and 2008.

Next we discuss industry's trade and production patterns by stages of production. The food industry, being a resource based sector, is characterized by low appropriability of resources. As such, it is dominated by those coun-

Figure 4.13: Food exports to GDP (%)



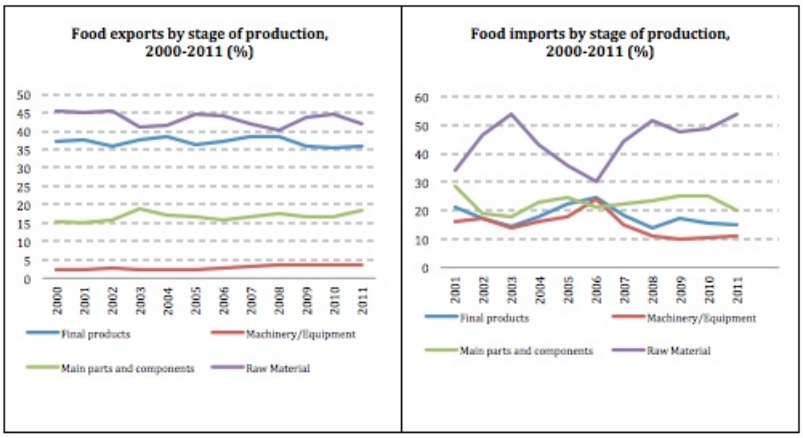
Source: Author's own calculations from TIVA provided by OECD-WTO.

tries that invest in basic and applied research (e.g. Switzerland, France, and the United States). Suppliers can generate most innovation and value added through the creation of new machinery, new seeds, new chemicals and fertilizers, and more recently through the application of ICT to agriculture. Therefore, upstream sector in food production provide higher value added opportunities. In Turkey, raw materials constitute highest portion of both exports and imports (Figure 4.14). Final products export share is above 35% and food machinery export share is below 5% throughout. Food machinery, main parts and final goods all together form the constitute 45% of imports.

Table 4.12 reports each stage's contribution to exports by groups of firms. Between 2003 and 2010, there is not much structural change in food exports. In terms of export value, 80% of the total is generated by final products or raw materials. Machinery exports is only 2% of total exports. More than 40% of exports are undertaken by large firms whereas firms with 50-200 employees increased their share between 2003 and 2010.

Table 4.13 reports value added contribution of each stage for firms differ-

Figure 4.14: Exports and imports in the food sector, 2000-2011



Source: Author's calculations based on Comtrade data.

Table 4.12: Share of exports (%), by size and stage of activity of Turkish firms in the food sector (2003 and 2010)

	Food (2003)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	2.9	1.98	N/A	3.78	0.12	8.79
20-50	3.91	5.32	N/A	11.31	0.69	21.23
50-200	7.94	6.27	N/A	13.2	0.58	27.98
more than 200	19.59	5.67	N/A	16.32	0.42	42
	Food (2010)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	1.56	0.55	N/A	1.56	0.18	3.86
20-50	5.65	4.76	N/A	7.18	0.9	18.49
50-200	10.28	7.5	N/A	14.92	1.18	33.88
more than 200	19.86	5.08	N/A	18.38	0.44	43.77

Source: Author's calculations based on firm-level data from TurkStat.

ent in size. The distribution of value added across segments of the value chain shows that despite machinery representing a small share of total food exports, its contribution to value added is about 30%. Hence, there is an important domestic market for machinery and equipment produced in Turkey which cannot be sold to foreign markets as much as other segments' products. Yet most of the value added (almost 60%) stems from final good production. Large firms dominate value added generation to a great extent (80% of value added).

Table 4.14 and Table 4.15 show that exports and imports of machinery used in food production are highly concentrated on 5 types of machines. These

Table 4.13: Share of value added (%) of Turkish firms in the food sector, by size and stage of activity, 2003 vs. 2009

	Food (2003)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	0.46	0.48	N/A	0.54	0.15	1.62
20-50	2.21	1.52	N/A	1.48	0.64	5.85
50-200	6.31	4.51	N/A	2.44	1.4	14.65
more than 200	39.91	11.98	N/A	12.94	13.05	77.88
	Food (2010)					
firm size (employees)/stage	final	main	standard	raw	machinery	total
less than 20	0.24	0.12	N/A	0.21	0.13	0.7
20-50	2.15	1.26	N/A	1.12	0.98	5.51
50-200	5.76	4.25	N/A	2.36	1.61	13.99
more than 200	47.87	11.13	N/A	9.64	11.16	79.8

Source: Author's calculations based on firm-level data from TurkStat. Note: Value added data are only available until 2009.

products account for over 60% of total machinery exports. The machinery and equipment used for food production is mid-tech. Also, there is a large concentration of raw materials on the import side. Spelt, common wheat and meslin form 40% of the total raw material food imports.

Table 4.14: Top 5 exported products in the Turkish agri-food value chain, by stage of production (2011)

Type	HS6	HS6 name	value	% share	rank	tech.
Final	200819	Nuts and seeds including mixtures, preserved	637658.6	14.1	1	low
Final	210690	Other food preparations, nes.	399441	8.9	2	low
Final	190530	Sweet biscuits; waffles and wafers	387282.5	8.6	3	low
Final	180690	Chocolate, etc, containing cocoa, not in blocks	290446.6	6.4	4	low
Final	170490	Sugar confectionery (incl. white chocolate)	271063.2	6	5	low
Mach.	843780	Mach for milling/working of cereals/ dried legume	148648.4	32.9	1	med.
Mach.	842240	Packing or wrapping machinery nes.	79708.19	17.6	2	med.
Mach.	842121	Filtering or purifying machinery and apparatus	53466.57	11.8	3	med.
Mach.	842230	Mach for fil/clos/seal/etc.btle/can/box/bag/ctn	28076.92	6.2	4	med.
Mach.	843810	Bakery mach. and machinery for the mfg of macaroni	24444.38	5.4	5	med.
Main	110100	Wheat or meslin flour	891814.1	38.4	1	low
Main	81310	Dried apricots	360906.6	15.6	2	low
Main	71340	Dried lentils, shelled	200884.7	8.7	3	low
Main	100630	Semi-milled or wholly milled rice	74786.15	3.2	4	low
Main	71290	Dried vegetables, nes.	66682.31	2.9	5	low
Raw	80222	Hazelnuts without shells, fresh or dried	1041429	19.9	1	low
Raw	80620	Dried grapes	506499.2	9.7	2	low
Raw	70200	Tomatoes, fresh or chilled	432460.8	8.2	3	low
Raw	80530	Lemons and limes, fresh or dried	354289.7	6.8	4	low
Raw	80520	Mandarins, clementines, wilkings etc.	338023.5	6.4	5	low

Source: Author's calculations based on Comtrade data.

The key features of Turkish involvement in food value chains are the following:

1. In 2000s, food exports constitute small and steady fraction of GDP whereas foreign content of food exports have increased.

Table 4.15: Top 5 imported products in the Turkish agri-food value chain, by stage of production (2011)

Type	HS6	HS6 name	value	% share	rank	tech.
Final	210690	Other food preparations, nes.	327479.3	28.9	1	low
Final	210110	Extracts, essences, concentrates and preparation	96716.61	8.5	2	low
Final	230990	Other preparations of a kind used in animal feed	83561.28	7.4	3	low
Final	190110	Preparations for infant use, for retail sale	83091.79	7.3	4	low
Final	220830	Whiskeys	55118.89	4.9	5	low
Mach.	842240	Packing or wrapping machinery nes.	233545.6	28	1	med.
Mach.	842230	Mach for fil/clos/seal/etc.btle/can/box/bag/ctn	127602.9	15.3	2	med.
Mach.	842121	Filtering or purifying machinery and apparatus	59779.09	7.2	3	med.
Mach.	843850	Machinery for the preparation of meat or poultry	52773.58	6.3	4	med.
Mach.	843820	Machinery for the manufacture of confectionery, cocoa	47706.75	5.7	5	med.
Main	230400	Oil-cake and other solid residues, of soya-bean	243029.3	15.8	1	low
Main	71340	Dried lentils, shelled	205554.7	13.4	2	low
Main	230630	Oil-cake and other solid residues of sunflower	141856	9.2	3	low
Main	230230	Brans, sharps and other residues of wheat	98989.76	6.4	4	low
Main	180500	Cocoa powder	71773.16	4.7	5	low
Raw	100190	Spelt, common wheat and meslin	1613624	39.8	1	low
Raw	120100	Soya beans	687498.3	17	2	low
Raw	20120	Fresh or chilled unboned bovine meat	506154	12.5	3	low
Raw	180100	Cocoa beans, whole or broken, raw or roasted	275472	6.8	4	low
Raw	100590	Maize (excl. seed)	121662.6	3	5	low

Source: Author's calculations based on Comtrade data.

2. Both exports and value added are dominated by final food products and raw materials.

3. While new machinery is one important way to increase value addition in the agri-food value chain, Turkey's exports in this segment are very concentrated. Over 60% of total machinery exports are accounted by three types of machines only.

4. There is a larger participation of small and medium sized firms, particularly in the production and exports of raw material.

5. Since the food industry is characterized by low appropriability of resources, other channels to increase value addition are: creation of new seeds, new chemicals and fertilizers, and more recently application of ICT to agriculture.

4.3 Conclusion

In this chapter, import dependency of Turkish exports is investigated. Although Turkish manufacturing exports depend less on imports compared to other countries' exports, Turkey requires more intermediate imports than its peers in order to increase its exports relative to GDP. Another important result of this chapter is about the use of intermediate imports. Similar to its peers, highest portion of Turkish imports stems from intermediate imports. However, in contrast to other countries the goods produced using imported intermediates end up being domestically sold rather than being exported. This result is not surprising since Turkey's export performance is relatively poor compared to its counterparts.

Our results show that the patterns observed for total manufacturing exports are also observed for three key sectors in Turkey, namely transport equipment, textiles and apparel and food. We also find that Turkey mostly specializes in production and exports of low value added and low- and medium-tech activities within these industries. Increasing domestic value added embodied in exports by simultaneously enhancing export performance is only possible if Turkey shifts its production and exports toward high value added and technologically advanced products.

CHAPTER 5

CONCLUSION

By building a Melitz-type trade model with heterogeneous workers and labor market frictions, Chapter 2 focuses on the effects of trade liberalization on wages and unemployment rates of skilled and unskilled workers. The results of the model suggests that in the long run, globalization increases the wages of both skilled and unskilled. Hence, average wages also increase in the economy. Moreover, unemployment rates of both skill groups falls due liberalization which in turn leads to a fall in aggregate unemployment.

However, trade liberalization affects skilled and unskilled workers asymmetrically even though countries are symmetric. The reductions in trade costs increases the wage of skilled more than unskilled. This leads skill premium to rise. Moreover, skilled unemployment falls more than unskilled due to trade liberalization. Therefore, the composition of unemployment pool changes toward unskilled.

While Chapter 2 focuses on outcomes of trade liberalization, Chapter 2 investigates the determinants of a large developing country's trade performance. More specifically, Chapter 3 provides a comprehensive investigation of Turkey's

trade performance between 1996-2013. The trade figures of Turkey is compared with countries peers (such as Czech Republic and Hungary) and the structural factors that lead Turkey to lag behind its global competitors are discussed. In the cross-county comparisons, Turkey's technological incompetency becomes prominent. The Turkish economy generally specializes in low- and medium-tech products and has not added high-tech products to its production and export basket. The firm-level analysis shows that innovation, technology transfer through intermediate imports and foreign ownership increase the likelihood of Turkish firms becoming exporters.

Since the innovation plays a crucial role in determining a firm's productivity and export behavior, it is important for government to take these interactions into account when implementing productivity-enhancing policies. The other important policies should include those that attract FDI, ease access to technologically advanced inputs, ease access to credit and improve marketing performance.

As Chapter 3 offers policy implications for Turkey to increase its export performance, Chapter 4 suggests that increased exports do not necessarily imply increased domestic value added. More specifically, Chapter 4 investigates import dependency of Turkish exports and shows that Turkish manufacturing exports depend less on imports compared to other countries' exports. However, Turkey requires more intermediate imports than its peers (again such as Czech Republic and Hungary) in order to increase its exports' share in GDP. Another important result of the chapter is related to the use of intermediate imports. Intermediate imports constitute the highest portion of total Turkish

imports which is the case for country's competitors. However, in contrast to other countries, the goods produced using imported intermediates end up being domestically sold rather than being exported. Given the results of Chapter 3, this result is not surprising.

The patterns observed for total manufacturing exports are also observed for three key sectors in Turkey, namely transport equipment, textiles and apparel and food. When we conduct a detailed investigation of these sectors, we find that Turkey mostly specializes in production and exports of low value added and low- and medium-tech activities within these industries. Increasing domestic value added embodied in exports by simultaneously enhancing export performance is only possible if Turkey shifts its production and exports toward high value added and technologically advanced products.

Chapter 3 and Chapter 4 discuss how export performance of Turkey can be improved and how can the country reap the benefits of better export performance. However, we should note that Chapter 2 shows that trade liberalization increases the inequality between different skill groups in terms of wages and unemployment while increasing the exports of the economy. Therefore, policymakers should take into account the effects of trade liberalization on labor market outcomes while increasing export performance of the country. In other words, the policies should target higher levels of exports and exports of more technologically advanced products with less intermediate import dependency by simultaneously reducing the inequality effects of increased openness.

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APPENDICES

A The Derivation of Wage and Job Creation Curves

Let $E(\ell, \varphi)$ and $E(h, \varphi)$ be values of being employed to unskilled and skilled labor, respectively. U_ℓ and U_h are values of being unemployed to unskilled and skilled labor, respectively. On the firm side, $\frac{\partial J(\ell|\varphi)}{\partial \ell}$ and $\frac{\partial J(h|\varphi)}{\partial h}$ are values of one more vacancy to low technology and high technology firms, respectively. Nash bargaining between low-tech firms and unskilled labor can be expressed as follows

$$(1-\beta)[E(\ell,\varphi) - U_\ell] = \beta \frac{\partial J(\ell|\varphi)}{\partial \ell} \tag{1}$$

Expected value of being employed for unskilled is the sum of wage the worker receives and the value of becoming unemployed if the match is broken with probability s

$$rE(\ell,\varphi) = w_\ell(\varphi) + s[U_\ell - E(\ell,\varphi)] \tag{2}$$

Rearranging (2) gives

$$[E(\ell,\varphi) - U_\ell] = \frac{w_\ell(\varphi) - rU_\ell}{r+s} \tag{3}$$

From the first order condition of low-tech firm's optimization problem (2.10) we know that

$$\frac{\partial J(\ell|\varphi)}{\partial \ell} = \frac{\partial J(\ell'|\varphi)}{\partial \ell'} \tag{4}$$

Then, the shadow value of unskilled worker to low-tech firm (2.11) can be rewritten as

$$\frac{\partial J(\ell|\varphi)}{\partial \ell} = \frac{1}{r+s}\left\{\frac{\partial r_\ell(\varphi)}{\partial \ell} - w_\ell(\varphi) - \frac{\partial w_\ell(\varphi)}{\partial \ell} l(\varphi)\right\} \tag{5}$$

Substituting (3) and (5) into (1) yields

$$w_\ell(\varphi) = (1-\beta) r U_\ell + \beta \frac{r_\ell(\varphi)}{\partial \ell} - \beta \frac{\partial w_\ell(\varphi)}{\partial \ell} \ell(\varphi) \tag{6}$$

Similarly, Nash bargaining between a high tech firm and skilled labor is expressed as

$$(1-\beta)[E(h,\varphi) - U_h] = \beta \frac{\partial J(h|\varphi)}{\partial h} \tag{7}$$

Expected value of being employed for skilled is the sum of wage the worker receives and the value of becoming unemployed if the match is broken with probability s

$$[E(h,\varphi) - U_h] = \frac{w_h(\varphi) - r U_h}{r+s} \tag{8}$$

Analogous to (5), the shadow value of skilled worker to high-tech firm is

$$\frac{\partial J(h|\varphi)}{\partial h} = \frac{1}{r+s}\left\{\frac{r_h(\varphi)}{\partial h} - w_h(\varphi) - \frac{\partial w_h(\varphi)}{\partial h} h(\varphi)\right\} \tag{9}$$

Substituting (8) and (9) into (7) yields

$$w_h(\varphi) = (1-\beta) r U_h + \beta \frac{\partial r_h(\varphi)}{\partial h} - \beta \frac{\partial w_h(\varphi)}{\partial h} h(\varphi) \tag{10}$$

Equations (6) and (10) are linear differential equations in $\ell(\varphi)$ and $h(\varphi)$, respectively. Using a similar method with Ebell and Haefke (2009b) one can verify that

$$w_\ell(\varphi) = (1-\beta) r U_\ell + \beta \frac{\partial r_\ell(\varphi)}{\partial \ell} \frac{\sigma}{\sigma - \beta} \tag{11}$$

solves (6) and

$$w_h(\varphi) = (1-\beta)rU_h + \beta\frac{\partial r_h(\varphi)}{\partial h}\frac{\sigma}{\sigma-\beta} \tag{12}$$

solves (10)[1].

First we will derive Wage and Job Creation Curves for unskilled labor. Substituting (2.3) into (11) and differentiating with respect to ℓ yields

$$\frac{\partial w_\ell(\varphi)}{\partial \ell} = -\frac{1}{\sigma}\left(\beta\frac{\partial r_\ell(\varphi)}{\partial \ell}\frac{\sigma}{\sigma-\beta}\right) \tag{13}$$

Replacing (13) in (2.12) gives

$$w_\ell(\varphi) = \frac{\partial r_\ell(\varphi)}{\partial \ell}\frac{\sigma}{\sigma-\beta} - \frac{c}{m(\theta_\ell)}\frac{r+s}{1-\delta} \tag{14}$$

Substituting (11) into (14) yields

$$w_\ell(\varphi) = rU_\ell + \frac{\beta}{1-\beta}\frac{c}{m(\theta_\ell)}\frac{r+s}{1-\delta} \tag{15}$$

Equation (15) suggests that wages are constant across low-tech firms. The discounted value of being unemployed for unskilled labor is the sum of unemployment compensation $b\overline{w_\ell}$ and the expected returns from finding a job:

$$rU_\ell = b\overline{w_\ell} + \theta_\ell m(\theta\ell)[E(\ell,\varphi) - U_\ell] \tag{16}$$

Substituting (3) and (15) into (16) reads

$$rU_\ell = b\overline{w_\ell} + \frac{\beta}{1-\beta}\frac{c\theta_\ell}{1-\delta} \tag{17}$$

Since wages are constant across low-tech firms, substituting (17) into (15)

[1]For the details of the derivation see Felbermayr et al. (2011a)

yields Wage curve for unskilled workers:

$$w_\ell(\varphi) = \frac{\beta}{1-\beta}\frac{1}{1-b}\frac{c}{1-\delta}[\theta_\ell + \frac{r+s}{m(\theta_\ell)}] \tag{18}$$

The pricing rule for low-tech firms reads

$$\frac{\partial R_\ell(\varphi)}{\partial \ell} = p_\ell^d(\varphi)\varphi\frac{\sigma-1}{\sigma} \tag{19}$$

and by constancy of wages across low technology firms, (14) suggests that

$$p_\ell^d(\varphi_1)\varphi_1 = p_\ell^d(\varphi_2)\varphi_2 = p_\ell^d(\tilde{\varphi}_\ell)\tilde{\varphi}_\ell \tag{20}$$

where $\tilde{\varphi}_\ell$ is the average productivity of low technology firms. Consequently, inserting (19) into (14) gives Job Creation curve for low technology firms:

$$w_\ell(\varphi) = \frac{\sigma-1}{\sigma-\beta}p_\ell^d(\tilde{\varphi}_\ell)\tilde{\varphi}_\ell - \frac{c}{m(\theta_\ell)}\frac{r+s}{1-\delta} \tag{21}$$

Similar steps are followed to derive Wage and Job Creation Curves for skilled labor. Substituting (2.3) into (12) and differentiating with respect to h yields

$$\frac{\partial w_h(\varphi)}{\partial h} = -\frac{1}{\sigma}(\beta\frac{\partial r_h(\varphi)}{\partial h}\frac{\sigma}{\sigma-\beta}) \tag{22}$$

Replacing (22) in (2.18) reads

$$w_h(\varphi) = \frac{\partial r_h(\varphi)}{\partial h}\frac{\sigma}{\sigma-\beta} - \frac{c}{m(\theta_h)}\frac{r+s}{1-\delta} \tag{23}$$

Substituting (12) into (23) gives

$$w_h(\varphi) = rU_h + \frac{\beta}{1-\beta}\frac{c}{m(\theta_h)}\frac{r+s}{1-\delta} \tag{24}$$

Equation (24) suggests that wages are constant across high-tech firms. The

discounted value of being unemployed for skilled labor is

$$rU_h = b\overline{w_h} + \theta_h m(\theta_h)[E(l,\varphi) - U_h] \tag{25}$$

Inserting (8) and (24) in (25) yields

$$rU_h = b\overline{w_h} + \frac{\beta}{1-\beta}\frac{c\theta_h}{1-\delta} \tag{26}$$

Since wages are constant across high-tech firms, substituting (26) into (24) gives Wage curve for skilled workers:

$$w_h(\varphi) = \frac{\beta}{1-\beta}\frac{1}{1-b}\frac{c}{1-\delta}[\theta_h + \frac{r+s}{m(\theta_h)}] \tag{27}$$

The pricing rule for high-tech firms reads

$$\frac{\partial r_h(\varphi)}{\partial h} = p_h^d(\varphi)\varphi\frac{\sigma-1}{\sigma} \tag{28}$$

By constancy of wages across high technology firms, (23) suggests that

$$p_h^d(\varphi_1)\varphi_1 = p_h^d(\varphi_2)\varphi_2 = p_h^d(\tilde{\varphi_h})\tilde{\varphi_h} \tag{29}$$

where $\tilde{\varphi_h}$ is the average productivity of high-tech firms. Therefore, replacing (28) in (23) gives the Job Creation curve for high technology firms:

$$w_h(\varphi) = \frac{\sigma-1}{\sigma-\beta}p_h^d(\tilde{\varphi_h})\tilde{\varphi_h}\gamma - \frac{c}{m(\theta_h)}\frac{r+s}{1-\delta} \tag{30}$$

B The Entry Cutoff

Inserting (2.46),(2.47) and (2.48) into (2.44) yields

$$f_e = (\varphi_d^*)^{-k}\frac{\overline{\Pi}}{r+\delta} \tag{31}$$

where

$$\frac{\overline{\Pi}}{r+\delta} = \frac{\overline{\Pi}_\ell^d}{r+\delta} + (\frac{\varphi_x^*}{\varphi_d^*})^{-k}\frac{\overline{\Pi}_\ell^x}{r+\delta} + (\frac{\varphi_h^*}{\varphi_d^*})^{-k}\frac{\overline{\Pi}_h}{r+\delta} \tag{32}$$

Average profit of a low-tech firms producing for only domestic market is

$$\frac{\overline{\Pi}_\ell^d}{r+\delta} = \int_{\varphi_d^*}^{\varphi_x^*} \frac{\Pi_\ell^d}{r+\delta}\frac{g(\varphi)}{1-G(\varphi_d^*)}d\varphi \tag{33}$$

whereas average profit of a low-tech firm serving for both markets is

$$\frac{\overline{\Pi}_\ell^x}{r+\delta} = \int_{\varphi_x^*}^{\varphi_h^*} \frac{\Pi_\ell^x}{r+\delta}\frac{g(\varphi)}{1-G(\varphi_x^*)}d\varphi \tag{34}$$

Finally, average profit of a high-tech firm serving for both market is

$$\frac{\overline{\Pi}_h^x}{r+\delta} = \int_{\varphi_h^*}^{\infty} \frac{\Pi_h^x}{r+\delta}\frac{g(\varphi)}{1-G(\varphi_h^*)}d\varphi \tag{35}$$

Using these average profit equations, FE condition can be written as

$$f_e = (\varphi_d^*)^{-k}[\int_{\varphi_d^*}^{\varphi_x^*} \frac{\Pi_\ell^d}{r+\delta}\frac{g(\varphi)}{1-G(\varphi_d^*)}d\varphi + \int_{\varphi_x^*}^{\varphi_h^*} \frac{\Pi_\ell^x}{r+\delta}\frac{g(\varphi)}{1-G(\varphi_x^*)}d\varphi + (\frac{\varphi_h^*}{\varphi_d^*})^{-k}\int_{\varphi_h^*}^{\infty} \frac{\Pi_h^x}{r+\delta}\frac{g(\varphi)}{1-G(\varphi_h^*)}d\varphi \tag{36}$$

Inserting (2.28), (2.30), (2.32) and (2.34) into (36) yields

$$\varphi_d^* = \Psi^{\frac{1}{k}}[f_\ell + \rho_x f_x + (\eta-1)\rho_h f_\ell]^{\frac{1}{k}} \tag{37}$$

where

$$\Psi = [\frac{r+1}{r+\delta}\frac{\sigma-1}{k-\sigma+1}\frac{1}{f_e}] \tag{38}$$

C Comparative Statics

C.1 The Effects of Trade Liberalization on θ_ℓ and θ_h

1. A reduction in τ increases labor market tightness of both skill groups: $\frac{\partial\theta_h}{\partial\tau} < 0$ and $\frac{\partial\theta_\ell}{\partial\tau} < 0$.

Labor market clearing conditions for unskilled and skilled workers are

$$LC_\ell(\theta_\ell, \theta_h) = LD_\ell(\theta_\ell, \theta_h) - LS_\ell(\theta_\ell, \theta_h) = 0$$

$$A\frac{1 + \frac{\rho_x f_X}{f_L} - \frac{\rho_h(\eta-1)}{\lambda^{\sigma-1}-1}}{\beta\theta_\ell + \frac{(1-b+b\beta)(r+s)}{m_0\theta_\ell^{-\alpha}}} - \frac{m_0\theta_\ell^{1-\alpha}}{s + m_0\theta_\ell^{1-\alpha}}(1-\rho_s)L = 0 \tag{39}$$

$$LC_h(\theta_\ell, \theta_h) = LD_h(\theta_\ell, \theta_h) - LS_h(\theta_\ell, \theta_h) = 0 \tag{40}$$

$$A\frac{\frac{\rho_h(\eta-1)\lambda^{\sigma-1}}{\lambda^{\sigma-1}-1}}{\beta\theta_h + \frac{(1-b+b\beta)(r+s)}{m_0\theta_h^{-\alpha}}} - \frac{m_0\theta_h^{1-\alpha}}{s + m_0\theta_h^{1-\alpha}}\rho_s L = 0 \tag{41}$$

where

$$A = \frac{(r+1)(\sigma-1)(1-b)kf_L}{(k-\sigma+1)c} \tag{42}$$

Taking the total derivative of both labor market clearing conditions with respect to τ yields

$$\frac{\partial LC_\ell}{\partial\theta_\ell}\frac{d\theta_\ell}{d\tau} + \frac{\partial LC_h}{\partial\theta_\ell}\frac{\partial\lambda}{\partial\theta_\ell}\frac{d\theta_\ell}{d\tau} + \frac{\partial LC_\ell}{\partial\theta_h}\frac{\partial\lambda}{\partial\theta_h}\frac{d\theta_h}{d\tau} + \frac{\partial LC_\ell}{\partial\tau} = 0 \tag{43}$$

Note that skilled labor market tightness (θ_h) affects unskilled labor market only through the marginal cost advantage of high technology (λ). Taking the total derivative of (39) with respect to τ produces the following equation.

$$-X_\ell\frac{d\theta_\ell}{d\tau} - Z_\ell\frac{d\theta_h}{d\tau} = T_\ell \tag{44}$$

where

$$X_\ell = A(k-\sigma+1)\frac{\rho_h(\eta-1)}{(\lambda^{\sigma-1}-1)^2}\lambda^{\sigma-2}\frac{\partial\lambda}{\partial\theta_\ell}\frac{1}{\beta\theta_\ell + \frac{(1-b+b\beta)(r+s)}{m_0\theta_\ell^{-\alpha}}}$$

$$+\frac{m_0\theta_\ell^{-\alpha}}{s + m_0\theta_\ell^{1-\alpha}}(1-\rho_s)L\left[\frac{\theta_\ell\left(\beta + \frac{(1-b+b\beta)(r+s)\alpha}{m_0\theta_\ell^{1-\alpha}}\right)}{\beta\theta_\ell + \frac{(1-b+b\beta)(r+s)}{m_0\theta_\ell^{-\alpha}}} + \frac{s(1-\alpha)}{s + m_0\theta_\ell^{1-\alpha}}\right] > 0 \tag{45}$$

$$Z_\ell = A(k-\sigma+1)\frac{\rho_h(\eta-1)}{(\lambda^{\sigma-1}-1)^2}\lambda^{\sigma-2}\frac{\partial\lambda}{\partial\theta_h}\frac{1}{\beta\theta_\ell + \frac{(1-b+b\beta)(r+s)}{m_0\theta_\ell^{-\alpha}}} < 0 \tag{46}$$

$$T_\ell = A\frac{k}{\tau}\left[\frac{\rho_x f_x}{f_\ell} - \frac{\rho_h(\eta-1)\tau^{1-\sigma}}{(\lambda^{\sigma-1}-1)(\tau^{1-\sigma}+1)}\right]\frac{1}{\beta\theta_\ell + \frac{(1-b+b\beta)(r+s)}{m_0\theta_\ell^{-\alpha}}} > 0 \tag{47}$$

Total derivation of skilled labor market clearing condition with respect to τ yields

$$\frac{\partial LC_h}{\partial\theta_\ell}\frac{\partial\lambda}{\partial\theta_\ell}\frac{d\theta_\ell}{d\tau} + \frac{\partial LC_h}{\partial\theta_h}\frac{d\theta_h}{d\tau} + \frac{\partial LC_h}{\partial\theta_h}\frac{\partial\lambda}{\partial\theta_h}\frac{d\theta_h}{d\tau} + \frac{\partial LC_h}{\partial\tau} = 0 \tag{48}$$

Akin to (48), the effect of unskilled tightness(θ_ℓ) on skilled labor market is only through the marginal cost advantage of high technology (λ). Using (41) and taking the total derivative with respect to τ produces the following equation.

$$X_h\frac{d\theta_\ell}{d\tau} + Z_h\frac{d\theta_h}{d\tau} = T_h \tag{49}$$

where

$$X_h = A\frac{\rho_h(\eta-1)}{\lambda^{\sigma-1}-1}\lambda^{\sigma-2}\frac{\partial\lambda}{\partial\theta_\ell}\frac{1}{\beta\theta_h + \frac{(1-b+b\beta)(r+s)}{m_0\theta_h^{-\alpha}}}\left[(\sigma-1) + \frac{(k-\sigma+1)\lambda^{\sigma-1}}{\lambda^{\sigma-1}-1}\right] > 0 \tag{50}$$

$$Z_h = A\frac{\rho_h(\eta-1)}{\lambda^{\sigma-1}-1}\lambda^{\sigma-2}\frac{\partial\lambda}{\partial\theta_\ell}\frac{1}{\beta\theta_h + \frac{(1-b+b\beta)(r+s)}{m_0\theta_h^{-\alpha}}}\left[(\sigma-1) + \frac{(k-\sigma+1)\lambda^{\sigma-1}}{\lambda^{\sigma-1}-1}\right]$$

$$+\frac{m_0\theta_\ell^{-\alpha}}{s+m_0\theta_\ell^{1-\alpha}}\rho_s L\left[\frac{\theta_h\left(\beta + \frac{(1-b+b\beta)(r+s)\alpha}{m_0\theta_h^{1-\alpha}}\right)}{\beta\theta_h + \frac{(1-b+b\beta)(r+s)}{m_0\theta_h^{-\alpha}}} + \frac{s(1-\alpha)}{s+m_0\theta_h^{1-\alpha}}\right] < 0 \tag{51}$$

$$T_h = A\frac{k}{\tau^\sigma}\left[\frac{\rho_h(\eta-1)\lambda^{\sigma-1}}{(\lambda^{\sigma-1}-1)(\tau^{1-\sigma}+1)}\right]\frac{1}{\beta\theta_h + \frac{(1-b+b\beta)(r+s)}{m_0\theta_h^{-\alpha}}} > 0 \tag{52}$$

From (44) and (49), we know that

$$\frac{d\theta_h}{d\tau} = \frac{\frac{T_h}{X_h} + \frac{T_\ell}{X_\ell}}{\frac{Z_h}{X_h} - \frac{Z_\ell}{X_\ell}} \tag{53}$$

$$\frac{d\theta_\ell}{d\tau} = \frac{T_h}{X_h} - \frac{Z_h}{X_h}\frac{\frac{T_h}{X_h} + \frac{T_\ell}{X_\ell}}{\frac{Z_h}{X_h} - \frac{Z_\ell}{X_\ell}} \tag{54}$$

After some algebra one can show that both $\frac{d\theta_h}{d\tau}$ and $\frac{d\theta_\ell}{d\tau}$ are lower than zero.

2. A reduction τ increases θ_h more than θ_ℓ: $|\frac{d\theta_h}{d\tau}| > |\frac{d\theta_\ell}{d\tau}|$.

In order to prove that θ_ℓ: $|\frac{d\theta_h}{d\tau}| > |\frac{d\theta_\ell}{d\tau}|$, it is sufficient to show

$$\frac{\frac{T_h}{X_h} + \frac{T_\ell}{X_\ell}}{\frac{Z_h}{X_h} - \frac{Z_\ell}{X_\ell}} < \frac{T_h}{X_h} - \frac{Z_h}{X_h}\frac{\frac{T_h}{X_h} + \frac{T_\ell}{X_\ell}}{\frac{Z_h}{X_h} - \frac{Z_\ell}{X_\ell}} \tag{55}$$

This inequality boils down to

$$\frac{\tau^{1-\sigma}}{\tau^{1-\sigma}+1} + \rho_x \frac{f_x}{f_\ell}\left(\frac{\tau^{1-\sigma}}{\tau^{1-\sigma}+1} - 1\right) < 0 \tag{56}$$

which can be proved by $\varphi_x^* > \varphi_d^*$.

3. Skill premium paid by firms increases and marginal cost advantage of high technology decreases due to a reduction in τ.

Since $|\frac{d\theta_h}{d\tau}| > |\frac{d\theta_\ell}{d\tau}|$, Note that the marginal cost advantage of high technology is a function of relative labor market frictions $\frac{\beta\theta_h + \frac{(1-b+b\beta)(r+s)}{m(\theta_h)}}{\beta\theta_\ell + \frac{(1-b+b\beta)(r+s)}{m(\theta_\ell)}}$ increases. Consequently, the marginal cost advantage of high technology

$$\lambda = \frac{\gamma}{\frac{\beta\theta_h + \frac{(1-b+b\beta)(r+s)}{m(\theta_h)}}{\beta\theta_\ell + \frac{(1-b+b\beta)(r+s)}{m(\theta_\ell)}}} \tag{57}$$

falls due to liberalization.

C.2 The Effects of Trade Liberalization on Probabilities of Exporting and Technology Adoption

1. The probability of exporting: ρ_x

A reduction in τ has only a direct effect on the probability of exporting. Since

ρ_x is defined as

$$\rho_x = \frac{1 - G(\varphi_x^*)}{1 - G(\varphi_d^*)} = \left(\frac{\varphi_x^*}{\varphi_d^*}\right)^{-k} = \left(\frac{f_x}{f_\ell}\right)^{\frac{-k}{\sigma-1}} \tau^{-k} \tag{58}$$

It is directly seen that $\frac{\partial \rho_x}{\partial \tau} < 0$.

2. The probability of technology adoption: ρ_h

Direct Effect: A reduction in τ increases the probability of technology adoption: ρ_h.

We have defined ρ_h as:

$$\rho_h = \frac{1 - G(\varphi_h^*)}{1 - G(\varphi_d^*)} = \left(\frac{\varphi_h^*}{\varphi_d^*}\right)^{-k} = \left[\frac{\eta - 1}{(\tau^{1-\sigma} + 1)(\lambda^{\sigma-1} - 1)}\right]^{\frac{-k}{\sigma-1}} \tag{59}$$

Equation (59) implies that $\frac{\partial \rho_h}{\partial \tau} < 0$.

Indirect Effect: We have shown that liberalization increases the skill premium paid by firms and consequently reduces the marginal cost advantage of high technology (λ). A reduction in λ decreases the probability of technology adoption: ρ_h. Again, this can be seen from (59): $\frac{\partial \rho_h}{\partial \lambda} > 0$. Therefore, indirect effect moves Labor Demand of skilled in opposite direction.

Net Effect: From labor market clearing conditions (39) and (39), we can write the relative demand for unskilled as

$$\frac{LD_\ell}{LD_h} = \frac{1 + \frac{\rho_x f_X}{f_L}(\lambda^{\sigma-1} - 1) - \rho_h(\eta - 1)}{\rho_h(\eta - 1)\lambda^{\sigma-1}} \tag{60}$$

We have shown that $|\frac{d\theta_h}{d\tau}| > |\frac{d\theta_\ell}{d\tau}|$. Therefore, the relative demand for unskilled falls due to liberalization: $\frac{\partial\left(\frac{LD_\ell}{LD_h}\right)}{\partial \tau} >$). Note that ρ_x increases and λ falls due

to liberalization. Therefore, ρ_h must be increasing to after a reduction τ for relative demand for unskilled to fall.

C.3 The Effects of Trade Liberalization on Cutoff Productivities

1. Exporting Cutoff: φ_x^*

We know that probability for exporting is $\rho_x = \left(\frac{\varphi_x^*}{\varphi_d^*}\right)^{-k}$. Inserting entry cutoff (2.49) into the exporting cutoff reads

$$(\varphi_x^*) = \Psi^{\frac{1}{k}} \left[\frac{f_\ell}{\rho_x} + f_x + (\eta - 1)\frac{\rho_h}{\rho_x} f_\ell\right]^{\frac{1}{k}} \tag{61}$$

Note that

$$\frac{\rho_h}{\rho_x} = \left[\frac{\tau^{1-\sigma}}{1+\tau^{1-\sigma}} \frac{f_\ell}{f_x} \frac{\eta - 1}{\lambda^{\sigma-1} - 1}\right]^{-\frac{k}{\sigma-1}} \tag{62}$$

As τ falls, *lambda* decreases and $\frac{\tau^{1-\sigma}}{1+\tau^{1-\sigma}}$ increases. Hence, the ratio of probabilities in (62) falls. We have shown that ρ_x rises as τ falls. Consequently, the exporting cutoff falls.

2. Technology Cutoff: φ_h^*

We know that probability for technology adoption is $\rho_h = \left(\frac{\varphi_h^*}{\varphi_d^*}\right)^{-k}$. Inserting entry cutoff (2.49) into the technology cutoff reads

$$(\varphi_h^*) = \Psi^{\frac{1}{k}} \left[\frac{f_\ell}{\rho_h} + \frac{\rho_x}{\rho_h} f_x + (\eta - 1) f_\ell\right]^{\frac{1}{k}} \tag{63}$$

The derivative of the technology cutoff with respect to τ gives

$$\frac{\partial \varphi_h^*}{\partial \tau} = \frac{\varphi_h^*}{\left[\frac{f_\ell}{\rho_h} + \frac{\rho_x}{\rho_h} f_x + (\eta - 1) f_\ell\right]} \left[\frac{\frac{\partial \rho_x}{\partial \tau}\rho_h - \frac{\partial \rho_h}{\partial \tau}\rho_x}{\rho_h^2} f_x - \frac{1}{\rho_h^2}\frac{\partial \rho_h}{\partial \tau} f_\ell\right] \tag{64}$$

To demonstrate $\frac{\partial \varphi_h^*}{\partial \tau} > 0$ we need to show that

$$\frac{\partial \rho_x}{\partial \tau} \rho_h \frac{f_x}{f_\ell} > \frac{\partial \rho_h}{\partial \tau} \left(\rho_x \frac{f_x}{f_\ell} + 1 \right) \tag{65}$$

We know that $\frac{\partial \rho_x}{\partial \tau} < 0$ and $\frac{\partial \rho_h}{\partial \tau} < 0$. Also, since $\frac{\partial \left(\frac{\rho_x}{\rho_h} \right)}{\partial \tau} < 0$, we can show that $|\frac{\partial \rho_x}{\partial \tau}| > |\frac{\partial \rho_h}{\partial \tau}|$. Then, in order to demonstrate $\frac{\partial \varphi_h^*}{\partial \tau} > 0$, it is sufficient to show $\rho_h \frac{f_x}{f_\ell} < \rho_x \frac{f_x}{f_\ell} + 1$. We know that $\varphi_x^* < \varphi_h^*$, then $\rho_x > \rho_h$. Now we can show that

$$\rho_h \frac{f_x}{f_\ell} < \rho_x \frac{f_x}{f_\ell} < \rho_x \frac{f_x}{f_\ell} + 1 \tag{66}$$

Therefore, a reduction in τ leads technology cutoff to fall: $\frac{\partial \varphi_h^*}{\partial \tau} > 0$.

3. Entry Cutoff: φ_h^*

1. Direct Effect: A reduction τ increases the cutoff for entry: $\frac{\partial \varphi_d^*}{\partial \tau} < 0$.

Also, since ρ_x and ρ_h increases due to liberalization, (61) implies that $\frac{\partial \varphi_d^*}{\partial \tau} < 0$. Consequently, the probability for entry $\rho_e = 1 - G(\varphi_d^*) = (\varphi_d^*)^{-k}$ falls: $\frac{\partial \rho_e}{\partial \tau} > 0$.

2. Indirect Effect: A reduction λ reduces the entry cutoff: φ_d^*.

After liberalization ρ_h decreases due to a fall in λ. Entry cutoff (61) implies that $\frac{\partial \varphi_d^*}{\partial \rho_h} > 0$. This result suggest that indirect effect of trade liberalization reduces the cutoff for entry $\frac{\partial \varphi_d^*}{\partial \lambda} > 0$. Consequently, the probability for entry $\rho_e = 1 - G(\varphi_d^*) = (\varphi_d^*)^{-k}$ rises: $\frac{\partial \rho_e}{\partial \lambda} > 0$. However, we know that direct effect dominates for ρ_h. Therefore, the entry cutoff rises and the probability of entering (ρ_e) falls after a liberalization policy.

D Robustness Checks

Table 3.9 reports the Heckman two-stage results for the years 2005 and 2008. Since most of the multinationals are exporters in 2013, foreign ownership variable drops out from the regressions. Therefore, the results for 2013 are excluded from Table 3.9.

Table 3.9: Heckman selection estimation results by year

	First Stage		Second Stage	
	2005	2008	2005	2008
Ln(size)	0.25***	0.40***	1.24***	1.13***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(prod.)	0.19***	0.28***	1.00***	1.08***
	(0.000)	(0.000)	(0.000)	(0.000)
Training	0.13	-0.18	-0.05	0.07
	(0.35)	(0.26)	(0.72)	(0.63)
University	-0.40	0.11	-0.56	-1.13**
	(0.54)	(0.84)	(0.32)	(0.01)
Product in.	0.33**	0.30**	-0.04	-0.21
	(0.01)	(0.04)	(0.78)	(0.19)
For. own.	1.83	0.89	-0.17	0.88
	(0.34)	(0.19)	(0.77)	(0.10)
For. inp.	1.09***	0.57**	0.01	0.13
	(0.00)	(0.03)	(0.97)	(0.62)
Loan	0.12	0.20	0.02	0.21
	(0.35)	(0.19)	(0.86)	(0.18)
$\frac{Loan}{Sales}$	0.02	0.22	0.00	-0.10
	(0.39)	(0.46)	(0.54)	(0.28)
Quality	0.02	0.53***	-0.07	0.14
	(0.91)	(0.00)	(0.59)	(0.50)
Website	0.41***	0.28	0.11	0.22
	(0.00)	(0.16)	(0.56)	(0.47)
Constant	-3.90***	-5.88***	-2.00	-3.36
	(0.00)	(0.00)	(0.22)	(0.15)
N	626	490	404	308
Wald chi2	746.70	368.20	746.70	368.20
$Prob > chi2$	0.00	0.00	0.00	0.00
Ind.*year fe	Yes	Yes	Yes	Yes
Region fe	Yes	Yes	Yes	Yes

The numbers in parenthesis denote p-values. $***$, $**$ and $*$ indicates the statistical significance at the 1%, 5% and 10%, respectively.