Essays on Trade, Specialization, and Development

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The University of St. Gallen, Graduate School of Business Administration, Economics, Law and Social Sciences (HSG) hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St. Gallen, September 28, 2010

The President:

Prof. Ernst Mohr, PhD

to my daughter

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Writing a thesis takes a long time, usually more than we anticipate. Working with various research topics until we get a full coverage of the issues with new insights; and then hoping to contribute a drop to the knowledge and wisdom ocean… Until then we have to motivate ourselves over and over by countering the big questions of 'what on earth am I doing?' and its derivatives like 'Is what I am doing really relevant, for academic or for society?'. But the contentment and pleasure we get after putting the last full stop to the dissertation makes us forget all difficulties that we had to overcome. Now I am grateful to all people who made this thesis possible.

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CHAPTER 1

INTRODUCTION

Factors of productions as well as the productive capacity of these factors are unevenly distributed over the world. Given the differences in factor endowments and productivity, people trade what they produce more than they need with those that they produce less than they need. When borders are drawn between the societies, deeds and needs in a society did not always match one another. Since each member of a society can contribute to the production of only a limited range of goods and services, optimization of total output is thought to hinge on the proficiency of the agents in a society in production of certain goods. As agents became increasingly specialized in what they accidentally, intentionally or forcibly started doing, the range, volume and quality of the goods through which they contributed to social welfare increased. As the range and quality of the goods produced in one society did not always match those produced in other societies ('foreigners'), people across the borders started exchanging the goods they produced with 'foreign' products at a rate determined by their willingness to pay for them. Being unable to compete with

their counterparts, some entrepreneurs called for protection against the goods coming across the borders.

Then some agents in these societies started discussing the wisdom of such an exchange on the well-being of society and then measuring the welfare impacts of trade and trade liberalization. They generally emphasized the significant role of trade in enhancing the welfare of societies. Theories featuring comparative advantage and factor abundance popped up characterizing the patterns of trade. When these theories failed to describe the trade patterns under certain conditions, 'new' trade theories, and subsequently theoretical works with firms operating under different productivity levels, were introduced. In most of these studies, these agents did not refrain from propagating higher specialization to achieve highest productivity levels and better economic performance. However, due to uneven distribution of skills and abundance, some societies faced a trade-off between specializing according to existing patterns and taking risks to discover new productive sectors, seeing that the discovery process might require some sort of diversification.

On the other hand, the number of agents emphasizing the importance of trade structure in economic performance has steadily increased. The question that they chiefly tried to answer was what actually determines the structure of trade; deterministic factors like factor abundance and skill or rather idiosyncratic elements. Some societies experience idiosyncratic economic and financial shocks; do they in fact explain any part of the story? Some other societies integrate to become economically more competitive; should we expect any restructuring in trade and production when societies virtually merge with each other? Or, is export diversification indeed a source of successful discovery of productive potentials?

These questions are still not answered properly and we lack convincing evidence on which factors account for the determination of relative trade structures for better economic performance. The questions raised in this rather unusual introduction involve the main inspiring elements in writing this thesis and we attempt to provide some evidence on these issues. In this context, we

analyze whether diversification of export structure is a source of productivity growth through discovery of new industries, whether greater economic integration influences the patterns of trade within the countries involved and finally whether economic and financial crises as idiosyncratic shocks have any impact on what countries export.

1.1 TRADE, SPECIALIZATION, AND DEVELOPMENT

In effect, we will neither discuss the terms specified in the title, nor explain the linkages between them. We extensively discuss them within the coming chapters. Instead, we unconventionally and somewhat provocatively question some of the common perceptions on trade, specialization, and development. It is no wonder that governments endeavor to raise the living standards of their residents. A belief that this natural process is a competition between nations and that development must come at the cost of others paralyzes the development of some nations; especially of weaker ones, as stronger ones determine the rules and may follow beggar-thy-neighbor approaches. Our explanation will be based on trade theories and policies.

Trade theories predict that richer countries export more technologically intensive and sophisticated products. Logically, countries that specialize in goods that richer countries export may grow faster than countries specializing in other goods. The very same theories predict that specialization according to existing comparative advantages increases the chance of growing faster, but existing comparative advantages may not necessarily be growth inducing. From the policy perspective, countries aiming to capture the range of goods with higher productivity returns within their borders may apply certain restrictions on trade until and/or after they obtain production advantages. It is in fact the instinct to rise above other nations that provokes countries to put restrictions. The spirit of competition is, however, not to defeat but improve against the others.

Admittedly, not every country can produce the same range and quality of goods. Even if we witness one day that all countries are rich, they will not produce the same products, but they will have to differentiate their products from others. Essentially there are no 'poor- or rich-making' commodities, but there are goods that can be produced with higher productivity or with lower productivity, or there are rich countries that can produce at higher productivity and poor countries that can produce at lower productivity. What leads to producing at higher productivity may include skills, absorptive capacity, or institutional quality. Improving the conditions that can initiate production of goods at higher productivity levels requires resources to be spent on human and physical capital investment. Until reaching some threshold, countries tend to direct these investments to build up the capabilities according to existing production structure. Countries that start with potentially less productive industries tend to suffer from low returns to their investments. They will then need to redirect the resources to discover new productive sectors with higher returns.

Higher standards of living are what mankind dreams about. The way they try to reach to these standards can be destructive if they believe that these are only possible at the cost of other nations. Free trade, however, opens the door for discovery of productive capacities. With free trade, every nation has equal opportunity in accessing foreign markets in order to experience their strengths and weaknesses and share ideas. Therefore, instead of blindly encouraging specialization or diversification in production and trade, why not let countries discover their capabilities through free trade.

1.2 ORGANIZATION AND CONTRIBUTIONS OF THE THESIS

The foremost motivation for the thesis comes from the idea that factor endowments, skills, and quality differences may not explain the real boundaries shaping the production and trade structure in promoting economic performance and idiosyncratic elements may contribute to pinning down the shape of actual frontiers. Specialization patterns are naturally not completely

predictable and we lack the understanding on the clear determinants of trade structure, but we do not claim that we can provide the answer. By investigating two important economic adjustment mechanisms, we aim to enhance our understanding on the factors that may contribute to shaping trade structure.

In the first case, we study the impact of greater economic integration (namely monetary unions) in several aspects. Cost reductions due to greater economic integration may have substantial impact on the firms and industries of the countries involved. When analyzing the relationship between trade and monetary union, existing studies concentrate mainly on the volume effects of monetary unions and ignore the potential restructuring in trade and production within and between the member countries. In the first chapter, we take the case of the Eurozone and test several predictions regarding the behavior of firms and industries. In this framework, we study the export behavior of small and medium sized enterprises, adjustments in specialization and concentration of export, and location of differentiated and high-tech industries. In all cases, we provide important empirical evidences and thus contribute to the literature.

The next chapter focuses on a relatively rarely studied field and investigates the association between crisis and trade. There are papers analyzing the impact of trade on crisis and few others studying the impact of crisis on the level of trade. Post-crisis developments, on the other hand, have not attracted much attention and no persuasive link has yet been established between crises and trade. By placing particular emphasis on the nature of crises, this second essay attempts to fill this gap in the literature by providing the first evidence on the potential impacts of crises on trade structure.

Welfare impacts of trade and trade liberalization are well documented in the literature. Recent empirical works highlight the importance of trade structure in economic development as well. The channels through which trade structure may improve economic performance are, however, widely ignored. Productivity growth is one of the salient channels contributing to better economic performance. Finally in the last chapter, we scrutinize the role of export diversification as a cost discovery process on productivity growth. There is

again to the author's knowledge no study conducted in investigating the relationship between export diversification and productivity growth and by providing early evidence, we hope to contribute to the literature.

Consequently, the thesis consists of three eminently empirical essays. Each of them concentrates on different dynamics to find out causal relationships between different economic phenomena. Research questions are all policy relevant and the outcomes yield important insights on each distinct issue. This may in turn stimulate further research studies in the related fields.

CHAPTER 2

TRADE AND SPECIALIZATION IN THE EUROZONE

ABSTRACT

This paper investigates the reallocation of export and production in the Eurozone following the reductions in trade costs due to monetary union. For this purpose, several hypotheses and predictions are contemplated and tested. These include the product specialization dynamics, export behavior of small and medium sized enterprises, trade in high tech products, and trade in industries with differentiated products. The findings reveal that SMEs, and especially medium-sized enterprises, benefit from cost reductions in entering into export markets. There is home-market effect in the EZ, which is below the world average, and it persists in spite of the single currency. This implies that the cost reductions following monetary

union have no significant impact on trade in differentiated products. We additionally find reduction in specialization and concentration of exports due to elimination of exchange rate volatility and detect structural breaks in specialization and concentration of exports in 1998 and 1999. Finally, though the impact is economically not too strong, the single currency diminishes the importance of being located at the core for the export of the high-tech commodities.

JEL Codes: F1, F33, D21
Keywords: Monetary Union, Trade, Specialization, Export Behavior of SME's, Trade in High-Tech and Differentiated Industries.

2.1 INTRODUCTION

There are only a few monetary unions formed by sovereign countries that were previously using their own currency. Sacrificing one's own monetary independence and sharing a common currency with several other countries should be considered separately from being unable to manage to print own currency and thus unilaterally letting circulate another country's currency. In the first case, by forming a currency union, countries hope to benefit in various aspects at the cost of losing their monetary independence, where they believe the benefits outweigh the costs. That naturally prompts passionate debates within each country. In the second case, however, a country lacks the fundamentals to establish its own monetary authority and desperately needs to take shelter of another country's monetary supervision, through ways including unilateral dollarization or euroization. Previous studies on the effects of monetary union, however, do not distinguish between these two completely different phenomena and, when conducting their analysis, they simply pool them in a single basket of 'monetary unions'. Therefore, these studies should be literally called the studies analyzing the impacts of using the same currency, rather than monetary unions.

Forming a monetary union between countries having certain monetary independence is practically complicated and also controversial as it entails both benefits and costs. Though the topic may be linked to many research questions, its association with trade flows became one of the major research subjects of the last decade. The scope of the extensive works on trade impacts of monetary union, however, remained remarkably narrow. The previous studies focused typically on the volume effect of monetary union on trade, without paying attention to the particular dynamics that may lead to higher trade volumes. Only recently there appeared some works completed by utilizing micro data. This paper takes another step to go beyond the studies of how big is the magic and investigates the potential restructuring in trade within the member countries of monetary unions.

Contrary to the theoretical works, the lack of understanding in what countries export and clear determinants of factors affecting trade structure in empirical studies lead us to study the impacts of serious events on trade structure.[1] In this context, this paper aims to study the adjustments in trade structure following the adoption of single currency, in the case of the Eurozone.[2] The literature provides two important predictions on monetary unions. The first is that trade volumes will increase due to reductions in trade costs and the second is that the location of industries will change following greater economic integration. Straightforwardly, if trade increases in an environment where the industries are geographically mobile, the structure of trade may change as well. And that is the key point in starting the investigation on the potential adjustments in trade structure within the member countries of a monetary union.

Even though we restrict the study to a single union, the case of the Euro is sufficiently exciting to contemplate and during about a decade of its circulation, it naturally turned out to be a major subject in various intense discussions and debates. In the European Union (EU), trade costs have been falling for decades, promoting trade and investment among the member countries. The most recent significant episode in this direction was the formation of monetary union. In order to analyze the potential restructuring in the EZ, we derive several hypotheses and predictions on trade specialization and location of industries from economic theory and test them with the best available data. Discussion of these predictions and hypotheses will help understand and explain why composition and/or volume of trade in a monetary union may/should change. In doing so, we attempt to identify the changes in export behaviors of small-and-medium-sized enterprises (SMEs) stimulated by monetary union, overall

[1] In the next chapter, we analyze the impacts of economic and financial crises on trade structure.

[2] When studying the proposed impacts, one would ideally wish to study all the existing monetary unions (actually there are only two: West African Monetary Union and European Monetary union), but this is rather impractical not only because of their diverse backgrounds and structure of current formation but also data availability problems. Therefore, we restrict this study only to the European Monetary Union (EMU), or the Eurozone (EZ).

specialization dynamics in member countries, trade in differentiated goods, and trade in high-tech commodities.

This chapter is organized as follows. The next section provides some preliminary information on monetary union, some stylized facts on trade and investment in the Eurozone and identifies the main theoretical arguments made on the relationships between economic integration and trade along with previous empirical studies. In the following section, we present our hypotheses and predictions derived from previous studies. Section 2.4 discusses the empirical methodology and data and section 2.5 presents the main findings. Finally, section 2.6 concludes the chapter.

2.2 PAVING THE WAY

Greater economic integration of nations can potentially lead to changes both in trade structure of integrating countries and the location of industrial production. In addition to basic textbook facts on merits of monetary unions, different economic theories provide various predictions on the adjustments and transformations within a monetary union.

Trade structure may change due to several underlying reasons. The factors that can play major roles in shaping trade structure in various ways can be classified under three broadly categorized factors. These are firm, industry (or product), and country characteristics.[3] Characteristics of firm, like the size and productivity, influence the nature of trade where bigger firms are able to reap the benefits arising from economies of scale and only more productive firms survive in foreign markets. SMEs on the other hand are less able to hedge the risks that emerge due to exchange rate volatilities. Industry (or product)

[3] Apart from these three characteristics, sunk costs may play also significant role in trade concentration. If sunk costs are specific to individual destinations and destinations differ in terms of their productivity, relatively more productive firms will export to more destinations. Again if they are specific to individual products and products differ in terms of their productivity, relatively more productive firms will export wider range of products (Bernard et al. 2007).

characteristics may determine the place where the particular industries under certain conditions locate. Economic theory suggests some predictions on the location of industries with particular properties, depending on technology intensity, transportation costs, and level of product differentiation. Country characteristics, such as factor abundance, technology, market potential, and centrality, may be important for both firms and industries in exporting or investing in a particular territory. Country characteristics have been always at the centre of trade theories. Factor abundance and technology in old trade theories, market size in new trade theories and market potential and centrality in new economic geography literature constitute the major components of each stated literature.

Below we provide brief information on the opportunities that monetary union brings for enterprises, some basic stylized facts on trade and investment in the Eurozone, followed by a summary of theoretical discussions. After a short review of the literature, we provide a short discussion on the identification of the impact of the euro.

2.2.1 Doing Business in Monetary Union

Monetary union improves the economic environment in which firms operate in various ways. These include elimination of transaction costs and exchange rate uncertainty, increase in price transparency, and possibility to exploit economies of scale at a larger market.[4] Additionally firms save on administrative costs, costs arising from technical regulations being different, costs to obtain information (information costs), and costs from fragile financial conditions.[5]

[4] With or without mergers and acquisitions, opportunities for firms to trade in the single market increases, enabling them to exploit more economies of scale. Even small enterprises can benefit from economies of scale if they are able to pay for fixed entry costs, which become lower after monetary union.

[5] For instance, some countries benefit from cut in interest rates. Even the anticipation of entry into EMU has produced a remarkable shift in the interest rate structure in some countries by substantially narrowing the risk premia vis-a-vis German government securities.

Greater nominal exchange rate stability, lower transaction costs, and price transparency[6] reduce information costs and thereby enhance competition and increase international competitiveness of enterprises. Greater price transparency discourages price discrimination, decreases market segmentation and fosters competition.

The elimination of exchange rate uncertainty has a direct impact on investment and, with the reduction of transaction costs, on trade. Managing financial flows at a lower cost will be particularly important for small and medium-sized enterprises that are less able to benefit from economies of scale. In managing exchange rate risks, smaller firms are less able to hedge than larger firms because of three main reasons. The use of derivative markets is more costly for smaller transactions. They are also less likely to be diversified in terms of the currencies in which they transact. Lastly, small firms are less likely to have the financial resources to absorb adverse currency movements.

Exchange rate uncertainty discourages firms from selling in foreign markets due to a lack of price transparency as well.[7] Although the price will be known at the point of transaction when paid for immediately, the actual price in terms of domestic currency will remain unknown. This will apply to many transactions between firms, where payment is often made a month or more after delivery of the goods. Therefore, participation in a single currency may be an important benefit to especially small firms' trade and investment by removing currency risk, increasing transparency, and reducing transaction costs within the union.

This in itself would reduce the interest burden on government debt and serve as stimulus to investment by the private sector.

[6] The costs of raw materials, intermediate inputs, and labor across European countries were not quite transparent. Increased price transparency was expected to have far-reaching effects, on the capability, willingness, and desire of enterprises to change their production and operation processes. For instance, it might reduce the number of distribution and storage facilities across Europe, or even may change their operating bases for multinational enterprises.

[7] It also discourages consumers from purchasing directly from foreign markets due to a lack of price transparency. This in turn affects the volume of trade.

It is clear that monetary union not only decreases the costs of doing business, but it also extends the opportunities and improves conditions in which firms do business. Two critical elements coming forward from these considerations are higher market potential and reduction in trade costs through economies of scale and they play crucial roles in firms' investment and production decisions. Production decisions of individual enterprises with increasingly lower trade costs have been analyzed in the so-called 'new economic geography' literature and trade decisions in the 'new trade theory'. Theoretical arguments put in these literatures are discussed in section 2.4. We now describe the major predictions about the effect of introduction of monetary union, especially for the behavior of firms.

Apart from the improvements in doing business, the expectations of firms' prior to the introduction of monetary union carry significant importance, as expectations drive to a large extent the outcomes. In effect, the size of the market where the enterprises operate increases considerably, with particular impact on non-exporting enterprises, and competitive pressure on firms increases. And that requires a new business strategy for the enterprises. The introduction of the euro as the single currency was expected by the European Commission to have a profound impact on the way enterprises operate. In a survey conducted by KMPG in December 1996, 52% of German- based firms said that they had a strategy already in place. Almost three quarters said that they expected to benefit from the euro. Another survey of 302 European enterprises carried out towards the end of 1997 found that %81 of those companies had carried out at least some form of review (Charlton, 1999). These surveys clearly depict that the firms themselves were expecting some competitive pressure and they reevaluated their positions in the market.

For many firms, however, the expectations on a potential butterfly effect that the monetary union can generate in the economies joining the union were already tamed by the initial uncertainties on the success of the union, still prevailing perceptions on the globalization and established national agendas, and also economic and political risks coming along with the monetary union.

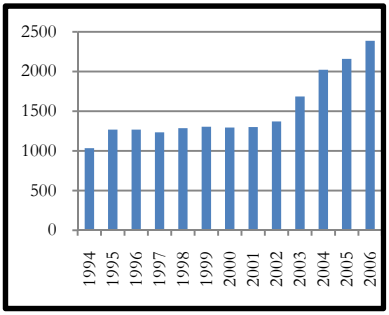
For that reason, we are not courageous enough to claim that the introduction of the euro may generate strong butterfly effect now or later in terms of its impact on trade and trade structure. However, small or large, some sort of restructuring is expected to take place and we attempt to quantify this impact.

2.2.2 A Glance at the Data

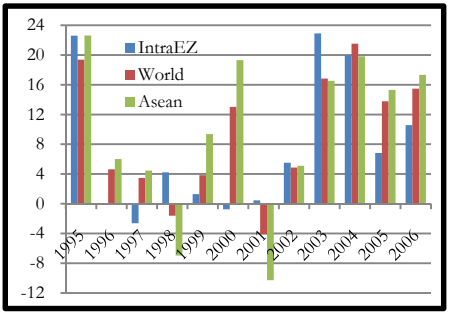
In this section, we present three important stylized facts on trade and investment. In doing so, we wish to extract any visible shifts in trade and investment in the EZ. The first descriptive evidence is on the volume of intra-EZ trade. Figure 2.1a shows that total exports in the EZ remained at around the same level until 2002, but then increased sharply. Impacts of currency union may have played a role in this increase. However, when we check the overall changes in trade in the world, we observe rather similar patterns in trade. Column b additionally shows the percentage changes in the world exports and exports of ASEAN to the world. Increase in total export after 2002 is not special to the Eurozone, but the rate of increase is much higher in the EZ in 1998, 2001, and 2003. In short, we found only little evidence supporting the impact of monetary and currency union on trade.

Figure 2.1: Total Export in the Eurozone and World

a) Total Export in the Eurozone



b) % Change in Total Export

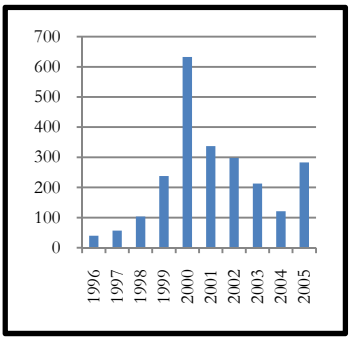


Source: Eurostat and WTO. In (b), percentage change with respect to previous year.

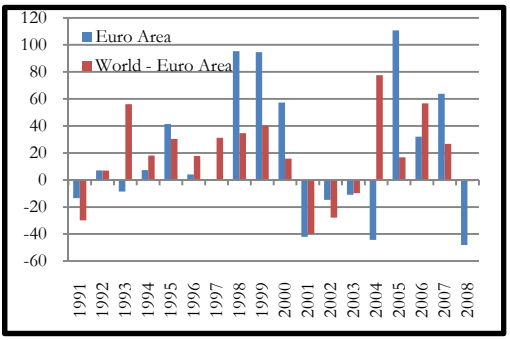
Figure 2.2 shows the peak in FDI inflows between 1999 and 2001, but since that might be the overall trend in the whole world, we check the relative increase in FDI inflows to the EZ compared to the FDI inflows in the world except the Euro Area. Column b in Figure 2.2 indicates that there was an over-proportional increase in the FDI inflows to the Euro Area between 1998 and 2000 as compared to other regions. Even though the FDI inflows are in general quite volatile, the dispersion in the growth rates of relative inflows is pretty informative. And this is fairly stronger evidence compared to the changes in trade figures and that may signal any changes in location of industries through FDI.

Figure 2.2: FDI Inflows in the Eurozone and World

a) Total FDI from EU15 to the EZ



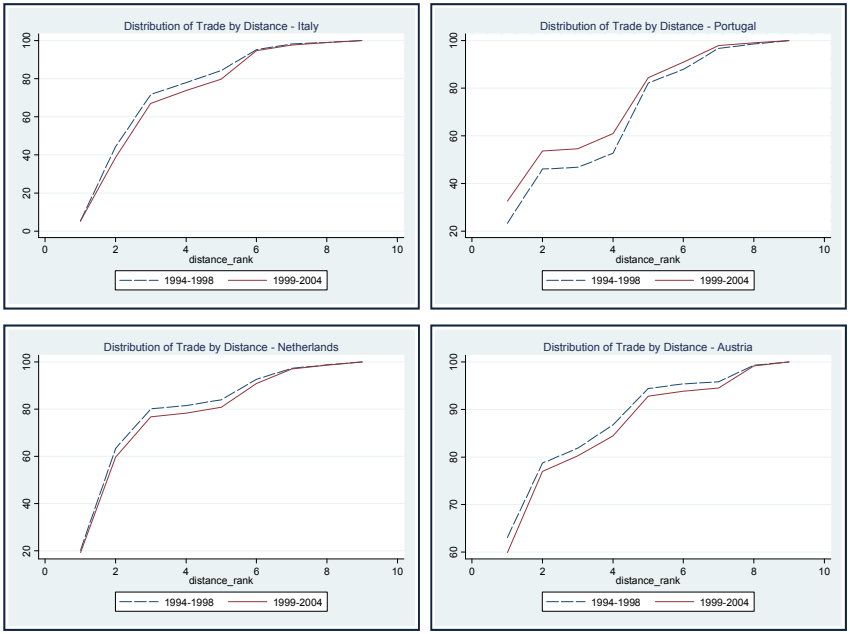
b) Growth Rates of FDI Inflows



Source: Eurostat and UNCTAD. Percentage change with respect to previous year.

In contrary to over-proportional increase in investments in the EZ, we do not observe the same compelling evidence in distribution of trade. Figure 2.3 depicts five-year averages of the cumulative distribution of trade of each member countries with other countries in the EZ with respect to the distance to the origin country before and after the currency union. In many countries, trade shares with remote members on average increase. For the countries located in the periphery (Portugal and Ireland) instead the reverse happens and their trade shares with neighbor countries increase and remote countries decrease.

Figure 2.3: Distribution of Trade by Distance



Source: Eurostat. Author's calculation.

In summary, an over-proportional increase in foreign direct investments in 1998 through 2000 and an increase in trade in 1998, 2001 and 2003 hint at the restructuring in investment and trade within the member countries of the union due to monetary union.

2.2.3 Theoretical Background on Trade and Industrial Production

The key outcome of monetary union is the reduction in trade costs and trade theories are commonly inclined to provide predictions toward higher specialization as trade costs fall. Both old and new trade theories and theories on economic geography predict higher specialization with increasing integration, or reducing trade costs. In old trade theory, comparative advantage drives countries to specialize in unique products. In the Heckscher-Ohlin

model, factor abundant countries export the goods that intensively use the abundant factors, giving rise to specialization again. Theories based on differences in production technology or factor abundance are less likely to explain trade between similar countries, as in the EZ countries.

In new trade theories, which are built on the assumptions of imperfect competition and increasing returns to scale, the price of a product depends inversely on the productivity of its producer. These theories are mostly designed to explain trade between similarly endowed countries and produced compelling evidences why similar countries may gain from trade. Economies specialize in order to take advantage of increasing returns, not due to differences in regional endowments (as contended by neoclassical theory). In particular, trade allows countries to specialize in a limited set of product groups and thus reap the advantages of increasing returns (i.e., economies of scale).

Heterogeneous-firm models of international trade (Melitz 2003, Bernard et al. 2003) assert that the existence of trade costs induces only the most productive firms to enter into export markets. Consequently, fall in fixed trade costs increases industry productivity due to expansion of high-productivity firms and also exit of low-productivity non-exporter firms. Cost reduction due to monetary union would be one of the natural experiments to be conducted in this framework to test the claimed hypothesis. This theoretical approach can be combined with the idea stated in the beginning: SMEs have difficulties in hedging risks arising from exchange rate uncertainty and, after this uncertainty disappears, otherwise competitive SMEs will likely enter into export markets that are productive enough to compete in foreign markets.

The literature on economic geography, on the other hand, suggests that greater economic integration leads to change in location of industries due to reducing trade costs. Firms locate their production facilities in the largest market where market size depends on the number of residents and jobs available, causing 'backward and forward linkages'. In an influential paper, Venables (1996) introduces a model based on vertically-linked industries, which is further extended by Krugman and Venables (1995), where agglomeration forces tend to

promote concentration of industrial activity via circular causality and changes in transportation cost determine the concentration of economic activity. Therefore, market size and number of industries requiring high proportion of intermediate inputs are the two main factors influencing the location of industries.

How does monetary union as a form of greater economic integration change the distribution of industrial activity and how is that will be reflected in trade composition if the location of particular industries changes? Firms' location is determined by underlying characteristics of market, like market potential, factor endowments and technology, which also determine the profitability of regions. If, as Venables (1995) argue, an increase in the number of firms at a location raises the return to other firms, then agglomeration effects will occur. As pointed out by Venables and some other studies on economic geography, the number of firms at a location can change through the "linkages" (backward-forward or input-output) and this change can affect the profitability of firms operating at the location. Same firms may be challenged with a new decision after monetary union if fall in trade costs is greater than the money they save from concentrating in a certain location. This can be relatively pronounced for particular groups of industries.

2.2.4 Related Literature

The empirical literature on trade effects of monetary union is voluminous but concentrated typically on the question of what is the 'volume' effect of trade. They exploit gravity equations in various forms to estimate the magnitude. Baldwin (2006) provides an outstanding review of literature and discusses some of the important mistakes made in the previous papers. The results found in majority of the papers reveal clear evidence in favor of higher trade volumes between member countries. It is however hardly possible to find a discussion why and how should that occur except a few papers (e.g., Alesina and Barro 2002).

Empirical studies analyzing trade effects of monetary union specific for the Euro area usually present positive effects. Micco et al. (2003) find 5-10% increase in bilateral trade among member countries, and even more cautious study by Bun and Klaassen (2004) suggests a 3% increase in trade by considering the trend effect as well. There are however controversial views in explaining the increase in trade. Some authors, for instance Nitsch (2002) and Berger and Nitsch (2005), argue that introduction of the Euro simply coincided with an accelerating process of European-wide political and institutional reforms favoring trade. Others, for instance Baldwin (2006), argue that the effect pertains more closely to the Euro itself and a rise in the number of exporting firms in a given country is likely to be the key to explain trade creation. In the same fashion, Fontagné and Freudenberg (1999) find that the elimination of exchange rate variability has fostered product differentiation in European trade: i.e., intra-industry trade is occurring more in horizontally differentiated goods (two-way trade in varieties) than in vertically differentiated goods (two-way trade in qualities).

Contrary to the literature on trade effects of monetary union, there are only a few studies on the location of industrial production in Europe. Venables (1995) argues in the European context that significant relocation of industries will happen with some countries losing a presence in some industries. The prediction of Venables is tested in empirical works investigating the question of whether greater economic integration affects the location of industries. Aiginger and Pfaffermayr (2004) and Storper et al. (2001) found evidence that geographic concentration did not increase in Europe during 1990s and Forslid (2002) finds an inverted U-shaped relation between trade costs and concentration in Europe. So the outcome is still inconclusive.

In a more closely related study to this paper, Midelfart-Knarvik et al. (2003) try to show how the introduction of the euro itself affect Europe's economic geography. But paradoxically their dataset does not cover the period the euro being used as the single currency, namely only from 1970 to 1997. Their methodology also does not rely on trade data, as suggested in this paper, so the

need to check the true effects still prevails. In another related paper, Mancini-Griffoli and Pauwels (2006) apply an end-of-sample structural break test by using panel data to measure the euro effect on trade and find indeed a short lived break in 1999Q1 by using a traditional gravity equation.

2.2.5 Identifying the Euro Impact

There are both measurable and immeasurable benefits of greater economic integration with monetary union. Elimination of exchange rate volatility and subsequent hedging costs, elimination of transaction costs and some other information costs are the main components of measurable part of the benefits. The huge literature on the impact of exchange rate volatility on trade provides no clear evidence and the findings are mostly mixed (see, e.g., Tenreyro 2007). On the other hand, perception of living in larger, more transparent, and expectedly more stable market bestow the economic agents with increased buoyancy and resilience that invigorate the enthusiasm to undertake new responsibilities. As a supporting premise to that idea, the story postulated by the "endogeneity of optimum currency area (OCA)" hypothesis has the implication that a monetary union may turn into an optimum currency area, even if it was not before (Frankel and Rose 1998). The basic intuition behind this hypothesis is that monetary integration reduces trading costs beyond the elimination of the costs from exchange rate volatility.

In estimating the impact of monetary union, we in general use dummy or interaction variables, which help to identify discrete changes in the variables of interest.[8] Whether the identified impact is completely attributable to monetary union is, however, ambiguous. In order to deal with this concern, we use nominal exchange rate volatility as a proxy for the reductions in trade costs after monetary union and conduct alternative estimations to verify the initial findings. Higher volatility is likely to depress the volume of trade as higher exchange rate

[8] The datasets we work with contains only data for the EZ countries and but no data for outside countries. Therefore dummy and interaction variables remain the most proper techniques in identification strategy.

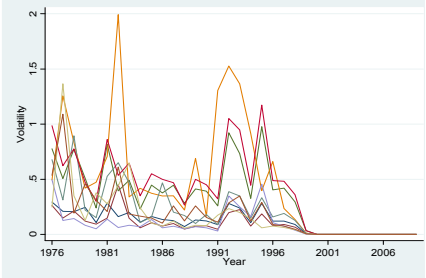
risk lowers the expected revenue from exporting[9] and monetary union eliminates this risk and validates the use of volatility as an instrument for the reductions in trade costs due to monetary union. We measure exchange rate volatility against ECU/Euro as

$$\sigma_i = std[d(\log(s_i)],$$

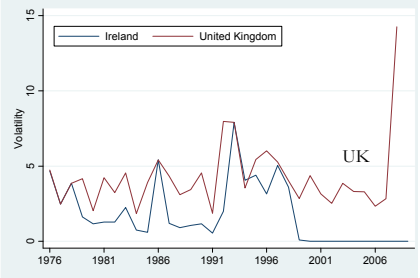
where s_i is the nominal exchange rate of country i against ECU/Euro. Explicitly, volatility is the standard deviation of the changes in the logarithm of bilateral exchange rates (as commonly defined in the literature, e.g., Gros and Thygesen 1998) and constructed using monthly data over 1.1976 to 12.2008 (Figure 2.4). This measure has the property of being zero in the presence of an exchange rate that follows a constant trend as after monetary union, therefore it is a plausible proxy for reductions in trade costs after monetary union.

Figure 2.4: Exchange Rate Volatility

a. Volatility in the Former Euro Area



b. Volatility in Ireland and UK



Notes: Former Euro Area countries include Austria, Belgium-Luxembourg, Finland, France, Germany, Italy, Netherlands, Portugal, and Spain (To keep the figure in panel (a) plain, the respective countries are not shown in the graph).

As depicted in Figure 2.4, volatility in the Eurozone countries was small but non-negligible before the introduction of the Euro. On the other hand, in two former members of ECU with relatively higher volatility, nominal exchange rate volatility disappeared in Ireland after monetary union but stayed at remarkably

[9] Risk-averse firms may reduce their foreign activity and relocate production toward domestic markets.

high levels in United Kingdom. This clearly depicts the gains from monetary union in terms of reductions in exchange rate volatility. It also validates the use of exchange rate volatility as a proxy for the reductions in trade costs after monetary union.

Awareness of living in a greater market with finer transparency probably provides more stimuli compared to cost advantages generated by the introduction of single currency. Without ignoring the non-negligible cost benefits of single currency, it is therefore reasonable to focus on this fairly abstract side of the benefits engendered by the monetary union. Since it is not possible to quantify this impact, the identification issue may remain a moot point in some cases. It is therefore not possible to conclusively identify and quantify which aspects of reductions in trade costs may actually account for the changes in trade structure.

2.3 ASPECTS OF RESTRUCTURING IN TRADE STRUCTURE

Inspired by the related empirical and theoretical studies in the literature, we identify several testable hypotheses and predictions with direct implications for firms and industries. Even though the discussion is oriented towards firms and industries, their impacts on trade structure among the member countries are evident. Increase in the number of exporting firms, for instance, can potentially explain the increase in trade volume at extensive margin. Or, trade in high-tech commodities in the union will be highly instructive in identifying the role of trade costs on location choice of industries in the core or periphery.

2.3.1 Implications for Firms: Size Matters

In its original framework, heterogeneous firm literature suggests that declining trade costs force low-productivity plants to exit the market either because of increased import competition from foreign varieties (Bernard et al. 2003) or because of increased probability of death at all levels of productivity after an increase in imports, while the death of low-productivity plants is actually driven

by the entry into exporting of other domestic firms (Melitz 2003). As is especially clear in Melitz's approach, decrease in trade costs reduces the cut-off level above which firms survive in export markets and reduced cut-off level eases the access to foreign markets. A natural implication of lower trade costs is higher trade volumes, as verified by empirical studies.

Whatever the level of reduction in trade costs, some firms will find their way to export markets with lower trade costs and with non-negligible cost reductions following monetary union. It is fair to expect that new firms will enter into export markets. Due to over-proportional benefits for SMEs, we hypothesize that these firms are largely SMEs. Below we first briefly discuss the importance of size in managing transactions in multiple currencies and then describe the two hypotheses that we derived from Helpman (2006) and Helpman et al. (2004).

2.3.1.1 Transactions in Multiple Currencies

In order to illustrate the significance of foreign exchange rate volatility on firm performance, we consider a simple cost function for managing foreign currency transactions. Trade costs due to transactions in multiple foreign currencies can be formulated for firm j as the sum of some fixed cost of foreign exchange risk management (q), which includes personnel and administrative costs, and variable costs of managing that risk depending on the size of transactions in foreign currency (k), volatility of exchange rate (σ), and rate of transaction costs (τ), and other costs (ω) related to transactions in foreign currency, including information costs. Suppose the trade costs of a firm due to transactions in foreign currencies take the form

$$V(j) = q + f(k, \sigma, \tau, \omega) \tag{2.1}$$

The components of variable costs depend completely on the size of transactions. When it comes to average costs, they have, therefore, no special implication for firms of different sizes. The total fixed cost of managing foreign currency transactions is however independent of the firm's output. Size of firms

only matters for average fixed costs: the larger the size of transaction (and size of firm), the lower is the average fixed cost. Therefore the fixed cost in a linear cost function gives rise to economies of scale, because the larger the firm's output, the less is the fixed cost per unit.

The cost function in (2.1) makes it possible to study the behaviors of firms of different sizes. As discussed previously, SMEs are disadvantaged with respect to their ability to manage international transactions and relatively higher level of average fixed costs inhibit profitable international operations for SMEs. Assuming monopolistic competition, as in the original Melitz model, profit-maximizing firms have to meet the criteria that the marginal revenue is equal to marginal cost plus marginal cost of transactions in foreign currencies ($MR = MC + f'(k, \sigma, \tau, \omega)$) in the export market in order to sell profitably.[10] After the elimination of the cost of transactions with multiple currencies, only the firms with $MR - f'(k, \sigma, \tau, \omega) < MC$ but with $MR \geq MC$ will be able to profitably export. Since $P = AC$, the cost reductions reduce the price level settled by SMEs more than big enterprises due to over-proportional decrease in average costs and generate price advantage for SMEs.

2.3.1.2 Predictions on Export Behaviors

After the short representation of the role of foreign currency transactions in export behavior of firms of different sizes, we turn to constructing the hypotheses. In constructing the hypotheses, we adopt the theoretical approach used in Helpman (2006) and Helpman et al. (2004). Helpman (2006) provides the following variables and functions and we take them as given:

- *Demand function:* $x(j) = Ap(j)^{-\varepsilon}$, with x indicating the quantity, p the price, A a measure of the demand level, and $\varepsilon = 1/(1-\alpha)$ the demand elasticity, which is assumed to be constant with $0 < \alpha < 1$.
- *Productivity:* $\theta(j)$, discoverable only after a firm enters the industry.

[10] MC represents here all marginal costs except the costs due to transactions in multiple currencies.

- *Production costs:* $c/\theta(j)$ is the variable production cost per unit of output and cf_i is the fixed cost, with c measuring the cost of resources and f_i a measure of fixed production costs in terms of resources.
- *Profits:* $\pi(j) = \theta(j)^{\varepsilon-1}Z - cf_i$

The profit function of a domestic firm is $\pi_d(\psi) = \psi(j)Z - cf_d$, the profit function of an exporting firm $\pi_x(\psi) = \tau^{1-\varepsilon}\psi(j)Z - cf_x$, and a firm's profit from FDI is $\pi_{fdi}(\psi) = \psi(j)Z - cf_{fdi}$, where $\psi(j) = \theta^{\varepsilon-1}(j)$ measures the productivity level of firm j and τ measures the melting iceberg trading costs such that $\tau > 1$ units have to be shipped for one unit to arrive. More detailed description of the profit functions and the derivation of them can be found in Helpman (2006).

i. Prediction on the Likelihood of SMEs to become an exporter:

The management of exchange rate risk is a particularly disadvantageous task for SMEs, as they do not have the critical size which gives them access to the most modern hedging instruments. They also lack qualified staff to discern exchange rate risks accurately. They are sometimes obliged to use the services of intermediaries and that increases their costs even further. The introduction of the euro effectively removes this disadvantage and makes them more competitive in international markets.

After monetary union, the transaction and hedging costs will disappear. By assumption, this will lead to reductions in both fixed (cf_x) and variable costs (τ) parameters. If productivity adjusted fixed costs ($c_u f_x/\psi$) are smaller for some firms than the updated trade cost inclusive parameter ($\tau_u^{1-\varepsilon}A$), then these firms will subsequently become exporters. This is illustrated in Figure 2.5. ψ_x^a represents the initial productivity cut-off level for all firms. Reductions in variable trade costs rotate the profit line for exporters and ψ_x^b becomes the new cut-off level. With reductions in fixed costs, the profit line shifts upwards and

ψ_x^c becomes the final cut-off level. Rotation of the profit line has no particular implication for firm size. However, the shift from ψ_x^b to ψ_x^c improves the likelihood of SMEs becoming exporters. Why this applies especially for SMEs is because of the fixed cost parameter (q) in equation (2.1). Average cost of doing business with multiple currencies will be higher for SMEs than big companies and SMEs will initially not be able to enter into export market due to higher average trade costs. As costs due to multiple currency transactions are eliminated, these firms will over-proportionately benefit from cost reductions.[11] This leads to an increase in the likelihood of SMEs to become exporters.

Now the first prediction reads as follows.

Prediction 1: *Likelihood of small and medium sized enterprises to become an exporter increases,* $P(E = 1|X, m = 1) > P(E = 1|X, m = 0)$.

For given productivity level for each firm independent of size, the number of exporters as well as the probability to become an exporter will increase after productivity cut-off level decreases. Additionally, the reduction in average costs will be higher for SMEs and these firms will get an additional cost advantage in export market participation. Since firms know their productivity only after they enter into market, firms enjoying a higher reduction in average costs in addition to already lower productivity cut-off will over-proportionately increase their chance to survive in export market, implying that the *probability* of SMEs will increase compared to their previous status with higher productivity cut-off level and compared to other firms' status with lower productivity cut-off level.

[11] As time passes, serving larger markets will require them to increase production capacity and some of the most successful SMEs may become MNE later. Long term trade effects of single currency may, therefore, be higher than its short term effects.

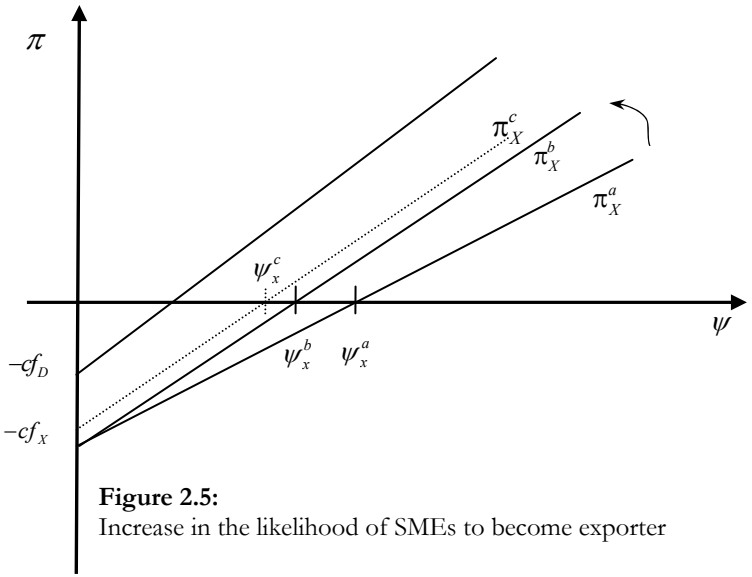


Figure 2.5:
Increase in the likelihood of SMEs to become exporter

Reductions in trade costs increase the profits that existing exporters can earn in foreign markets and reduce the export productivity cutoff above which firms export. There are two different mechanisms that may bring about an increase in the number of exporting firms. The first one is the direct mechanism: if firms sell or want to sell abroad, their trade-cost-inclusive marginal costs will decrease and they will better compete with incumbent firms in foreign markets. The second one is an indirect mechanism and concerns the firms that do (or must) import some intermediary inputs from foreign markets to become more productive. For these firms, marginal costs will fall and they will automatically update to exporter status, provided that they are productive enough. For other firms serving only the domestic market and not dealing with foreign trade, the impact of the single currency on their marginal costs will be probably limited. At the end, the share of non-exporters will decrease in total economic activity.

Nguyen et al. (2007) find that the introduction of the Euro is associated with a reduction in both the number of firms that have significant foreign exchange exposure and the magnitude of exposure. Baldwin and Taglioni (2004) show that exchange rate volatility naturally hinders exporting by small firms, so

reduced volatility tends to especially promote exports from small firms. These results provide the first supporting evidence for the prediction.

ii. Prediction on the Likelihood of MNEs to Concentrate:

Reductions in trade costs may also promote the trade in raw materials and intermediary products. One outcome of this result is that the companies do not need to be closely located to the places where they acquire, and probably process, these goods. Flam and Nordstrom (2006) estimate the euro's trade effect on the level of processing. They find a positive and significant trade effect for semi-finished and finished products but not for raw materials. They argue that these effects actually explain the positive trade effect they find for aggregate exports. Implications of the reduction in trade costs for trade in intermediate products are especially important for MNEs. These companies usually have complex enterprise structure with facilities in more than one location. Multinational enterprises confront a hard decision between being closer to local markets and making use of increasing returns to scale, generating a proximity-concentration trade-off.[12]

For MNEs, whenever the condition $\pi_x(\psi) > \pi_{fdi}(\psi)$ or $(1-\tau^{1-\varepsilon})\psi Z > cf_{fdi} - cf_x$ applies, then they prefer concentrating spatially and serving remote markets from a central location. After the elimination of certain trade costs with the introduction of single currency, if the gain from the change in trade costs overweighs the cost advantage of serving markets locally at given productivity level, $\Delta\tau^{1-\varepsilon}(\psi Z) + \Delta c(f_x) > \pi_{fdi}(\psi) - \pi_x(\psi)$, then firms prefer concentration over proximity. This fact is depicted in Figure 2.6. Though practically controversial, even a tiny change in trade costs can have great impact on the productivity cut-off level needed in order to benefit from serving markets through foreign direct investment.

[12] By choosing proximity (FDI) instead of exporting, firms give up concentration of production. This raises the fixed costs due to construction of new production facilities but avoids certain trade costs.

The second hypothesis reads as follows:

Prediction 2: *Likelihood of multinational enterprises to concentrate increases.*

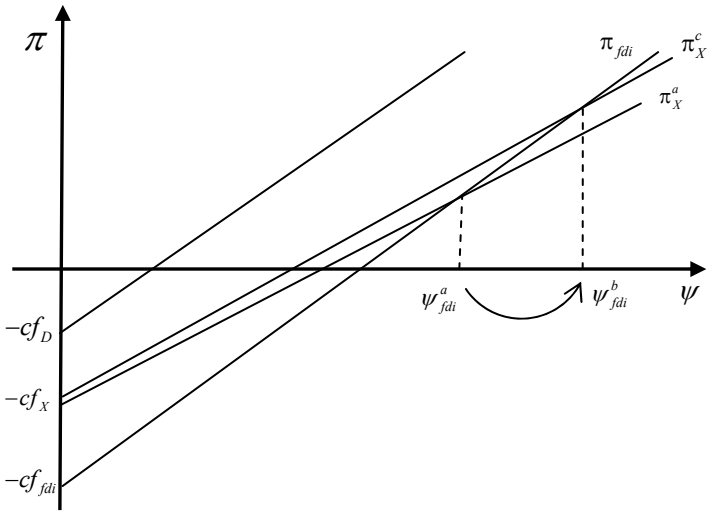


Figure 2.6: Increase in the likelihood of MNEs to concentrate

As in the previous prediction, firms discover their productivity only after they enter the market. The overall probability of random draw for high productivity firms –that prefer proximity to concentration– will decrease after the elimination of some export costs. Firms that otherwise would prefer FDI to export at a given probability level may, therefore, prefer concentrating instead of proximity, implying an increase in their overall probability of concentrating. Admittedly, in real economic life, the expected change in the firms' decision to serve foreign markets through FDI or export will not happen overnight. For some firms that will take perhaps years to adapt to the new economic environment. This consideration should be taken into account in the estimation methodology.

2.3.2 Implications for Industries: Predictions on Trade Structure

We now set apart the major predictions on trade and industrial production associated with higher economic integration in the literature. Three of them are found to be strongly associated with the purpose of this paper. Notwithstanding possible alternative predictions on trade structure that can be made due to monetary union, we concentrate only on three of them. Below we provide a summary of these predictions and implications for this study.

2.3.2.1 Specialization and Concentration

Specialization, though propagated by old and new trade theories, is rather undesirable within a monetary union, especially for the central bankers. Different industrial structures within the union will make the shocks increasingly asymmetric and adjustments difficult. The efficient operation of the European Monetary Union, therefore, may be hampered by increasing specialization within the member countries. However, the predictions are generally in favor of higher specialization in the Eurozone. For instance, Kalemli-Ozcan, Sørensen and Yosha (2001) provide empirical evidence that financial integration (risk sharing) enhances specialization in production. If higher integration increases specialization, that brings about lower diversification. This makes then the currency area not an optimal formation, generating a paradox.

In general, trade theory predicts that the degree of specialization increases as trade costs fall. Loosely speaking, neoclassical models establish a linkage between a reduction in trade barriers and higher specialization of countries in their sectors of comparative advantage or higher factor abundance. The new trade theories and economic geography literature, on the other hand, predict concentration of industries due to economies of scale specific to locations.[13]

[13] The model considered by Venables (1996), for instance, generates concentration of industry in one country when trade costs between two identical countries are reduced.

Therefore a direct association between trade barriers and specialization is established in the literature.

The third prediction reads then as follows:

Prediction 3: *Trade theory predicts that specialization and concentration in the EZ should increase due to cost reductions after monetary union.*

To have a better grip of this prediction, we make a careful distinction between specialization and concentration. The term specialization symbolizes the outcome of active, deliberate chain of actions that countries undertake. Concentration, on the other hand, corresponds to a more passive stance for countries, as the main dynamics in leading to concentration, such as backward and forward linkages, are commonly industry specific. If any country sells more of some products, this may reflect two facts: either *countries specialize* in these products (or industries), or *industries concentrate* in specific locations (e.g., countries or regions).[14] And the point of view one pursues in a specific field determines the way questions are raised and resolved. Concentration, for instance, is what lies at the core of new economic geography literature. With the goal of extensive examination of the subject matter, we treat them separately and study both the specialization and concentration dynamics in the EZ.

Regarding the existing structure of European trade and production, there is a consensus among scholars that industrial structures are different among European countries. However, there is a disagreement in the literature concerning the progress of specialization and its relationship with the process of European integration. De Grauwe (2003) classifies two opposing views that emerged from the discussion on the specialization effects of currency union, the Krugman and the European Commission viewpoint. According to the Krugman viewpoint, in reference to Krugman (1993), increasing integration would inevitably lead to increased specialization. According to the European

[14] More specifically, the share of any sector *i* in the total activity of country *c* forms the basis of the country analysis of specialization. The share of any country *c* in the total activity of industry is the basis of the industry analysis of concentration.

Commission and Frankel and Rose (1998), conversely, European integration will make economic structures more similar among participating countries leading to less specialization rather than more. Empirical evidence suggests, however, some support for the Krugman view. Midelfart-Knarvik et al. (2003) argue that increasing product market integration has been associated with modest increases in specialization across EU countries. Similarly, Sapir (1996), using the Herfindahl index and export data to measure country specialization, found that specialization has remained constant after 1992 in Germany, Italy and the UK and has increased in France; and Amiti (1999), constructing a Gini index with production and employment data, found an increase in specialization in all the EU countries between 1980 and 1990. Finally, Midelfart-Knarvik and Overman (2002) show that states and regions are becoming more specialized within the EU, but this process is found to be very slow.

Eichengreen (1996) contrasts the developments of eight industrial sectors across Europe and the US States and reports an increase in specialization in Europe and a fall in specialization in the US. In its report on the competitiveness of European industries, the EU Commission finds that there is evidence of increasing specialization but declining concentration (Mangelli 2002). Overall evidence suggests that the specialization in Europe will increase and that will have important implications in many aspects.

2.3.2.2 Industries with High Transport Costs and More Differentiated Products

The tendency for differentiated-product industry to concentrate in a large country, Krugman's so-called home-market effect theory, may adjust after the formation of currency union, even though there is not a direct relationship between the two. The home market effect reflects a trade-off between trade costs and production costs. Hanson and Xiang (2004, henceforth HX04) examine how home market-effects vary with industry characteristics and come to the conclusion that industries with high transport costs and more differentiated products (i.e. with low substitution elasticity) tend to be more concentrated in large countries. Fall in trade costs may decelerate or even

reverse this tendency if the benefits of relocation outweigh the costs. The next prediction states that:

Prediction 4: *The tendency for industries with high transport costs and more differentiated products to be more concentrated in large countries than industries with low transport costs and less differentiated products may be decelerated or reversed with monetary union.*

More technically, HX04 provides the following equation in identifying an industry exhibiting home-market effect.

$$Y\left[\frac{x(z)}{w^{\sigma(z)}}-1\right]>\left[x(z)w^{\sigma(z)}-1\right],$$

which states that benefit of relocating to the large country outweighs the costs of relocation. Here, Y indicates income, $x(z)=\tau(z)^{\sigma(z)-1}$ represents the trade costs for industry z, and $w^{\sigma(z)}$ represents the production costs. The equation can be rewritten as $x(z)>\frac{(Y-1)w^{\sigma(z)}}{Y-w^{2\sigma(z)}}$. With reductions in trade costs, it follows that:

- If the change in trade costs eliminates the cost advantage of locating in the large country, $\Delta x(z)>x(z)-\frac{(Y-1)w^{\sigma(z)}}{Y-w^{2\sigma(z)}}$, then the tendency for industries with high trade cost and more differentiated products to locate in larger market may reverse.
- If the change in trade costs reduces the cost advantage of locating in the large country, $\Delta x(z)<x(z)-\frac{(Y-1)w^{\sigma(z)}}{Y-w^{2\sigma(z)}}$, then the tendency for industries with high trade cost and more differentiated products to locate in larger market may diminish.

To be rigorous, for industries with higher trade costs, relocating from a small to a large country is beneficial as it yields savings in trade costs and small increase

in production costs. After monetary union, some of these industries may not find it profitable anymore to locate in the large country, since in the small country both production costs (by assumption) and trade costs are now lower. If this prediction is true, we should observe a deceleration or reversal of this process and industries with more differentiated products should start locating in small countries as well. Naturally, that will happen in an industry if and only if the benefits of the relocation outweigh the costs.

2.3.2.3 High-Tech Industries

Midelfart-Knarvik et al. (2000) show that industries that are high tech, medium returns to scale and, capital intensive tend to locate in the core. Their findings are based on the data only until 1997, i.e. before the monetary union. They capture the centrality of different countries by corresponding market potential, where high values correspond to the core and lower values to the periphery of the union. If that prediction is true, countries located in the core are expected to export more high tech products than others. Gros and Thygesen (1998) point out that the peripheral countries might benefit more than the core countries from EMU, enjoying lower transaction costs, risk premia, and greater price stability. However, these benefits may not include export of high-tech products. The final test will be whether the cost reduction affects the location of high-tech industries. The final prediction, therefore, states that:

Prediction 5: *The tendency for high-tech industries to locate in the core may be decelerated or reversed with monetary union.*

Except for Midelfart-Knarvik et al. (2000), there is no comparable study on this prediction. More investigation would provide some important insights into the behavior of high-tech industries.

2.4 EMPIRICAL APPROACH AND DATA

This paper does not develop a model from which an estimation equation can be derived, as it takes into account diverse theoretical predictions that are not easy to combine in a single model. Each hypothesis and prediction, therefore, will be

treated separately when they are tested. We highlight the methodologies in the following order. First the methodology for productivity and entry decision of SMEs will be illuminated. Then we look at the specialization pattern in the Eurozone both at aggregated and disaggregated levels. Finally we make two different industry specific analyses: trade relations in industries with more differentiated products and trade in high-tech industries.

2.4.1 Likelihood of SMEs to become exporter

Analysis of whether the likelihood of high productive SMEs to become an exporter increases after monetary union requires very detailed dataset broken down by firm size. Since there is only limited data available for such an analysis, we use firm level data from a representative survey of the German manufacturing sector, the Mannheim Innovation Panel (MIP) published by ZEW, to detect the exporter status of German firms after monetary union. Data is available from 1994 to 2004. Table 2.1 provides the descriptive statics for exporters and non-exporters. As it is evident, exporters are more productive, more innovative, larger, and located mostly in the West.

Table 2.1: Descriptive Statistics (Mean) of Exporters and Non-exporters

Variable	Exporters	Non-exporters
Productivity	0.276	0.210
R&D Intensity	0.023	0.008
Wage	5.566	5.897
Non-innovator	0.223	0.532
Size	2.020	1.406
Export Intensity	0.291	0
Investment Intensity	0.068	0.0864
Sales (million €)	130.137	30.802
East Germany	0.276	0.494
Number of Employees	375.350	125.065
Number of Observations	5601	1939

The empirical literature finds evidence in favor of recent international trade theories with heterogeneous firms by proving a robust positive correlation between productivity at the firm level and exporting. Micro-evidence on this issue is available for a number of the Eurozone countries: for Spain (Delgado et al. 2002), for Italy (Castellani 2002), for Germany (Arnold and Hussinger 2005) and the German state of Lower Saxony (Bernard and Wagner 2001), and for France (Eaton et al. 2008). The limitation on the availability of longitudinal data at the firm level is one of the most important challenges for researchers. Therefore, previous studies also worked commonly with regional or country-level data, without having the possibility to work with cross-country data.

In order to estimate the export decision of SMEs, we follow the approach used in Arnold and Hussinger (2005) and estimate an empirical probit model in which export behavior depends on a variety of observed, firm-specific characteristics:

$$P(EXP_{i,t} = 1) = \Phi(LP_{i,t-1}, RD_{i,t-1}, Filter_{i,t-1}, Skill_{i,t-1}, SME_{i,t-1}, East_{i,t-1}, MU_{t-1}, D_t)$$

where Φ is a normal cumulative density function, *LP* is labor productivity, *RD* is the ratio of the expenditures in research and development to turnover, *Filter* separates out the non-innovator firms, *Skill* is the average wages and used as a proxy for average level of skill in each firm, *East* is a dummy variable if a firm is located in East Germany, *MU* is a dummy for the monetary union, and *SME* is a dummy for small and medium sized enterprises where SME is defined as firms with employees less than 250. More explicitly, firms with less than 50 employees are considered to be small enterprises and firms with more than 50 but less than 250 employees are regarded as medium-sized enterprises. All covariates are lagged one period as in Arnold and Hussinger (2005). Finally, in addition to industry dummies to control for industry-specific effects, we add year dummies to capture time-specific effects not specific to an individual firm and not attributable to monetary union.

2.4.2 Specialization and Concentration of Trade in the Eurozone

The literature provides limited guidance on how to proceed in estimating a relationship for a general trade model. There are only a few papers using a trade specialization index as a dependent variable, including Midelfart-Knarvik et al. (2000) and Amiti (1999). None of them present a theoretical model before setting up their estimation equation and they basically regress a specialization index on the variables they think suitable. The dependent variables they add include economies of scale, intermediate input intensity, and factor intensity in Amiti and market potential, share of manufacturing and some interaction variables of country and industry characteristics in Midelfart-Knarvik et al. (2000). We combine the approaches used in these papers and construct our estimation methodologies. That includes all three variables used in Amiti and additional variables of market potential, country characteristics and industry characteristics, whenever appropriate. We believe these variables to be the most germane elements of classical and new trade theories.[15] At the end, it is just such a general trade model estimation, incorporating both old and new trade theory along with new economic geography effects that we believe is driving specialization and concentration patterns across the European Monetary Union. Below we provide more explicit description of estimation methodologies.

2.4.2.1 Specialization

Stemming from various theoretical predictions, monetary union is predicted to have significant impacts on specialization in the Eurozone. To test this prediction, we first analyze the specialization pattern in the Eurozone. Then we

[15] That may also help test whether any of these theories are consistent with the pattern of trade emerging after greater economic integration among similarly endowed countries. It is not the direct purpose of the paper to test the various theoretical predictions of international trade, but the variables included in the model may provide some insight on these, as the product and country characteristics include a proxy for factor intensities (in reference to Heckscher-Ohlin), a proxy for economies of scale (in reference to new trade theory), and a proxy for intermediate goods intensity (in reference to new economic geography literature). This approach is similar to that of Amiti (1999) and Midelfart-Knarvik et al. (2000).

test for the structural break due to monetary union for manufacturing products classified under ISIC 4-digit classification. The test in fact should be conducted at satisfactorily disaggregated level of classification in order to study the characteristics of the products that have become increasingly concentrated or relocated and test whether product categories with certain properties tend to be exported by countries with specific characteristics. Conducting this experiment at industry level may not be suitable, as we do not expect clear-cut specialization pattern at industry level. However due to lack of data availability, we can study the data only at the given aggregation of 4-digit.

In order to study the specialization patterns in the Eurozone, we estimate the following estimation derived from the theoretical considerations made earlier:

$$s_{ict} = \beta_1 scl_{ict} + \beta_2 itr + \beta_3 fti + \left(\beta_4 giv_{ict} + \beta_5 vafc_{ict} + \beta_6 pop_{ct}\right) + \eta_i + \tau_c + \mu_t + \varepsilon_{ict}$$

where $s_{ict} = \dfrac{x_{ict}}{\sum_i x_{ict}}$ is the export share of product i in country c with respect to total export. The equation without the variables in parenthesis represents the parsimonious model and the structural break test will be conducted under this parsimonious model. η_i, τ_c are unobserved time invariant industry and country fixed effects and μ_t captures the time specific effects, with the subscript c denoting country i denoting industry and t denoting time. Among the explanatory variables, scl is the economies-of-scale variable constructed by dividing the employment by number of enterprises. This is generated as a proxy for the scale effect inherited in new trade theories. itr is intended to capture the intermediate input intensity of the industries. We follow the approach used in Amiti (1999) and construct the variable as

$$itr_{ict} = \frac{pr_{ict} - va_{ict}}{pr_{ict}}$$

where pr is total production and va is the value added. It is then expected that the higher the proportion of intermediate input, the higher the geographic

concentration, a contention postulated in the new economic geography literature. *fti* is constructed to capture the factor intensities by obtaining the deviation of the share of the factor costs (wage) to value added at factor costs from its mean:

$$fti_{ict} = \left| \frac{wase_{ict}}{vafc_{ict}} - \frac{av(wase_{ict})}{av(vafc_{ict})} \right|$$

That is the hypothesis of the old trade theories; that countries specialize in industries that use their relatively abundant factors intensively. The higher the value in absolute terms means higher geographic concentration.

2.4.2.2 Concentration

Finally, in order to study the concentration patterns in the Eurozone, we estimate the following equation:

$$q_{ict} = \beta_1 scl_{ict} + \beta_2 itr + \beta_3 fti + \gamma_1 mp_{ct} + (\gamma_2 lfse_{ct} + \gamma_3 arb_{ct} + \varphi bor_t +) \eta_i + \tau_c + \mu_t + \varepsilon_{ict}$$

where the concentration is calculated as $q_{ict} = \frac{x_{ict}}{\sum_c x_{ict}}$ which is the export share of country c in product *i* in total trade to the Eurozone. Among the other variables, *scl*, *itr*, and *fti* are defined as before, *lfse* is the labor force with secondary education and *arb* is the percentage of arable land in total land area. Equation without the variables in parenthesis again represents the parsimonious model and the structural break test will be conducted under the parsimonious model as in the case of specialization.

Among the explanatory variables, market potential is considered to be an important factor in concentration choice of industries and it is defined for country *i* as the distance-weighted sum of GDP in other *n* countries, as provided by Fujita et al. (1999) and Hanson and Xiang (2004). Following Fujita et al. (1999) and Hanson and Xiang (2004), market potential is defined for country *i* as the distance-weighted sum of GDP in other *n* countries. Explicitly:

$$MP_i = \sum_{n=1}^{J} Y_n d_{ni}^{-\lambda}$$

Following Hanson and Xiang, λ is set equal to 0.92. In fixed effect estimation of specialization, time-invariant country characteristics are dropped from the equation. In estimating the concentration, on the other hand, time invariant industry characteristics are dropped out of the equation.

2.4.3 Industries with high trade costs and more differentiated products

Hanson and Xiang (2004) predict that industries with high transport costs and more differentiated products tend to be concentrated in large countries. They work with both transport costs and elasticity of substitution in identification of home-market effect for different industries. Monetary union has no effect on transportation costs; therefore it is unlikely to expect a change in trade after monetary union from this perspective. A potential challenge is the identification of industries that are sensitive to costs associated with the use of different currencies, because it is necessary to find another proxy for trade costs that can capture the industry sensitiveness to multiple currencies. A rather straightforward approach is to consider industries that are traded in larger proportions as they are likely to be affected most by the usage of multiple currencies.

As a result, we select the treatment and control industries according to three criteria: elasticity of substitution,[16] share of particular industry in total export, and freight rates. We choose the industries according to the following cutoffs:

[16] We assume that the more differentiated an industry is the more is the backward and forward linkages exist, giving rise to an increase in the likelihood of an impact on these industries after the formation of monetary union. According to Hummels (2001), the elasticity is useful both as an indicator of the effect of trade barriers on trade volumes and as a measure of the markup over marginal cost that producers of differentiated goods can charge. HX04 use elasticity as a measure of product differentiation, with low elasticity meaning higher product differentiation and vice versa. We also use the elasticity in identifying the industries with more differentiated products.

for the treatment (low sigma, high transport cost, high export share) industries, export shares more than 0.9%, freight rates greater than 0.10 and elasticity of substitution less than 4.9, and, for the control (high sigma, low transport cost, low export share) industries, export shares less than 0.7%, freight rates less than 0.05 and elasticity of substitution greater than 7.5. Table 2.2 lists the industries that are identified following these criteria and they are largely similar to those identified by HX04. Since we have a third criterion, the number of industries is fewer than that in HX04.

Table 2.2: List of Control and Treatment Industries

Control industries					Treatment industries				
Ind.	Industry	share	sigma	freight	Ind.	Industry	share	sigma	freight
514	Nitrogen Compounds	0.0058	7.5	0.0476	641	Paper and Paperboard	0.0399	4.25	0.1368
714	Power Generating Machinery	0.0045	7.87	0.0217	642	Paper Products	0.0106	4.25	0.1313
726	Printing Machinery	0.0064	8.52	0.0495	662	Clay	0.0096	2.65	0.2721
751	Office Machines	0.0059	11.02	0.0481	672	Iron Ingots	0.0169	3.53	0.1404
759	Computer Parts	0.0029	11.02	0.042	673	Iron Bars	0.0177	3.53	0.1557
763	Telecommunications	0.0050	9.44	0.0368	674	Iron Sheets	0.0345	3.53	0.1099
881	Cameras	0.0026	8.13	0.0477	821	Furniture	0.0329	3.64	0.1573
882	Camera Supplies	0.0058	8.13	0.0488	892	Miscellaneous Manufactures	0.0135	4.88	0.1007
884	Optical Lenses	0.00530	8.13	0.0405	893	Miscellaneous Manufactures	0.0197	4.88	0.1272
885	Watches and Clocks	0.00186	8.13	0.0489	894	Miscellaneous Manufactures	0.0115	4.88	0.1077

To empirically search for evidence of deceleration or reversal in home market effects, we again adopt the difference-in-difference gravity specification developed by HX04. We estimate the following model specification;

$$(2.2) \qquad \ln\left(\frac{S_{mjkt}/S_{mhkt}}{S_{ojkt}/S_{ohkt}}\right) = \beta f\left(Y_{jt}/Y_{ht}\right) + \Phi\left(X_{jt} - X_{ht}\right) + \theta \ln\left(d_{jkt}/d_{hkt}\right) + \mu_t + \varepsilon_{mojkht}$$

The dependent variable is, for a pair of countries, log relative exports in a treatment industry minus log relative exports in a control industry. This difference-in-difference gravity specification can eliminate the effects of import tariffs, home bias in demand, importing-country remoteness, and the tendency for larger countries to export more of all goods. By estimating this equation, we attempt to find out whether there is a change in coefficient β -representing whether large countries export relatively more of products in industries with more differentiated products- due to monetary union.[17] A more detailed description of the equation can be found in HX04.

2.4.4 High-tech industries

The conclusion of Midelfart-Knarvik et al. (2000) is that the high-tech industries tend to locate in the core. In estimating the concentration of high-tech exports, we consider the following specification:

$$HTS_{ct} = \alpha_1 MP_{ct} + \alpha_2 MPMU_{ct} + \alpha_3 Emp_{ct} + \left[\alpha_4 \mathrm{P}V_{ct} + \alpha_5 VA_{ct} + \alpha_6 NE_{ct} + \alpha_7 Exp_{ct}\right] + u_{ct}$$

HTS is the share of high-tech product export in the Eurozone, *MP* is the market potential defined as in the previous section, *MPMU* is the interaction variable obtained by multiplying the market potential by monetary union dummy, *Emp* is the share of high-tech employment in total employment, *PV* is the share of production in high-tech products, *VA* is the share of value added in high tech, *NE* is the number of high-tech enterprises, and *Exp* is the R&D expenditure per inhabitant. All variables are in log form, so the coefficients measure the elasticity with respect to covariates. The variables *VA*, *PV*, and *NE* represent the share of any member country in the total Euro Area, whereas the covariates *Emp* represents the share within the countries. The variables in the bracket are the alternative control variables that can be used in explaining the share of high-tech export.

[17] For countries j and h, the ratio of their relative exports of good m (high trade costs, low elasticity of substitution) to their relative exports of good o (low trade costs, high elasticity of substitution) will be higher the larger is the size of country j relative to country h.

In the above specification, the main variable of interest is *MPMU*. If the coefficient of that variable, α_2, is positive and statistically significant, then we will be able to confirm the prediction identified in the literature. If it is, however, found to be negative, it will indicate that countries in the periphery will export a higher share of high-tech products after monetary union. Although not of primary interest, the estimations results for other covariates will also be reported.

We use the data on high-tech industries disseminated by Eurostat. In search of a suitable estimation methodology, we make several tests to verify the estimation methodology to be used. We first ran the fixed effect regression and tested the results for heteroscedasticity using the Wald test for groupwise heteroscedasticity,[18] which specified that the null hypothesis of constant variance was rejected. We alternatively ran the model using random effects and then tested this approach using the Breusch and Pagan Lagrangian multiplier test for random effects, which indicated that random effects approach was rejected. Finally we test for serial correlation by using the Wooldridge test for serial correlation in panel-data models. The null hypothesis of no first-order autocorrelation was rejected. Therefore, we adopted a feasible generalized least squares (FGLS) estimation technique that can deal with heteroscedasticity and serial correlation in panels.[19]

[18] The error process may be homoscedastic within cross-sectional units, but its variance may differ across units. This condition is known as groupwise heteroscedasticity.

[19] Stata commands *xtgls* and *xtpcse* estimate linear panel data models using feasible GLS and OLS estimates with panel-corrected standard errors, respectively. These commands allow estimation in the presence of autocorrelation within panels, as well as heteroscedasticity or cross-sectional correlation across panels. In the case of cross-sectional correlation, xtgls requires T > N, which is met in our sample. This is essentially because we are estimating variance parameters for each panel and the estimates require many time-periods per panel for consistency of standard errors.

2.4.5 Data

Since we test several predictions and each of them requires different datasets, data used in these estimates incorporate different data sources. The main sources are Eurostat, UN Comtrade, UNIDO, Mannheim Innovation Panel, and WDI along with some other sources. Some properties of these data are described below.

Trade data disseminated by Eurostat would be the best reliable trade data but data is available only after 1995. Data provided by UN Comtrade database covers a wider range of time intervals from 1980 to 2006. In the analysis of overall specialization, we use the UN Comtrade database and in structural break test we employ the Eurostat database. In analysis of trade in high tech products we use Eurostat data. One particular advantage of using trade data, as opposed to industrial production data, is that geographical concentration measures may not be able to take account of change in plant size when firms decide to increase capacity due to lower trade costs and higher transparency. Classified under 5-digit SITC classification, the Eurozone countries report data for more than 1300 product groups, roughly 1000 of which belong to manufacturing (5-8) sectors, and will be tested for structural break.

From the existing fifteen member countries in the Eurozone, only eleven of them will be included in the study. Since trade data for Belgium and Luxembourg is distributed together until 1999, they will be considered together. That reduces the number of countries to ten.[20]

Analysis of the export behavior of SMEs (prediction 1) requires productivity data at firm level. The perfect data would be firm level data for all member countries broken down by firm size. We use firm level data from a representative survey of the German manufacturing sector, the Mannheim Innovation Panel (MIP) published by ZEW, to detect the export status of German firms after monetary union. This dataset is stratified by firm size,

[20] These are the countries that first adopted the euro in 1999: Austria, Belgium-Luxembourg, Finland, France, Germany, Ireland, Italy, Netherland, Portugal, and Spain.

therefore useful in analyzing the behavior of small and medium sized enterprises.

For data on GDP, data related to high tech production such as value added and research and development expenditures, we obtain data from Eurostat. For country characteristics related to industry production costs (the average costs in low-skill industries), we use data from the United Nations Industrial Development Organization (UNIDO) industrial database. Data on gravity variables is obtained from Jon Haveman (www.eiit.org). Industry freight rates are obtained from HX04 and industry substitution elasticities are obtained from Hummels (2001).

2.5 FINDINGS

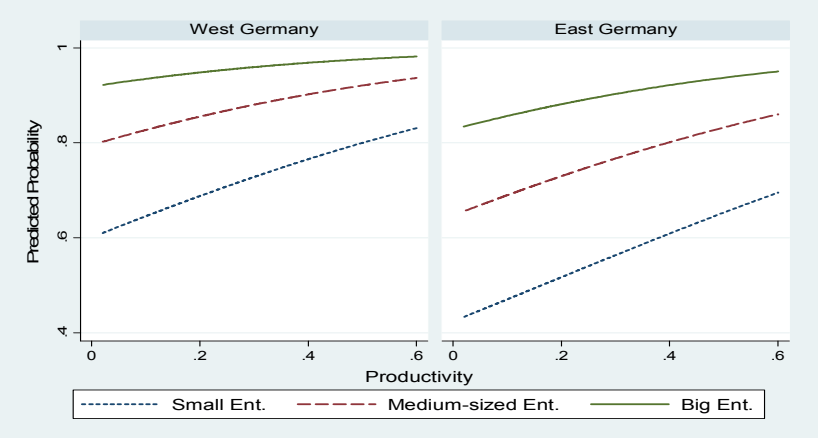
This section summarizes the results of the tests for respective predictions.

2.5.1 Export Behavior of SMEs

We hypothesized that the likelihood of small and medium-sized enterprises to become an exporter increases following the cost reductions due to monetary union. A limitation of the data used in this analysis is that they do not include information on the destination of exports. Without this information it is not possible to judge whether the change in export behavior is really due to cost reductions in trade after monetary union. What we present in fact reflects more plainly the impact of the year 1999, not the monetary union, even though we have strong reasons to believe that the impacts are due to monetary union, including eliminated exchange rate volatility (see Figure 2.4). Therefore, we use nominal exchange rate volatility as an instrument for cost reductions after monetary union agreement (see Table 2.4 for the findings). Table 2.3 additionally presents the probit estimation results for the marginal effects of all years separately without explicitly denoting the year of monetary union and it indicates that the years after monetary union significantly affects the export behavior of SMEs.

Figure 2.7 demonstrates the fact that big enterprises are more likely to become exporters at every level of productivity. Firms located in East Germany are disadvantaged compared to their counterparts in West Germany and their likelihood of becoming exporter is lower.

Figure 2.7: Predicted Probability of Exporting vs Firm Size



Assuming the impact of 1999 is due to the adoption of monetary union, we present the main findings in Table 2.3. Standard probit estimation results for SMEs are reported in (c. I). The coefficients are reported in terms of z-scores so it may be hard to interpret.[21] The results indicate that a one-unit increase in the productivity level results in a 1.55 standard deviation increase in the predicted probit index. The coefficient for size is interpreted to mean that the change from 0 to 1 reduces the predicted probit index by 0.8 standard deviations. And the coefficient for monetary union indicates that after monetary union the predicted probit index increases 0.24 standard deviations.

[21] The probit regression coefficients give the change in the probit index, also called a z-score or standard normal scores and can be transformed into predicted probabilities using tables of standard normal distribution. Z-score interpretation is useful when seeking to compare the relative standings of the units with different means or standard deviations.

Since these results are still difficult to interpret, (c. II) reports the marginal effects at the means, that is, the change in the probability for an infinitesimal change in each independent, continuous variable and the discrete change in the probability for dummy variables. It states that the probability of SMEs is in general 18.4% lower than other firms. However after 1999, the likelihood of these firms entering foreign markets increases by 6.6%. The findings additionally confirm that more productive firms are more likely to become exporters. Firms with higher skills (lower personnel cost per sales) and higher R&D intensity are again more likely to enter into export markets. Likelihood of exporter status decreases by 12.3% when firms are located in East Germany and by 15.8% when they are not innovators.

In c. IV and c. VI we separate out the impact of small and medium-sized enterprises respectively. Higher productivity is associated with higher likelihood of becoming an exporter for both small and medium-sized enterprises. It is however small enterprises which are particularly disadvantaged due to their size. After monetary union, their likelihood of becoming an exporter does not change (c. IV). The impact of single currency is stronger for medium-sized enterprises (c. VI), which indicates around 6% increase in the probability of becoming an exporter. Since these are the firms at the boundary, this result is not unexpected.

Finally Figure 2.8 depicts the outcome we obtained. In the left panel, the predicted probability of small-sized enterprises does not change both in West and East Germany. For medium-sized enterprises, the probability clearly increases both in West and East Germany (right panel). In general, as the level of productivity increases, the probability of exporting rises more rapidly for firms in East Germany compared to those in West Germany.

Table 2.3: Export Behavior of SMEs						
	Small & Medium-sized E.		Small Enterprises		Medium-sized Ent.	
	I	II	III	IV	V	VI
Productivity	1.554+	0.435+	1.309+	0.363+	1.848+	0.530+
	(0.231)	(0.064)	(0.234)	(0.064)	(0.234)	(0.066)
Size	-0.804+	-0.184+	-0.786+	-0.231+	0.322+	0.089+
	(0.086)	(0.015)	(0.059)	(0.018)	(0.059)	(0.016)
Size x Mon. Union	0.241**	0.066**	-0.004	-0.001	0.229***	0.062***
	(0.118)	(0.031)	(0.081)	(0.023)	(0.085)	(0.021)
Skill	-0.072+	-0.020+	-0.091+	-0.025+	-0.066***	-0.019***
	(0.020)	(0.006)	(0.020)	(0.006)	(0.020)	(0.006)
R&D Intensity	6.382+	1.784+	7.037+	1.952+	6.457+	1.851+
	(0.905)	(0.249)	(0.914)	(0.249)	(0.934)	(0.263)
Filter (Non-innovator)	-0.524+	-0.158+	-0.443+	-0.131+	-0.580+	-0.179+
	(0.046)	(0.015)	(0.047)	(0.015)	(0.046)	(0.015)
East	-0.419+	-0.123+	-0.478+	-0.141+	-0.498+	-0.151+
	(0.044)	(0.014)	(0.045)	(0.014)	(0.044)	(0.014)
Constant	1.570***		1.618***		0.601	
	(0.505)		(0.512)		(0.501)	

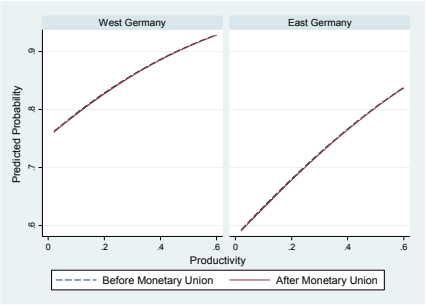
Notes: Table presents the probit estimation results for SMEs. Columns I, III, and V present standard probit estimation results and columns II, IV and VI present the marginal effects obtained from standard probit estimation. All estimators include year and industry dummy variables. Small enterprises are the firms with less than 50 employees and medium-sized enterprises are the firms with more than 50 but less than 250 employees. Robust standard errors are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

Naturally, each sector will have a different response to reductions in trade costs due to monetary union. In Table 2.4, we present the relative marginal impact of cost reductions for each sector compared to all other remaining sectors. It indicates that firms operating in mining, chemicals, food & tobacco, glass &

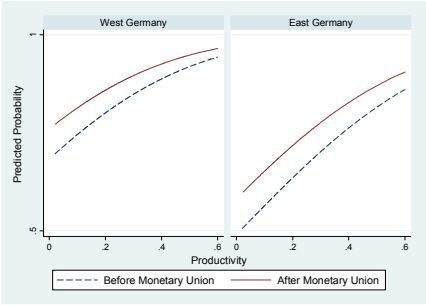
ceramics, wood & paper industries become less likely to enter into foreign markets. Firms operating in electrical equipment, plastics, medical & other instruments, machinery, furniture and textiles industries become more likely to enter into export markets. Finally firms in transport equipment and metal industries experience no significant impact on export behavior. The most disadvantaged firms are in mining, food & tobacco and wood & paper industries, for which the likelihood to export decreases by 18-26%. The firms benefiting most are in the furniture industry, with an increase in probability by around 14%.

Figure 2.8: Predicted Probability of Exporting for SMEs before and after Monetary Union

Small-sized Enterprises



Medium-sized Enterprises



In order to gain a better grasp of the factors that account for export behavior of firms, we further investigate the export behavior of firms with different productivity levels. As reported in Table 2.5, productivity matters only for firms whose productivity is lower than average. Size of firms plays again a significant role in affecting export behavior. As the size of firms increases, their probability of exporting increases as well (c. I-IV). SMEs are however disadvantaged at all productivity levels compared to larger firms (c. V-VIII). After monetary union, the relative significance of being larger in export markets decreases by about 4% (c. I) for firms with productivity above the average. No further impact of monetary union is detected for other firms with different productivity levels. Being an innovator always significantly improves the probability of exporting.

R&D intensity appears to be especially important for firms with productivity below the average (c. II, III, VI, VII). Being located in the East does not affect the firms with significant dispersion from the average productivity levels (c. III, IV, VII, VIII).

Table 2.4: Export Behavior of Different Industries

Industries	Coefficient	Industries	Coefficient	Industries	Coefficient
1. Mining	-0.261+	6. Glass, Ceramics	-0.058*	10. Machinery	0.080+
	(0.000)		(0.095)		(0.000)
2. Chemicals	-0.058*	7. Wood, Paper	-0.177+	11. Metals	-0.001
	(0.094)		(0.000)		(0.957)
3. Electrical Equipment	0.080+	8. Plastics	0.090+	12. Furniture	0.138+
	(0.000)		(0.000)		(0.000)
4. Food, Tobacco	-0.206+	9. Medical and other instruments	0.074***	13. Textiles	0.086+
	(0.000)		(0.001)		(0.000)
5. Transport Equipment	0.000				
	(0.990)				

Notes: Table presents the marginal effects obtained from standard probit estimation for different industries. All estimators include year dummy variables. P values are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

Up to this point, we provided important evidence on the export behavior of firms. It may be, however, argued that these results do not necessarily imply that they are an outcome of monetary union. Even though we include dummy variables for each year to control for time specific impacts not attributable to monetary union, one may claim that the predicted impact may include factors other than monetary union. In order to provide supporting evidence, we use volatility of German Mark (DM) against Euro/ECU as an instrument for the elimination of trade costs due to monetary union. The findings are reported in Table 2.6.

Table 2.5: Export Behavior of Firms with Different Productivity Levels – Marginal Effects

	All Enterprises				Small and Medium-sized Enterprises			
	I	II	III	IV	V	VI	VII	VIII
Prod. Level	$\psi > \bar{\psi}$	$\psi < \bar{\psi}$	$\psi < \bar{\psi} - \sigma$	$\psi > \bar{\psi} + \sigma$	$\psi > \bar{\psi}$	$\psi < \bar{\psi}$	$\psi < \bar{\psi} - \sigma$	$\psi > \bar{\psi} + \sigma$
Productivity	-0.042	0.822+	0.319	0.056	-0.021	1.082+	0.407	0.054
	(0.511)	(0.000)	(0.617)	(0.673)	(0.757)	(0.000)	(0.516)	(0.699)
Size	0.114+	0.189+	0.157**	0.097+	-0.132+	-0.218+	-0.055	-0.099***
	(0.000)	(0.000)	(0.013)	(0.000)	(0.000)	(0.000)	(0.773)	(0.002)
Size x Mon. Union	-0.039**	0.012	0.063	0.011	0.049	0.080	0.149	-0.042
	(0.028)	(0.670)	(0.504)	(0.732)	(0.101)	(0.135)	(0.541)	(0.490)
Skill	-0.029+	-0.012	0.024	-0.013	-0.027+	-0.003	0.038*	-0.011
	(0.000)	(0.124)	(0.261)	(0.334)	(0.000)	(0.724)	(0.070)	(0.417)
R&D Intensity	0.401	2.732+	3.359+	0.324	0.340	2.538+	3.049+	0.415
	(0.209)	(0.000)	(0.000)	(0.585)	(0.314)	(0.000)	(0.000)	(0.484)
Filter (Non-innovator)	-0.072+	-0.139+	-0.096*	-0.077**	-0.094+	-0.177+	-0.125**	-0.092***
	(0.000)	(0.000)	(0.085)	(0.011)	(0.000)	(0.000)	(0.021)	(0.003)
East	-0.047**	-0.163+	0.008	-0.027	-0.047**	-0.145+	0.034	-0.040
	(0.017)	(0.000)	(0.892)	(0.440)	(0.019)	(0.000)	(0.564)	(0.271)

Notes: Table reports the marginal effects of probit estimation on the export behavior of firms with different productivity levels. ψ denotes the productivity level $\bar{\psi}$ denotes the average productivity level and σ denotes the standard deviation. All estimators include dummy variables for year and industry. P values are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

Table 2.6 provides evidence when exchange rate volatility is used as a proxy for the elimination of exchange rate volatility following monetary union. The marginal impacts of all covariates are very close to previous estimation results. Exchange rate volatility turns out to reduce the overall probability of exporting for SMEs. Compared to other firms, small enterprises on the other hand do not benefit from the elimination of the volatility and medium-sized enterprises gain from eliminated exchange rate volatility. These results confirm the previous findings and provide supporting evidence that the impact is indeed due to introduction of single currency.

Table 2.6: Export Behavior of SMEs – Exchange Rate Volatility as an Instrument for MU

	Small & Medium-sized E.			Small Enterprises			Medium-sized Ent.		
	Marg. Eff.	St. Err.	P value	Marg. Eff.	St. Err.	P value	Marg. Eff.	St. Err.	P value
Productivity	0.431+	(0.064)	(0.000)	0.360+	(0.064)	(0.000)	0.526+	(0.066)	(0.000)
Size	-0.138+	(0.017)	(0.000)	-0.230+	(0.017)	(0.000)	0.148+	(0.014)	(0.000)
Size x Volatility	-0.124**	(0.061)	(0.042)	-0.007	(0.042)	(0.876)	-0.132***	(0.043)	(0.002)
Skill	-0.020+	(0.006)	(0.000)	-0.025+	(0.006)	(0.000)	-0.019***	(0.006)	(0.001)
R&D Intensity	1.780+	(0.249)	(0.000)	1.950+	(0.250)	(0.000)	1.837+	(0.263)	(0.000)
Filter (non-innovator	-0.156+	(0.015)	(0.000)	-0.130+	(0.015)	(0.000)	-0.178+	(0.015)	(0.000)
East	-0.125+	(0.014)	(0.000)	-0.142+	(0.014)	(0.000)	-0.152+	(0.014)	(0.000)

Notes: Table provides probit estimation results by using nominal exchange rate volatility as an instrument for the reduction in trade costs due to monetary union. In each category, first column provides the marginal effect, second column provides the standard errors and third column provides the p values. All estimators include year and industry dummy variables. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

Table 2.7: Export Behavior of SMEs with Year Effect

Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
Productivity	0.434+	East	-0.123+	SME after 2000	-0.075
	(0.000)		(0.000)		(0.299)
SMEs	-0.212+	SME after 1996	0.031	SME after 2001	0.057
	(0.000)		(0.767)		(0.352)
Skill	-0.020+	SME after 1997	0.031	SME after 2002	0.024
	(0.000)		(0.735)		(0.703)
R&D Intensity	1.787+	SME after 1998	-0.076	SME after 2003	0.040
	(0.000)		(0.233)		(0.535)
Filter (Non-innovator)	-0.158+	**SME after 1999**	**0.133***	SME after 2004	-0.016
	(0.000)		**(0.059)**		(0.848)

Notes: Table presents the probit estimation results for SMEs. It includes dummy variables for year and industry. P values are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

As a final experiment, without explicitly attributing any specific role to events starting from a particular year, we include dummy variables for all the years that take the value of 1 for the years including and after a given year from 1996 to 2004. The purpose is to check if there is similar impact of any unidentified event at any on the export behavior of SMEs (Table 2.7). We find that SMEs only benefit including and after 1999 and that directly hints at the monetary union.

Regarding the prediction on the concentration decision of MNEs, we lack a suitable dataset for the analysis. The MIP dataset offers only limited information on the MNEs and that may be insufficient for proper identification of the behavior of MNEs. Therefore we skip testing the second hypothesis.

2.5.2 Trade Specialization in the Eurozone

Figures 2.1 and 2.2 in section 2.2 provide the first descriptive evidence on the patterns of trade and investment in the Eurozone. The growth rates of export to the EZ increased during the years 1998-99 and 2002-03. We additionally observe an over-proportional increase in FDI inflows to the EZ again in 1998 and 1999. Although there is no clear indication that specialization has changed significantly after the introduction of monetary union, these facts lead us to suspect that some structural change might have taken place around 1999. Table 2.8 provides the estimation results for specialization and concentration patterns in the intra-EZ trade.

Columns I and II in Table 2.8 show the estimation results for trade specialization in the Eurozone. In almost all of the columns, factor intensity, economies of scale and intermediate goods variables are significant and have the same sign. Countries tend to specialize in industries in which intermediate input requirement is high, plant-specific scale effect is significant and deviation of the factor intensity from the mean is small. These findings are similar to Amiti, except for the role of factor intensity, where she obtains the opposite impact. Monetary union has a negative impact on the specialization of trade, which is however not uniformly confirmed. This result implies that monetary union

spreads out the trade within the union and plays a significant role in reducing overall specialization. Other control variables also seem to have significant importance. Higher investment and higher value added in industries increase the export share of these industries, but higher population decreases the overall specialization in all industries.

Columns III and IV provide the results for concentration of export in member countries. Intermediate input requirement, economies of scale and factor intensity have a similar impact on concentration as on specialization. Monetary union appears to have no significant impact on concentration pattern. Border variable is constructed as a count variable by determining the number of borders a member country has to other member countries. Having more borders with countries in the union increases the concentration. Factor abundance is also expected to have significant impact on concentration. Higher share of arable land decreases the concentration of industries, but share of labor force with secondary education seems to have no effect.

One would argue that measuring the concentration of industries by trade data is problematic and production data is the better choice. We additionally conduct the test using production data instead of trade data and we practically found the similar results for some variables, which are given in columns V and VI in Table 2.8. In contrast to trade data, production data improves the estimates by finding significant impact of monetary union on concentration. Higher market potential and higher level of labor force with secondary education increase the industrial concentration in the member countries. Impacts of border and share of arable land, in contrast to the findings with trade data, vanish.

These results may provide some clues on the impacts of monetary union, but not sufficient to argue that the euro caused a structural change in the specialization and concentration of export in the Eurozone. Finally, the results of the structural break tests are reported in Table 2.9. Instead of testing for potential break for only the years the monetary and currency union introduced

Table 2.8: Specialization and Concentration in the EZ						
	Specialization		**Concentration (T)**		**Concentration (P)**	
	I	II	III	IV	V	VI
Factor Intensity	-0.047+	0.005	-0.048+	-0.055+	-0.058+	-0.065+
	(-4.764)	(0.611)	(-4.804)	(-5.013)	(-9.633)	(-10.077)
Economies of Scale	0.606+	0.086+	0.601+	0.618+	0.631+	0.632+
	(34.305)	(4.676)	(34.070)	(32.446)	(59.159)	(55.726)
Intermediate Goods	1.550+	1.839+	1.529+	1.605+	1.691+	1.698+
	(12.840)	(16.077)	(12.680)	(12.256)	(23.201)	(21.817)
Monetary Union dummy	-0.095	-0.124*	0.148	0.026	-0.908+	-0.893+
	(-1.613)	(-1.791)	(1.563)	(0.198)	(-13.412)	(-11.344)
Market Potential			-0.157	-0.010	0.370+	0.321***
			(-0.860)	(-0.049)	(3.369)	(2.593)
Gross Investment		0.084+				
		(3.742)				
Value Added at Factor Costs		0.753+				
		(27.947)				
Population		-4.630+				
		(-5.386)				
Border				1.192+		-0.016
				(10.714)		(-0.245)
Labor Force with Secondary Education				0.003		0.009**
				(0.531)		(2.570)
Arable land				-0.052***		-0.009
				(-3.155)		(-0.933)
Constant	-6.548+	67.494+	-2.936	-7.615***	-8.952+	-8.767+
	(-47.172)	(4.671)	(-1.342)	(-3.264)	(-6.786)	(-6.333)
R-squared	0.6579	0.7432	0.6528	0.6573	0.7923	0.7996

Note: Table presents the fixed effect estimation results for specialization and concentration patterns in the Eurozone. Columns I and II presents the results for specialization and columns III-VI present the results for concentration. Columns I-IV use trade data and columns V and VI use production data. Group variable for specialization is country and for concentration is industry. Regressions include time dummies. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

(1999 and 2002), we experimented for the all six years from 1998 to 2003, to test for likely or delayed adjustments in trade structures. We found statistically significant changes (at 5% significance level) both in specialization and concentration of export in the years 1998 and 1999. No further change is detected. This finding is also in line with the previous papers on the trade effects of the Euro, which find a one-time jump in trade in 1999.[22]

Table 2.9: Structural Break (Wald) Test		
	Specialization	**Concentration**
1998	Prob > F = 0.0118	Prob > F = 0.0365
1999	Prob > F = 0.0121	Prob > F = 0.0480
2000	Prob > F = 0.1402	Prob > F = 0.3702
2001	Prob > F = 0.4131	Prob > F = 0.7362
2002	Prob > F = 0.6270	Prob > F = 0.8124
2003	Prob > F = 0.6991	Prob > F = 0.6742
Notes: Table provides structural break test results obtained from Wald test statistics.		

Finally, in order to provide further support for the above results, we use volatility of national exchange rates against Euro/ECU as an instrument for the reductions in trade cost after monetary union. Table 2.10 reports the findings under parsimonious case and compares them with the previous findings.

Although the coefficients of standard covariates do not change, the impact of volatility becomes more significant. This indicates that higher volatility is associated with higher specialization and concentration. This implies that the elimination of exchange rate volatility reduces the overall specialization and concentration of European industries in the Eurozone. It appears that the impact of monetary union is similar to the impact of the elimination of exchange rate volatility.

[22] See Mancini-Griffoli and Pauwels (2006).

Table 2.10: Specialization & Concentration in the EZ						
	Spec. / Volatility	Spec. / MU	Conc. (I) / Volatility	Conc. (I) / MU	Conc. (P) / Volatility	Conc. (P) / MU
Factor Intensity	-0.046+	-0.047+	-0.048+	-0.048+	-0.058+	-0.058+
	(-4.681)	(-4.764)	(-4.846)	(-4.804)	(-9.676)	(-9.633)
Economies of Scale	0.607+	0.606+	0.601+	0.601+	0.631+	0.631+
	(34.401)	(34.305)	(34.105)	(34.070)	(59.192)	(59.159)
Intermediate Goods	1.534+	1.550+	1.529+	1.529+	1.691+	1.691+
	(12.715)	(12.840)	(12.678)	(12.680)	(23.199)	(23.201)
Volatility / MU	0.110+	-0.095	0.060**	0.148	0.035*	-0.908+
	(4.824)	(-1.613)	(2.026)	(1.563)	(1.952)	(-13.412)
Market Potential			0.145	-0.157	0.547+	0.370+
			(0.618)	(-0.860)	(3.842)	(3.369)
Constant	-6.642+	-6.548+	-6.608**	-2.936	-11.098+	-8.952+
	(-47.437)	(-47.172)	(-2.326)	(-1.342)	(-6.463)	(-6.786)
R-squared	0.6587	0.6579	0.653	0.6528	0.7924	0.7923

Notes: Table reports the fixed effect estimation results for specialization and concentration patterns in the Eurozone. Columns I and II presents the results for specialization and columns III-VI present the results for concentration. Columns I-IV use trade data and columns V and VI use production data. Group variable for specialization is country and for concentration is industry. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001. Columns II, IV, and VI replicates the results in Table 2.8.

2.5.3 Trade in High Tech Products

It is predicted in the literature that high-tech industries tend to locate in the core. However, there is no prediction regarding whether this tendency persists after monetary union. Given the reduction in trade costs following the adoption of single currency, one would expect that the relative significance of being located at the core diminishes. Given these predictions and arguments, after the introduction of the euro, one would suspect that the share of high-tech products exported by the countries with lower market potential may increase. Market potential, as defined in section 2.4.2.2, is calculated by the distance-weighted sum of GDP for each member country. Thus, countries with further

distance to other markets should export more of the goods in high-tech industries. The estimation results are provided in Table 2.11.

Table 2.11: Location of High-Tech Industries

	Feasible GLS			PCSE		
	I	II	III	IV	V	VI
Market Potential	0.710+	0.653+	0.766+	0.663+	0.929+	0.669***
	(10.495)	(10.070)	(9.450)	(8.542)	(8.175)	(3.175)
Market Potential x Monetary Union	**-0.007***	**-0.010*****	**-0.014*****	**-0.011****	**-0.014****	**-0.013**
	(-1.791)	(-2.589)	(-2.887)	(-1.998)	(-2.001)	(-1.541)
Employment in High Tech Ind.	0.922+	0.644**	0.892***	0.955***	1.329+	0.565
	(4.258)	(2.408)	(2.839)	(2.945)	(3.493)	(1.444)
R&D Exp. in High Tech Industries		0.415***	0.409***	0.204	0.084	0.234
		(2.959)	(2.683)	(1.200)	(0.425)	(1.196)
Number of High Tech Enterprises			-0.028		-0.196***	
			(-0.556)		(-2.682)	
Value Added in High Tech Ind.						0.332
						(1.543)
Constant	-13.207+	-14.487+	-16.454+	-13.900+	-17.774+	-13.254+
	(-14.384)	(-16.209)	(-15.535)	(-12.674)	(-12.675)	(-3.676)
Wald chi2	147.44	205.15	335.52	128.05	236.19	381.83
Prob>chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: Table presents the estimation results for the high-tech industries. Columns I-III are estimated with feasible GLS, heteroscedastic panels, and serial correction. Columns IV-VI are estimated with panel corrected standard errors (PCSE). T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

The results suggest that market potential has a positive impact on exporting higher share of HT products, as predicted in the literature. However, monetary union decreases the relative importance of having higher market potential. The estimated impact is around -0.010, indicating that after monetary union,

hundred per cent increase in market potential is associated with ten per cent reduction in the HT export shares. Thus, it is fair to argue that monetary union, which implies significant cost reductions in trade, eliminates some of the significance of being located in the core and supports the activities in the periphery, even though the total impact is economically not too strong. Additionally, the coefficients of other covariates indicate that higher employment in HT industries and higher expenditure on R&D generate higher share of export in these products.

Table 2.12: Location of High-Tech Industries – Volatility Estimation

	Feasible GLS			PCSE		
	I	II	III	IV	V	VI
Market Potential	0.735+	0.693+	0.762+	0.709+	0.909+	0.521***
	(12.535)	(12.905)	(10.274)	(10.527)	(8.223)	(2.732)
Market Potential x Volatility	**0.011*** **	**0.015+**	**0.015*** **	**0.015*** **	**0.013***	**0.021**
	(2.791)	(3.687)	(2.687)	(2.777)	(1.645)	(1.290)
Employment in High Tech Ind.	1.075+	0.871+	0.739**	1.180+	1.263+	0.486
	(5.173)	(3.300)	(2.437)	(3.766)	(3.466)	(1.277)
R&D Exp. in High Tech Industries		0.336**	0.406***	0.134	0.076	0.198
		(2.526)	(2.775)	(0.845)	(0.404)	(1.060)
Other covariates	-	-	HTE.	-	HTE	HTE + VAHT
Wald chi2	223.87	370.35	352.21	225.88	220.47	308.65
Prob>chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: Table presents the estimation results for the high-tech industries. Columns I-III are estimated with feasible GLS, heteroscedastic panels, and serial correction. Columns IV-VI are estimated with panel corrected standard errors (PCSE). Due to space limitation, the covariates of number of high tech enterprises (HTE), value added in high tech industries (VAHT) and constant are not reported. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

For the sake of robustness, we again use exchange rate volatility as a substitute for monetary union and present the corresponding results in Table 2.12. The

results clearly confirm the previous findings. Higher volatility increases the relative importance of higher market potential. The elimination of exchange rate volatility thus reduces the role of market potential and one percent reduction in volatility is associated with a reduction in the significance of market potential by about 11-15%.

2.5.4 Trade in More Differentiated Products

It was predicted that reduction in trade costs may bring about a change in pattern of trade in goods with high trade costs and low elasticity of substitution (high product differentiation). Table 2.13 reports the findings of the estimation of equation (2.2). Each regression includes dummy variables for the industry match and year and adjusts standard errors to allow for correlation in the disturbances across observations of the same exporter pair.

The main findings are consistent with those obtained by HX04. Impact on GDP is similar to that obtained by HX04, where they find the impact of GDP around 0.42 and relative exports increase in relative exporter GDP. The estimated impact is around 0.28 (Table 2.13, column I) and it is reasonable to expect lower impact in the EZ, as the countries in the EZ are more integrated than any other country pairs used in HX04. The positive impact implies that larger countries in the EZ export more differentiated goods, consistent with home-market effect hypothesis. Quantitatively, if a country is 1% larger than another country in the EZ, then the larger country will export 0.28% more of differentiated goods than the smaller one.

Coming to the main coefficient of interest, we do not detect any significant impact of common currency on the existing pattern (columns II, IV, and V). So the reduction in trade costs due to monetary union is not significant enough to change the pattern of trade in differentiated products. The results become significant only if we ignore the correlation in the disturbances across observations of the same exporter pair (column VI). In that case, the impact of

Table 2.13: Trade in More Differentiated Products

	Main Results				Additional Results	
	I	II	III	IV	V	VI
GDP	0.275***	0.262***	0.053	0.247**	0.237**	0.053+
	(2.762)	(2.854)	(0.472)	(2.586)	(2.000)	(4.562)
GDP x Monetary Union		0.021	-0.038	-0.021	0.027	-0.038+
		(0.583)	(-1.003)	(-0.560)	(0.675)	(-5.335)
Market Potential			-0.852***			-0.852+
			(-2.783)			(-31.994)
Labor Force with Secondary Education	-0.610+	-0.612+	-0.290*		-1.417+	-0.290+
	(-5.906)	(-5.891)	(-1.960)		(-14.000)	(-22.635)
Wage in Low-Skill Industries	0.529+	0.530+	0.320***	0.457+	0.674+	0.320+
	(6.912)	(6.970)	(2.950)	(4.746)	(6.626)	(34.996)
Arable Land	-4.098+	-4.100+	-2.702+	-3.805+	-5.799+	-2.702+
	(-19.448)	(-19.423)	(-4.983)	(-15.736)	(-19.041)	(-56.234)
Common Border	0.470+	0.469+	0.405+	0.569+	0.485+	0.405+
	(6.983)	(6.957)	(6.064)	(7.173)	(3.804)	(30.894)
Common Language	0.108	0.110	0.147*	0.049	0.252*	0.147+
	(1.389)	(1.407)	(1.897)	(0.604)	(1.834)	(9.036)
Distance	0.024	0.023	-0.060	0.115*	-0.275**	-0.060+
	(0.395)	(0.377)	(-0.967)	(1.743)	(-2.602)	(-5.426)
Labor Force with Primary Education				0.605+		
				(4.888)		
Constant	-0.057	-0.056	-0.053	-0.055	0.007	-0.053
	(-0.157)	(-0.163)	(-0.219)	(-0.167)	(0.011)	(-0.742)

Notes: Table presents the estimation results for trade in more differentiated industries in the Eurozone. GDP is the GDP ratio for a country pair. Other variables are expressed as differences (common language, common border) or log differences (all other variables) for a country pair. Columns I to IV present the main results. Column V includes zero trade flows by considering them as 1, as in HX04. Column VI ignores the correlation across exporting country pairs. All estimations include time dummy. T statistics (calculated from standard errors that have been adjusted for correlation of the errors across observations that share the same pair of exporting countries, except in column VI) are in parentheses. Statistical significance are denoted by * $p<0.10$, ** $p<0.05$, *** $p<0.01$, + $p<0.001$.

monetary union is negative, shrinking the size of the home-market effect. However, there are no convincing arguments for ignoring that correlation. Therefore, monetary union is found to have no impact on trade in differentiated goods.

In c.III and c.VI, market potential is added to the model in order to take the neighbor effects into account, which can also affect industry location. Having large neighbors may have two potential outcomes. That may either create high demand for such countries' goods, leading to agglomeration; or these neighbors may offer attractive markets, leaving high trade cost and low elasticity of substitution industries less concentrated in these countries compared to other small countries (known as agglomeration shadow). The impact of market potential is found to be negative and that result is consistent with an agglomeration shadow. Home market effect appears to be weaker in countries with larger neighbors and relative importance of the country size also becomes insignificant with the inclusion of market potential into the specification.

Coefficients on relative wage, relative arable land area, common border, and common language suggest that relative exports of differentiated products are higher for countries having lower wage rates, smaller land area, and common language and border. Another finding, which is not of primary interest, is the impact of the education level of the labor force. Although the impact of secondary education is negative, implying a decrease in relative exports in differentiated goods, the impact of labor force with primary education is just the opposite (columns II and IV). That may indicate the fact that the labor force with secondary education may claim higher wages due to higher productivity that they can offer and that increase the production costs, reducing the relative exports.

2.6 CONCLUDING REMARKS

There has been much research in attempting to quantify the monetary union's impact on trade volume during the last decade. After the formation of monetary

union, existing theoretical and empirical studies predicted two important changes to happen concerning trade and industrial production: change in the 'volume of trade' and change in the 'location of industries'. A direct implication of these findings is that 'who trades what', namely the trade structure should also change. This straightforward implication prompted the main motivation to investigate the change in the composition of trade in the Eurozone countries. In an early study supporting the proposition, Venables (1995) argues in the European context that significant relocation of industries will happen with some countries losing a presence in some industries.

This paper attempts to identify the important impacts of monetary union in various aspects that may arise due to the reductions in trade costs.[23] Dynamics that may lead to changes in trade structure and location of industrial production in the Eurozone may be numerous, and we have arguments to reasonably justify the proposition that the composition of trade among the member countries has changed. We investigate the changing nature of trade in the Eurozone by proposing two hypotheses and testing several other predictions. Thereby we concentrate on the overall specialization dynamics, export behavior of small and medium sized enterprises, trade in high tech products, and trade in industries with differentiated products.

The important findings are the followings:

[23] Introduction of monetary union is associated with reduction in trade costs with potential impact to change the export and production behavior of firms. In fact, the cost reduction that we build our study may be quite trivial and probably it may be naïve to expect quite significant changes due to trifling reductions in trade costs. It is fair to argue that higher economic integration gives investors and consumers more confidence and perception of living in a greater market and all of these may have more solid impacts than cost reductions due to monetary union. There have been many studies conducted on relationships between exchange rate volatility and trade and most of them have found either no or insignificant effect of exchange rate uncertainty on trade. Therefore, even though the arguments are built on the reductions in trade costs, we believe that the driving force of restructuring should be more than mere trade cost reductions.

i. The likelihood of small and medium-sized enterprises to become an exporter increases. Medium-sized corporations benefit more than small corporations. This implies that size matters. What is more, firms operating in furniture, electrical equipment, plastics, medical instruments, machinery and textiles are more likely to benefit from monetary union.
ii. Monetary union has no impact on the concentration of exports but it has a negative impact on the concentration of production. Production structure is more diversified in the EZ compared to the years before the Euro. The Euro has also negative impact on export specialization. We identify structural breaks in specialization and concentration of exports in years 1998 and 1999, which is also in line with the previous findings of a one-time jump in trade in 1999 on the trade effects of Euro.
iii. Following the common currency, there is no significant change in the trade of differentiated goods. There is a home-market effect in the EZ, which is below the world average, and it persists in spite of the single currency.
iv. Though the impact is economically not too strong, the single currency diminishes the importance of being located at the core for the export of the high-tech commodities. Countries located relatively more in the core lose some part of their advantage.

These results are robust to using exchange rate volatility as an instrument for the cost reductions due to monetary union. These findings indicate that the integration process in the EZ still continues and introduction of single currency accelerated this process. SMEs firms became able to enter into export market, small and relatively disadvantaged countries benefited from the monetary union, and monetary union led to a decrease in the specialization and concentration in the EZ.

APPENDIX

Table 2A.1: Descriptive Statistics – Data for Industries with Differentiated Products

Variable	Observation	Mean	Std. Dev.	Min	Max
Relative Export Share	970634	-0.00090	3.32825	-21.042	22.6183
GDP	1221280	0.00256	1.60145	-3.5279	3.52788
Market Potential	1221280	0.00101	0.71154	-1.5787	1.57867
Labor Force w. SE	670130	0.00249	0.75545	-1.8547	1.85473
Wage in Low-skill Ind.	530070	0.00086	2.14441	-5.0597	5.05971
Arable Land	1005240	0.00034	0.68936	-1.5856	1.58556
Common Border	1221280	0.00028	0.58255	-1	1
Common Language	1221280	0.00014	0.35766	-1	1
Distance	1221280	-0.0015	0.86397	-2.3713	2.37133
Labor Force w. PE	670130	-0.0016	0.61633	-1.6364	1.63635

Table 2A.2: Descriptive Statistics – Data for Specialization and Concentration

Variable	Observation	Mean	Std. Dev.	Min	Max
Specialization	12820	-6.18504	2.057316	-18.8001	-0.91988
Concentration (T)	12820	-3.28566	1.999713	-16.5242	-0.18249
Concentration (P)	10284	-2.86703	1.467101	-9.1643	0
Factor Intensity	10208	-3.01916	1.222662	-20.1323	3.23781
Economies of Scale	10292	3.202258	1.279968	-1.60944	8.61076
Intermediate Goods	10235	-0.404	0.152238	-1.38629	0.998529
Gross Investments	9219	3.66602	1.744452	0	9.215825
Value-added at FC	10208	5.577064	1.750949	0	10.63376
Population	12980	16.68973	1.04732	15.0989	18.22881
Market Potential	12980	12.91305	1.034625	11.00953	14.63183
Arable Land	12221	23.52366	8.32179	6.95	34.13
Labor Force w. SE	11402	39.94283	15.67252	10.6	69.1

Table 2A.3: Descriptive Statistics – Data for High-Tech Industries

Variable	Observation	Mean	Std. Dev.	Min	Max
HT Trade Share	120	-2.84723	1.178033	-5.41053	-1.19204
Market Potential	120	12.93664	1.036484	11.00953	14.66592
Employment in HT	120	1.453058	0.354773	0.512824	2.033398
R&D Expenditure	118	5.860642	0.707513	3.848018	6.999605
HT Enterprises	99	-3.02409	1.298234	-5.645	-0.3153
Value-Added in HT	87	-2.65327	1.166361	-4.82162	-0.87164

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CHAPTER 3

ADJUSTMENTS IN TRADE STRUCTURE AFTER MACROECONOMIC AND FINANCIAL CRISES

ABSTRACT

This paper investigates the potential effects of macroeconomic and financial crises on the structure of trade. We consider two types of macroeconomic shocks, four types of financial crises, one dual crisis, and three measures of trade structure. The findings reveal that economic crises have immediate and long-lasting negative impact on diversification, technological intensity of exported goods and of the goods in which countries have comparative advantage. Following financial crisis, we observe the opposite effects. Economies diversify their exports and experience an upgrade in the technological intensity of the goods

exported. Finally joint definition of crises indicates that economies increase their capability to match world demands while no clear improvement in technological intensity takes place.

KEYWORDS: Economic crisis, financial crisis, trade structure, recovery, diversification, technological intensity, comparative advantage

JEL: F1, F4, E2, O16

3.1 INTRODUCTION

Irrespective of their level of development, much of the world has experienced economic and financial crises in the past, and some of these crises have left detrimental effects on real economies. Several of these countries went from boom to bust virtually overnight. The causes and various impacts of these crises have been well documented in the literature. As one would expect, some particular role has been ascribed to international trade in explaining these crises, and it is claimed that existing trade relations may facilitate the spread of the crises to other economies (contagion) (see Glick and Rose 1999). Post-crises developments, on the other hand, did not attract much attention and no persuasive link has yet been established for the reverse causation, namely the effects of crises on trade. This paper attempts to fill this gap in the literature by investigating the potential impacts of crises on trade structure, acknowledging that even if the asymmetrical alternation of recessions and expansions are tamed, they will not be over and we need a better understanding of the impacts of these phenomena.

Economic crises may strike even in the absence of any macroeconomic imbalances and despite of sound economic fundamentals. And once a crisis takes place, it may drastically alter the fundamentals of an economy and force the economic actors to respond radically to alleviate the potential negative effects. In the middle-to-long run, the post-crisis state of an economy may be better or worse than before, depending on the overall reaction of the economy to the crisis. If one follows a Schumpeterian view of creative destruction, which is "an essential fact about capitalism" (Schumpeter 1942, p.83), a crisis should wipe out inefficient firms in an economy and lead to higher productivity and better economic performance. If one does not wish to rely on this mechanical process of creative destruction, one may praise the right intervention of policy makers and economic agents and claim that better economic performance in the post-crisis period may be a result of proper political and economic reforms. On the other hand, if sufficient reforms do not take place or "the essential fact"

does not work properly, a form of "creativity destruction" may come to pass and this will require a long time before an economy recovers.

This paper is intended to study neither the causes of economic and financial crises hitting economies every now and then, nor the reforms necessary to force an economy to "work" again, but to investigate the change in trade structure following potential restructuring in the manufacturing sector. The importance of trade structure derives from its impact on recovery and growth. The role of trade in economic growth has usually been found to be significant in the empirical studies of recent decades (e.g., Frankel and Romer 1999; Edwards 1998). Recent empirical studies also emphasize the nature of trade as a factor in promoting economic growth (e.g. Hausmann et al. 2007; Crespo-Cuaresma and Würz 2005; Dalum et al. 1999). This is also to say that the possibility that international trade may lead some countries to specialize in sectors with a slow growth potential is not ruled out. This proposition has previously found support in a model of Matsuyama (1992) who found a negative relationship between specialization in agriculture and economic performance. From all the recent empirical evidence, the arguments over the significance of the composition of trade will be considered valid and taken as given and the paper will then build its propositions on this line of reasoning. Indeed, this article is partly motivated by mounting evidence that trade structure matters for better economic performance.

The main purpose of the paper is to identify how the trade structure is affected by economic and financial crises. In doing so, we ignore the level effects and analyze the diversification of exports, technological intensity of traded goods and technological intensity of goods in which the countries have comparative advantage. Then by digging deeper, we try to understand the major factors driving the changes in trade structures by using alternative definitions of crises. There is an enormous gap in the literature on this field and we expect to contribute to the literature by providing some basic evidence. However, we ignore how sustainable the newly emerged trade structures are and whether they are temporal reactions to crises or do they determine the long-term

development path of the economies. Consequently, the approach is eminently empirical.

Several factors allow us to claim that crises can change the production structure and also the trade structure. We categorize them under different subheadings like supply-side, demand-side, and regulative factors and discuss in detail in section 3.5. Among the supply side dynamics we consider trade financing and change in competitiveness due to price changes in tradable goods as two important factors. Among the demand side factors we consider contraction in income and redistribution of it and changing consumption and saving patterns. Finally, policy makers may put restrictions to protect domestic industries or may provide special incentives for the sectors that they consider crucial for the country. All these factors preserve the latent dynamics inherent in crisis-hit economies, with potential to alter the structure of trade. [1]

To identify that the crises in fact may be a source of restructuring, we refer to the approach used in Hausmann et al. (2007), where authors argue that specialization patterns are determined by both fundamentals and idiosyncratic elements. Specialization is partly undetermined and may be shaped by idiosyncratic elements, like country-specific shocks. Since specialization is incomplete in any country from a theoretical point of view, any kind of idiosyncratic shock may have a significant effect on the structure of trade. The case of economic and financial crises would be a particularly fitting approach in analyzing the impacts of idiosyncratic shocks on trade structure. More concretely, products that enjoyed a comparative advantage versus those that suffered a disadvantage might react differently to such kind of crises and change the trade composition of these countries. Or, reinforced by the policy maker's intentional interventions, changing demand and supply dynamics may alter the existing attitudes and practices in the economy. This may in turn imply different patterns of recovery, and in the long run different paths of development.

[1] Although some other factors can be identified, we concentrate mainly on these factors when explaining potential changes in trade structure in section 3.5.

In a nutshell, following crisis, domestic producers will have short-lived comparative advantage due to devaluation but experience long-lasting harms on the industry due to severe contraction. It is therefore the time where the producers are more creative in terms of finding extraordinary solutions to extraordinary problems. The survivors will then determine the new path of the development of the economy. For that reason, we believe it is crucial to study the impacts on trade structure when crisis-hit countries endeavor to regain and maintain the economic stability. Finding evidence on the positive association between the post-crisis recovery and shifts in the patterns of trade towards more value added (or more productive, higher growth inducing) products will lead us to argue that economic crises have a positive effect on the growth of economies in the long run as they help them to bring to better paths of development. That would then support the previous findings on the positive link between volatility and growth[2] by providing an important channel for this link. From such an analysis, one additionally might find clues why, for example, Indonesia was sluggish in recovery compared to South Korea or Malaysia after 1997 Asian crisis and compose new arguments what will be the paths of development after the latest subprime mortgage crisis.

This chapter is organized as follows. Next section takes a closer look at the data and compares the trade and income responses of economies to crisis. Section 3.3 reviews the alternative definitions of crises and discusses the types of crises used in this paper. Then, we shortly discuss the role of trade structure in economic development and present the alternative measures of trade structure adopted for the analyses. In section 3.5, potential linkages between crises and real economic activities will be provided by explaining channels and mechanisms that can lead to an alteration in trade structure. In section 3.6, we discuss the empirical methodology in detail, which constitutes the discussion of

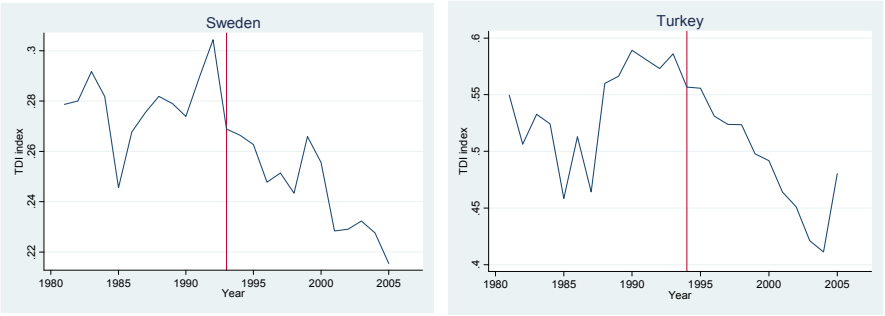
[2] Gali and Hammour (1993), for example, by using a structural vector auto regression for U.S. data, find evidence that recessions lead to higher productivity growth in the medium to long term. Rancière et al. (2008) find positive link between volatility and growth.

the primary estimation technique (matching) along with two additional estimation methodologies. Section 3.7 presents the major findings under alternative measures of trade structure and crisis definitions. We finally conclude in section 3.8.

3.2 A GLANCE AT THE DATA

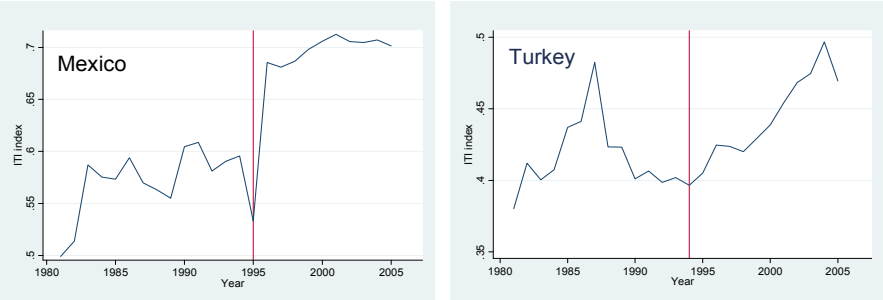
We look over two different responses to crisis, one is change in trade structures and the other is the change in growth rates in exports and income. Figures 3.1 and 3.2 respectively show the changes in Trade Diversification Index (TDI) and Index of Technological Intensity (ITI) for selected countries (see section 3.4 for the definitions). The impacts of crisis on different economies and on their trade structure are not similar. Although there can be observed significant changes in indices for some countries, for the others there seems to be no considerable effect of economic crisis on the trade. Especially for Turkey, there is a strong impact on the trade diversity index, bringing them closer to world demands by diversifying the export structure properly. Among the developed countries, Sweden also experience significant improvement in its trade diversity index. Other countries appear to respond only slightly to the shocks in terms of trade dissimilarity of exports (graphs not added).

Figure 3.1: Trade Dissimilarity Index for Selected Countries



Concerning the technological intensity index, Turkey and Mexico give the impression that they strongly benefited from the shocks hitting their economies, though in different speeds. Contrary to these economies, South Asian economies look as if they did not have a crisis at all (graphs not added). For both indices, we picked the countries that reacted to the shocks in favorable manner, and this is not the case for all the countries. Therefore this rather trivial investigation of trade indices points only to the possible impacts of crisis on the trade structure and these impacts are going to be not the same for any country undergoing an economic shock.

Figure 3.2: Index of Technological Intensity for Selected Countries



Finally, Table 3.1 shows the growth rates in exports, high-tech exports and per capita income at the year of the crisis and the three subsequent years after the countries experience the crisis.[3] We observe no systematic relationship between crisis and change in the growth of exports, high-tech exports, and per capita income. Some countries experience export growth at the crisis year (Ecuador, Mexico, Turkey), but others contraction in trade; some experience strong growth in high-tech exports in the crisis year and later (Mexico), but others only unstable growth. And recovery, when measured by the growth in per capita income, seems not to be directly linked to the changes in trade.

[3] See section 3.3.2 for the definition of crisis and the list of crisis episodes.

Table 3.1: Growth Rates of Export, Hi-tech Export and Per Capita Income in Crisis Countries

	Export growth	Hi-tech export growth	Growth in per capita income	Export growth	Hi-tech export growth	Growth in per capita income	Export growth	Hi-tech export growth	Growth in per capita income
	Argentina02			Ecuador99			Indonesia98		
t	-3.36	-24.63	-11.77	6.69	27.39	-7.63	-10.53	-14.59	-14.30
t+1	16.72	18.77	7.80	9.56	7.07	1.41	1.73	22.14	-0.55
t+2	15.49	8.19	7.99	-4.65	-5.44	3.98	27.64	113.24	3.55
t+3	16.81	7.97	8.12	9.05	36.29	2.97	-12.30	-22.72	2.28
	Italy93			Korea98			Malaysia98		
t	-5.05	-4.74	-0.95	-4.67	-1.72	-7.52	-7.29	7.30	-9.64
t+1	13.16	11.10	2.13	9.92	34.05	8.71	16.99	26.33	3.63
t+2	22.24	17.56	2.82	21.22	31.33	7.58	17.04	17.60	6.42
t+3	7.71	5.93	0.69	-14.04	-25.78	3.08	-10.62	-12.95	-1.80
	Mexico95			Sweden93			Thailand98		
t	30.65	43.23	-7.86	-10.86	-14.08	-2.56	-6.89	7.12	-11.48
t+1	20.69	26.31	3.52	21.99	21.53	3.17	7.62	3.25	3.38
t+2	15.03	32.12	5.23	32.73	47.62	3.31	19.58	23.61	3.76
t+3	6.44	23.47	3.45	5.99	19.97	1.20	-7.09	-11.96	1.29
	Turkey94			Turkey01			Uruguay02		
t	17.80	46.52	-6.43	11.89	-7.36	-7.22	-10.16	6.38	-11.04
t+1	19.49	-10.12	5.91	16.73	-43.49	4.49	18.68	-19.46	2.33
t+2	45.92	43.79	5.44	27.62	43.56	3.65	37.87	39.11	11.88
t+3	0.13	53.76	5.66	30.94	30.54	8.69	20.00	8.40	6.49

In short, a closer look at the data does not provide a clear-cut relationship between crisis and export growth. Data only confirms that there is no unique pathway the countries go after and there are substantial differences in responses to crises. The various structural background and fundamentals along with a mixture of reactions to the shocks should generate different outcomes in each country and reliable estimates of the impact can be obtained only after considering country and time specific characteristics into account.

3.3 VARIETY OF CRISES AS OUTPUT SHOCKS

Crises come in many varieties. While some countries collapse following a crisis, many others do not suffer catastrophic consequences. This section provides a broad discussion of major types of crises and presents those used in the empirical investigation of the paper.

3.3.1 Crises as Output Shocks

When considered in terms of their impacts on the economies, there are plenty of "shocks" that can be regarded as crises. Financial shocks (currency crises, banking crises, debt crises, and sudden stops), real economic shocks (declines in the terms of trade), country-specific external shocks (natural disasters), socio-political shocks (wars and political turbulences), and shocks in global scale (increase in world interest rate and oil prices) can be listed as the major shocks causing considerable output drops.[4] Irrespective of the nature of the shocks, the impacts they initiate on the real economies carry considerable importance for the present study and by adopting different crisis definitions, we will try to disentangle the impacts attributable to each type of crisis.

Before proceeding, it is important to distinguish between two seemingly parallel events; crises and recessions. Economic crises are considered as shocks that are usually unpredictable and less systematic. However, recessions are partly predictable and more systematic and they usually happen when profitability is low. On the other hand a shock (crisis) to an economy occurs even in the absence of any macroeconomic imbalances. It is not a rare presumption among macroeconomists that a recession increases restructuring activity (this is the

[4] See Becker and Mauro (2006) for a comparison of these output shocks and their relevance for growth. Authors also analyze changes in trading partner growth as another type of country-specific external shock, but found them to have little systematic relationship with output drops. In general, the second-order effects become more sizeable in a global crisis, i.e., the loss of export opportunities to crisis countries can undermine the growth in third countries. This, in turn, diminishes the export opportunities from the crisis countries to other countries.

assumption we made for crises), however there is also controversy about whether this is true or socially costly or beneficial. Caballero and Hammour (2005) find contradicting evidence to this presumption based on the U.S. manufacturing sector, indicating that recessions reduce rather than increase the cumulative amount of restructuring in the economy. As an important contribution on the impact of trade structure on business cycles, Imbs (2004) finds a reverse relationship that specialization patterns have a sizable effect on business cycles. There exist no study analyzing the impacts of shocks on trade-related restructuring activities and the present study, to the best of our knowledge, is the first one by focusing on the restructuring in tradable goods sector. Moreover, homegrown recessions and recessions stemming from abroad have different implications. More export-oriented economies tend to suffer less from homegrown recessions but are likely to suffer more from recessions stemming from abroad. Trade structure will dynamically change with the homegrown crisis, but the extent of trade diversification will determine the vulnerability of an economy to external shocks.

Finally, a relatively well developed strand of literature related to the present research paper is the volatility and growth literature. Recent theories and empirical studies establish a strong link between volatility and long-run economic performance which may be positive or negative depending on the mechanisms driving the relationship (Imbs 2002). Theoretically, this relationship could be caused by the joint determination of volatility and growth (as endogenous variables) or could be a result of a causal effect from one variable to the other (for theoretical analyses, see Caballero and Hammour 1994, and Aghion and Saint-Paul 1998; and for empirical evidence see Ramey and Ramey 1995, Martin and Rogers 2000). Martin and Rogers, for instance, find that industrial countries and regions that have a higher standard deviation of growth and of unemployment have lower growth rates. Similar to Schumpeterian cycles, in which the adoption of new technologies and the cleansing effects of recessions play a key role, Rancière, Tornell, and Westermann (2008) develop a model to analyze the relationship between

systemic risk and growth in which financial bottleneck play a dominant role. They document that countries that have experienced occasional financial crises have, on average, grown faster than countries with stable financial conditions. That is another theoretical support for the study topic of this paper where it is claimed that abrupt shocks may have significant effect on future economic performance by shifting a country's growth path through adjustments in export structure.

3.3.2 Alternative Definitions of Crisis

There are variety of crises with potentially unpredicted impacts on real economic activities and trade structure. In order to obtain the fairly accurate impacts to be attributed to particularities in each type of crises, we make use several alternative definitions of crises provided by alternative sources. We consider seven different types of crises clustered under three broad categories: macroeconomic (GDP and consumption disasters), financial (banking, currency, sudden stops and twin crises) and dual (macroeconomic and financial) crises. The reason for considering both macroeconomic and financial crisis definitions is due to their anticipated implications for potential adjustments in trade structure. In general, economic crises potentially destroy fractions of the productive capacities and leave long-lasting hard-to-recover distress on economies. Financial crises, on the other hand, limit the same capacities without seriously injuring them. So the recovery should take place faster when countries experience financial crisis. The types of crises used in this paper are provided in Table 3.2.

We consider two types of macroeconomic crises: GDP disasters and consumption disasters. Barro and Ursúa (2008) try to isolate economic disasters for consumption and GDP by following the procedure in Barro (2006). They use the definition of an economic disaster as a peak-to-trough fall in GDP per capita or consumption of at least 10 percent. As noted by the authors, the peak-to-through method for assessing the size of contractions is reasonable if shocks are permanent or independent and identically distributed. This method can be

Table 3.2: Alternative Definitions of Crises

Form of Crises	Type of Crises	Broad Definition	No. of cr. episo.	Year / Duration Notes	Source
Macroeconomic	GDP disaster	Cumulative decline in GDP of at least 10%	7/49	Peak-to-through Gauged by One-Sided Hodrick-Prescott Filters	Barro and Ursúa (2008)
	Consumption disaster	Cumulative decline in consumption of at least 10%	7/45	Peak-to-through Gauged by One-Sided Hodrick-Prescott Filters	Barro and Ursúa (2008)
Financial	Banking crisis	Identification if one of many conditions hold	58 / 201	Peak / to-through Banking sector distress	Demirguc-Kunt and Detragiache (2005)
		Large number of defaults in financial sector	44	Peak Systemic banking crisis	Laeven and Valencia (2008)
	Currency crises	Uses regression tree methods	57	Peak	Kaminsky (2006)
		Currency crises defined by depreciation and reserve losses	37	Peak A weighted average of the depreciation of the two components exceeding its sample mean by two SD or more	Hong and Tornell (2005)
	Twin Crises	Instances in which a bank crisis is accompanied by a currency crisis	17	Peak Companion in either the previous, current, or following year.	Kaminsky (2006)
	Systemic Sudden stops	Large changes in capital flows	40/67	Peak-to-through Systemic sudden stops	Calvo et al. (2008)
Dual	GDP disaster, currency, and banking crises	GDP fall more than two SD and depreciation >20%	12	Peak Filtered with DKD crisis episodes	Author's calculation

Notes: Due to different data coverage of this paper from the above cited papers, the actual number of crises may vary from the numbers in the original papers.

misleading when shocks are temporary. We adopt therefore their modified approach in identifying the long-run economic contractions, which uses one-sided Hodrick-Prescott filters. This approach tends to count only the more persistent declines and eliminate crises that reflect largely temporary measurement error in GDP and consumption.

Regarding financial crises, we consider four types of financial crises: banking, currency, sudden stops and twin crises. By concentrating only a single indicator of financial crisis, such as currency depreciation, it is generally too demanding to expect significant changes in patterns of trade. Depreciation increases the prices of tradables relative to non-tradables and exporting and import-competing industries may become more competitive, and that is something noteworthy for any economy. But, a financial crisis includes usually more than currency depreciation and that is the reason why we adopt alternative definitions of financial crisis provided in the literature. Moreover, as indicated earlier, this paper is not interested in explaining the causes of crises (which may include large current account deficits, unsustainable public debt, large capital inflows, or balance sheet fragilities) or ways of accelerating economic recovery (which usually includes reallocating wealth from taxpayers toward banks and debtors).

In defining banking crisis, we adopt the crisis definition used by Demirguc-Kunt and Detragiache (2005, henceforth DKD). They identify banking sector distress as a situation where one of the following conditions hold: ratio of non-performing assets to total assets is greater than 2 percent of GDP; cost of the rescue operation was at least 2 percent of GDP; banking sector problems resulted in a large scale nationalization of banks; and extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees were enacted by the government in response to the crisis. The number of crisis episodes in their study is 77 (58 after dropping the countries for which the data are not available). The approximate duration of each crisis episodes is also reported. Complete list of countries and duration of crises are listed in Table 3A.3 in the appendix. Laeven and Valencia (2008) provide another list of systemic banking crisis episodes by concentrating

on the number of defaults in financial markets. This second definition is used in verifying the results obtained from the first definition of banking crisis.

Currency crises usually involve sharp depreciation of the currency, a reduction of foreign exchange reserves, an increase in interest rates, or a deterioration in the capital account. The two different definitions used in this paper are obtained from Hong and Tornell (2005) and Kaminsky (2006). Hong and Tornell use a weighted average of the depreciation of the real exchange rate and reserve losses and identify the currency crises episodes if a weighted average of the two components exceeds its sample mean by two standard deviations or more. Kaminsky, on the other hand, tries to identify variety of currency crises by using regression tree methods and emphasize the fact that not all the crises are the same.

When currency depreciation exacerbates banking sector problems through foreign currency exposures of economic agents, financial crises may turn into twin crises, especially in countries with fixed exchange rates. Although a currency crisis is typically preceded by a banking crisis (Kaminsky and Reinhart, 1999), the sharp reduction in capital supply during a currency crisis aggravates the already weak banking sector and curbs the role of financial intermediation, leading to credit crunch problem (Hong and Tornell, 2005). Twin crises are therefore potentially more damaging compared to currency and banking crises separately. In order to estimate the impacts of twin crises, we combine the currency and banking crises definitions of Kaminsky (2006) and obtain a list of twin crises countries by determining the episodes in which a banking crisis is accompanied by a currency crisis in either the previous, current, or following year.

As a final crisis definition, we combine macroeconomic and financial factors in defining a joint version of crisis, what we call "dual crises". To do this we consider significant changes in two major economic indicators, requiring literally an economy to be hit severely, or "impaired (or jolted) enough". The first one is a massive change in the real value of domestic currency and the other is the heavily abnormal contraction in national income. These indicators

capture the two major channels through which international trade can be distorted by economic crises: credit shortages and lower economic growth. The episodes identified with this experiment are further filtered by the banking crisis definition of DKD so that to include banking distresses into these criteria.[5] More explicitly, if a country experiences depreciation more than 20% and GDP declines more than two standard deviations away from the average growth rate between 1981 and 2007, that country is considered to have a dual crisis.[6] That is, $CR = 1$ if $y_{it} < \frac{1}{27}\sum_{t=1981}^{2007} y_{it} - 2\sigma_{\hat{y}}$ and $\Delta s_t^{t+1} > 20\%$. Among 110 countries[7], twelve of them (with two separate episodes in Turkey) are found to be fitting to these specifications within the period from 1985 to 2002 and these economies will be considered as "severely hit economies" in this paper. The final list of the countries and years of crises are given in Table 3A.2.

[5] Evidently, it would be not sufficient to rely just on ex-ante indicators of crisis without knowing if these are really "abnormally severe and distinctive" events in any crisis-hit country. Therefore we need to know ex-post changes in output and it is for this reason necessary to include the contraction in GDP growth rates to observe and take the potential effects on real economy into account.

[6] Hnatkovska and Loayza (2005) distinguish between 'normal' volatility (repeated but small cyclical movements) and 'crisis' volatility (sharp negative fluctuations). They define crisis volatility as the portion of the standard deviation of GDP growth that corresponds to downward deviations below a certain threshold and this threshold is set equal to one standard deviation of the world distribution of overall volatility measures (thus, it is common to all countries). With such characterization, they found that the effect of a one-standard-deviation increase in crisis volatility is almost twice as large as that of one in total volatility—a loss of 2.15 percentage points of per capita GDP growth. On the other hand, we used the downward deviation in per capita growth rates more than two-standard-deviation from average growth rates of each country. Therefore, we believe that our measure indeed captures the real severe economic shocks.

[7] From the all countries for which the date is available at WDI database, small countries (with population less than one million), oil exporting countries, newly independent countries (including the former Soviet Union countries), and major conflict areas are excluded. Therefore the above experiment is conducted for the remaining 110 countries. Exclusion of former Soviet Union countries, though none of them classified as crises economies in Demirguc-Kunt and Detragiache (2005), was due to their different nature of transformation to market economy.

3.4 SIGNIFICANCE OF TRADE STRUCTURE

Importance of trade structure comes from its predicted impact on growth. The relationships between trade and growth, trade composition and growth, and volatility and growth are well documented in the literature. On the other hand, the linkages between trade (or its composition) and crisis (or volatility) are poorly established. Below, we first provide a discussion of literature providing important insights on the strong linkages between trade structure and growth. Then we discuss the alternative measure of trade structure used in this study.

3.4.1 Role of Trade Structure in Economic Performance

There is hardly any disagreement that trade liberalization is associated with better economic performance. Edwards (1998), Dollar (1992), Sachs and Warner (1995), Frankel and Romer (1999), and Wacziarg (2001) are some of the major studies approving the positive relation between trade and growth. Edwards (1998) showed that, out of nine indicators of trade policy openness, eight were positively and significantly related to TFP growth in a sample of 93 countries. By classifying countries using a simple dichotomous indicator of openness, Sachs and Warner (1995) found that open economies experienced annual growth rates 2% more than closed economies in the period 1970-1989. Later studies of Frankel and Romer (1999) and Wacziarg (2001) considered the importance of reverse causation, or endogeneity, in their studies and find still similar results. Using geographic variables as an instrument for openness, for instance, Frankel and Romer estimated that a 1% increase in the trade to GDP ratio causes almost a 2% increase in the level of per capita income. Wacziarg and Welch (2008) also show that episodes of trade liberalization are followed by an average increase in growth about 1% to 1.5% per annum.[8]

[8] There are also more skeptical studies criticizing the specifications and measures used in these studies. Rodriguez and Rodrik (2000) argue that one of the problems associated with estimating the impact of trade on growth is that protectionism is highly correlated with other badly managed policies, such as policies that generate macroeconomic imbalances. This suggests that the measurement of trade openness in fact captured other growth-reducing

An important drawback in these studies was the missing link between trade and growth and only a few studies try to single out these potential links. That in turn makes it difficult to identify the channels through which trade openness improves economic performance.[9] In this respect, Alcalá and Ciccone (2004) revisit the issue by concentrating on the labor productivity and find significant impact of trade on productivity by using a new measure of the volume of trade. Berg and Krueger (2003) provide a survey of this literature.

Apart from the volume of trade, the importance of the composition of trade for economic growth is also well documented. Baldwin (1992) demonstrates how an increase in international trade increases the real value of production by combining Solow growth with the gains from comparative advantage. By critically examining Baldwin's model, Mazumdar (1996) indicates that medium-run growth depends on the composition of trade. Mazumdar argues that if the consumption good is the import and the capital good is the export, then trade will not lead to growth, although there might be substantial income gains. The reason is that the relative price of the investment good rises as a result of trade, thereby counteracting any effect trade might have had on savings or the rental price of capital. Lee (1995) suggests similarly that capital-importing countries benefit from trade because trade causes the cost of capital to fall. Lewer and Van den Berg (1998) find supportive evidence for this hypothesis. Other recent empirical works also emphasize the role of specialization and trade structure on economic performance.

On the other hand, there are surprisingly few studies investigating the linkages between crisis and trade. The empirical works by Ma and Cheng (2003) and Berman (2009) are two of the very few studies in this field. Ma and Cheng test the impact of financial crises on trade and predict the changes in import and

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policies rather than trade impediments. Therefore openness itself should not be treated as the magic key for growth.

[9] Possible channels include technological spillover, better domestic policies, better functioning institutions, higher foreign direct investment, economies of scale, and increased competition and productivity.

exports during and after the crisis. Berman shows that crises have long-lasting negative impacts on exports and due to these impacts, they remain below their natural level during five years. He also studies the different channels through which international trade may be affected. Importantly, specialization of countries in certain industries is found to have substantial effect on the reaction to a crisis.

Finally, Hausmann and Rodrik (2003) provide some anecdotal evidence suggesting that successful new industries often arise for idiosyncratic reasons. As they put, there is much randomness in the process of discovering what one can be good at. Additionally we make a crucial assumption concerning the firms and we assume that they do not expect crisis, even if they expect, they do not know the time of crisis. Therefore it is totally random for firms to experience crisis and crises can be considered as exogenous shocks and such unpredicted shocks can provide an explanation for the rise or fall of industries for idiosyncratic reasons.

3.4.2 Measures of Trade Structure

There are plenty of indices available that can be used to quantify and assess the trade structure in some form. Instead of embarking on random indices, we will be firmly selective on the alternative measures and work with those that are believed to be the most pertinent for the purpose of this study. In determining these indices, we consider that it can to some extent map the restructuring in domestic manufacturing industry and potential upgrading of production processes. We consider three alternative indices as a proxy for trade structure. These are trade diversification index, index of technological intensity and technological intensity of comparative advantage. These indices measure the level of diversification, technological intensity of the goods exported and of the goods in which countries have comparative advantage. Each of the indices will be discussed more in detail in the followings.

In general, trade is said to be beneficial to growth if an economy specializes in industries where world demand is strong. To capture this proposition, an

indicator called 'trade dissimilarity (or diversification) index' will be used to measure the similarity in an economy's pattern of trade with world demand. It is defined as the sum of the differences between the share of industry (j) in country's exports and the share of that industry in total world export. It is constructed as:

$$TDI = \frac{1}{2}\sum_{j=1}^{N}\left|\frac{X_{ijt}}{X_{it}} - \frac{X_{jt}}{X_{t}}\right|$$

Trade dissimilarity index (TDI) ranges from zero to one, with higher values indicating higher dissimilarity, or country i exports commodities in industry j, where world demand is relatively low. It also evaluates if a change in the exports behavior is oriented towards more dynamic products demanded by the rest of the world. It is commonly argued that export diversification is especially important for developing countries because of their dependence on primary commodities for their export revenues. Lower dissimilarity index means higher diversification and diversification into new export products protects economies against unstable price and terms of trade shocks. Diversification of export into manufactured commodities would be especially desirable for developing economies as it generates higher and more stable export earnings, creates new jobs and skills, and thus develops a better infrastructure with higher growth potential. That would stimulate the confidence for the development of even newer export products and thus accelerate the post-crisis recovery and promote the long-run growth.

Apart from the diversification, the technological intensity of the exported goods is also believed to be vital for development. A second index is then constructed by grouping manufacturing industries into 4 groups based on their technological intensity. This is to measure if a shock brings a country to export more technology intensive products. Hatzichronoglou (1997) provides a classification of industrial sectors by level of technological intensity. This approach is also used by Crespo-Cuaresma and Würz (2005). Table A.1 in appendix shows the

list of industries and their assigned technological intensity. **Index of Technological Intensity (ITI)** is calculated as:

$$ITI_{it} = \frac{1}{4}\sum_{\gamma=1}^{4} \gamma.\delta_{it}$$

where $\delta_i = \frac{x_{\gamma it}}{x_{it}}$ is the export share of group γ industry in country i and γ is the respective technological intensity ranging from 1 to 4. This index ranges from zero to one and higher values indicate higher technological intensity in export goods. A change in this index will measure the impacts of economic crisis on the structure of trade in an economy in terms of its technological intensity.

Finally, a rather appealing scrutiny is to analyze if products that enjoyed a comparative advantage react differently than those that suffered a comparative disadvantage. Having comparative advantage in a specific sector is itself not an adequate measure of upgrading in trade structure, because having comparative advantage in technology intensive sector is always more desirable compared to that in a technologically less intensive sector, like agricultural products. In order to take this into account we generate a new index called TICA by aggregating the revealed symmetric comparative advantage (RSCA) index multiplied by Index of Trade Intensity, whenever RSCA is greater than zero –i.e. whenever a country has a comparative advantage in a certain industry. We thus obtain an index measuring respective importance of concentration in those sectors that a country has comparative advantage. For that reason, we call this index '**Technological Intensity of Comparative Advantage (TICA)**'. The TICA index is defined as

$$TICA_{it} = \frac{1}{4}\sum_{\gamma=1}^{4} \frac{x_{ijt}}{x_{it}}.\delta_{it}.rsca_{it} \quad \text{if } rsca_{it} > 0$$

Where $rsca = \frac{rca_{it}-1}{rca_{it}+1}$ and $rca = \frac{X_{ijt}}{X_{it}} / \frac{X_{jt}}{X_t}$. By the help of this index, we can study how valuable it is to gain comparative advantage in certain industries. [10] This index has also advantage of taking the second-order impacts of crises into account, if any; because gaining comparative advantage is not purely result of any single country's changing trade structure, but also of change in other countries' trade structure and productivities of factors of production. Summary statistics of each of above indexes are provided in the table below (Table 3.3).

Table 3.3: Summary Statistics – Trade Structure Indexes

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Trade Diversification Index (TDI)	1280	0.5199858	0.1964107	0.1429925	0.9329932
Index of Technological Intensity (ITI)	1280	0.4744738	0.1362128	0.2525773	0.852693
Technological Intensity of Comparative Advantage (TICA)	1280	0.3538908	0.1182556	0.150101	0.8362914

A remark on terms of trade changes is in order. It may be well argued that the recovery might be captured through the developments in terms of trade, which usually deteriorates dramatically after crisis. We argue however that it would be not a reliable indicator of recovery in the context of this paper where we pay attention to the nature of recovery. The terms of trade measures only the relative price of exports compared to imports and since it is all about prices, it cannot be a reliable indicator of recovery. Reduction or increase in the unit value of exports, for example, may be compensated by equivalent change in the unit value of imports and this indicator may not capture the advancement in

[10] Despite of some theoretical limitations on the revealed comparative advantage (rca), Laursen (2000) argues that rca is a better measure compared to other frequently used measures of comparative advantage, like chi square measure, and a change in the RCA is consistent with changes in relative factor endowments and productivity of countries (Marchese and Simone 1989), and using TICA index in this context should be considered as suitable.

exporting industries. And highly volatile prices in primary goods may change the indicator drastically in many developing countries, without experiencing any technological progress. Concisely, the terms of trade shocks are usually the shocks to a country's income but they are not shocks to a country's productivity.

After sharp deterioration in the terms of trade during 1980's, for example, many countries in Latin America have sought to increase their exports to generate extra capital flows so as to serve their debts. That however merely led to a reduction in export prices, deteriorating the terms of trade further. However, increasing exports might have increased the productivity and generated new skills when adapting the goods into new markets. When accompanied by productivity growth in the exporting industries, deterioration in the terms of trade due to lower export prices does not necessarily mean a loss of real income. It only means that part of the productivity gains are accrued to the importing countries instead of domestic economy.

3.5 CHANNELS AND MECHANISMS: IDENTIFYING THE UNCOMMON ROUTINES

Instead of postulating a complete structural model, this section explains the major factors that may lead to restructuring of manufacturing and exporting industries in crisis-hit economies.[11] Economic and financial crises may result in changes in the factor endowments used in the production and that can be especially severe if an economy experience severe contraction of income. Such changes may explain some part of the restructuring in a crisis economy. Before discussing the potential channels through which trade structure may alter, a

[11] There is huge literature in each of the channels to be discussed (impacts of exchange rate movements, trade finance, protectionism, and income on trade) and what really matters is the overall impacts of all possible reactions of all actors to crisis and resulting trade structure. A specific model would be, therefore, restrictive in understanding the complete restructuring in an economy.

theoretical explanation can be provided by concentrating on the changes in factor endowments.[12]

In constructing the framework, let us consider an economy with two factors of production (labor (L) and capital (K)) within the context of H-O theorem. A useful theorem in analyzing the contraction in an economy is the Rybczynski theorem, which demonstrates how changes in an endowment affect the outputs of the goods when full employment is maintained. The theorem additionally assumes two consumption goods, say, good 1 and good 2, each produced according to constant returns to scale (CRS) and perfect competition. The theorem states that an increase in a factor endowment will increase output of the industry using it intensively, and decrease the output of the other industry.

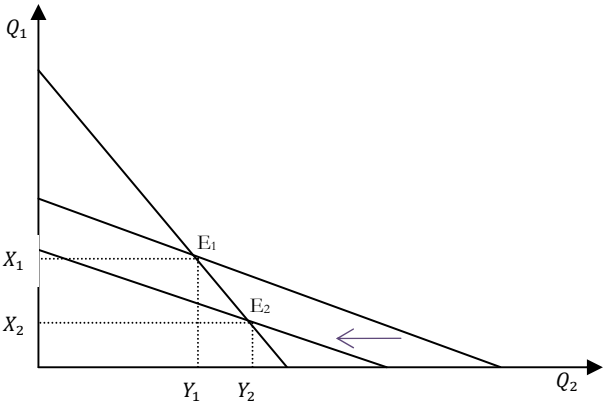

Figure 3.3: The Rybczynski theorem

Now assume it is the capital that shrinks following crises. Then, the theorem implies that, if good 1 is capital intensive and good 2 is labor intensive, a decrease in capital investment leads to a decrease in the equilibrium supply of good 1 and an increase in the equilibrium supply of good 2 at given price. To demonstrate that, consider the diagram (Figure 3.3) depicting a labor constraint (the steeper line) and a capital constraint (the flatter line). Suppose production occurs initially on the PPF at point E_1, with

[12] Restructuring of economies and change in trade structure are definitely different things but we assume that change in trade structure maps the restructuring in manufacturing sector of an economy. Otherwise, it is not our intention to study the precise impact on the restructuring of manufacturing industries.

production level at X_1 for goods 1 and Y_1 for goods 2. Now suppose capital level decreases following crises. That will cause an inward shift in capital constraint and the equilibrium production will shift to point E_2. Production of capital intensive goods will decrease and of labor intensive goods will increase. This implies in general that, an economy experiencing contraction in any of the factors of production, the production in that sector may decrease in favor of other sectors and affect the specialization and diversification structure of that economy.

The theorem provides only some insights how contraction in endowments alter the way an economy organize, but it is far being fitting. Therefore, we now turn to the commonly observed factors leading to restructuring during a crisis, which may be numerous. In addition to automatic adjustments in free market mechanism, there might be deliberate interventions to the economies to speed up the recovery following crises. Besides regulative policies of governments, where governments opt to place certain restrictions to protect domestic industries or provide special incentives for the sectors that they consider crucial for the country, we consider trade financing and change in competitiveness due to price changes in tradable goods, contraction in income and redistribution of it and changing consumption and saving patterns and analyze the potentiality of any restructuring due to each of these factors. Now we discuss each of them in some detail.

3.5.1 Change in Relative Prices and Competitiveness Effect

The substantial changes in relative prices and capital outflows are two major mechanisms that transmit the impact of crisis on the real economic activities. Depreciation has different implications for non-exporting and exporting firms. As a result of sharp depreciation of the local currency, prices of tradable goods will rise against non-tradable goods and services. This is usually associated with higher inflation and decline in the purchasing power of consumers. Reduced purchasing power has disadvantageous implications for non-exporting firms due to fall in domestic demands. At the exporter side, lower valued currency

relative to main trading partners' currencies makes the domestic producers of tradable goods more competitive at home and abroad.[13] That will increase export and decrease imports.[14] After exchange rate depreciation, the traditional competitiveness effect under liquidity constraints comes into play and works as follows: Due to fixed costs of exporting, only more productive firms can profitably export, and some others, though being enough productive, cannot do so because of liquidity constraints. Therefore only those productive firms that can generate sufficient liquidity can profitably export. After the depreciation of the exchange rate, potential exporters with liquidity constraints gain competitiveness and can profitably export (trade increase in extensive margin). Depreciation also helps existing exporters to increase their exports (trade increase in intensive margin).

Firms and other microeconomic agents are supposed to retain the flexibility to adjust to shocks by reallocating resources across production plants, economic sectors, and geographic areas. Adjusted competitiveness and trade under latest relative prices provide the incentives and mechanisms for such reallocations. An undervalued currency can stimulate exports and domestic production without biasing incentives toward any particular domestic industry. Unbiased incentives provide equal chances for each industry, if not distorted by government interventions. In such circumstances, increases in exports may counterbalance the falls in domestic demand. In the wake of the Asian crisis in 1997-8, there was a sharp increase in demand from abroad, partially offsetting the falls in

[13] Devaluation can restore competitiveness of the economy and provide a boost to the production of tradables provided the Marshall-Lerner condition holds. Mexico, for example, experienced an increase in the export volumes more than 50% in the following two years after its crisis in 1994 by floating its currency (Fingerand and Schuknecht, 1999).

[14] The short run impact of devaluation has been described as the J-curve: if demand is inelastic in the short run, devaluation may have a negative impact on the current account in the short run, before the competitiveness effect comes into play and exports catch up. Demand for exports picks up and domestic consumers switch their expenditure to domestic products instead of expensive imported products. Likewise, foreign consumers may switch their expenditure to lower-priced imported products and away from their domestically produced goods and services.

domestic demand. This increase in external demand led exports to rise rapidly and imports to fall, and this exceeded in some cases 20 percent of GDP (McKibbin and Martin, 1999).

3.5.2 Trade Financing: Increasing risk perception, capital outflows, and credit constraints

Another channel through which the effects of crises on international trade come about is the tightening of liquidity and shortage in trade finance. The sharp deterioration of domestic economic prospects triggers foreign capital to outflow and credit risks to be re-assessed. When combined with tight monetary and fiscal policies, crises become the source of a sharp increase in the cost of credit and insurance for trade operations. These shocks can cause a real or perceived shortage of capital for banks, restraining the credits available even for investors with precious trading and investment opportunities. As a result, financial sector may become unwilling to provide credits even to viable companies and instead may prefer to invest excess liquidity in safe assets such as government bonds.[15] Thus, the crises in the financial sector are likely to place a disproportionately negative impact on the firms that rely heavily on external sources of finance.

Credit shortages may have significant impacts on trade by raising the costs of trade financing and thereby reducing exports and imports. However financial institutions are likely to preserve the credit lines of exporters in order to maintain their ability to pay their debt. Credit financed investment projects with significant share of imported capital goods are, however, trimmed down. For this reason it would be reasonable to think that exporters are likely to suffer less than importers during crisis times. Attrition of the home market by the crisis may make domestic producers to seek alternative markets to keep the business running and service their financial obligations, thus making these firms exporters.

[15] That was also the response of Turkish banks following 1994, 1999, and 2001 financial crises.

The level of financial sector development is also found to play substantial role in molding the trade structure. Hur et al. (2006) find that economies with higher levels of financial development have higher export shares and trade balance in industries with more intangible assets. Weak financial institutions increase the uncertainty during crisis times and increased uncertainty about whether and at what price loans will be available can also result in a shortage of funds to be borrowed. These effects can be particularly severe for bank lending because banks, compared to other financial intermediaries, are more likely to lend to firms that suffer from a greater degree of informational asymmetries (Laeven et al. 2002). Better financial sector will consequently mitigate the impacts of crises on corporate sector.

Moreover, crisis alters the way the risks are perceived and assessed and financial institutions become increasingly less willing to supply credit to firms and households. The higher cost of trade finance will inescapably connote for firms that some transactions that made economic sense earlier are no longer profitable, reducing both trade and investment. Given the general uncertainty about market conditions, firms may also not be able to anticipate the level of demand for their products, due to contracted domestic demand and uncertain international demand, which may boost due to more competitive exchange rate but suffer from second order effect in partner countries due to lower export revenues. All these factors can be a triggering source of reshaping in export and import structure of an economy.

3.5.3 Reshaping Trade Policies: Special Incentives and Threat of Protectionism

Crisis periods are also the occasions in which governments are more enthusiastic in opting for special incentives for certain industries in order to avoid their impairment during crisis and promote their expansion as leading sectors of the economy. Furthermore, a country may opt to shift their production from sectors which are vulnerable to financial crises to less vulnerable/sensitive sectors and put restrictions to protect those industries that

are believed to be strategic in generating employment and in attaining long term development objectives. Under the pressure of various interest groups, governments may be tempted to introduce restrictive policies for trade even without any strategic considerations. In this sense, protectionism appears to be a tailor-made tool to shelter the domestic producers and raise their profitability. And all these policies carry risks of retaliatory barriers, which may further weaken the economies.

Economic slowdown following crises prompts calls for government support in many industries and governments pick the industries that carry strategic importance in overcoming the crisis and maintaining the long-run growth. Though being important trade policy instruments, tariffs and subsidies are not the only ways of supporting strategic industries. Other policies like tax redemption and extended credit facilities are also preferred in many countries.[16] Governments provide subsidies through low-interest loans to the operations of domestic firms to see them through difficult economic times. Tax policy can also be designed to favor investment at home rather than investment abroad.[17] Moreover, some developing countries may defer the collection of customs duties on capital goods that are essential for ramping up production of traded goods and services.[18]

[16] Local campaigns like "buy local" by unions or ordinary groups or incentives provided by governments when bought domestically may raise protectionist barriers even governments do not put any legal restrictions.

[17] In determining trade policy, Grossman and Helpman (1994) propose a neat solution to the problem of how the government simultaneously considers the contributions of numerous lobbies along with consumer welfare, the so-called 'protection for sale' model.

[18] Formal restrictive policies for current and capital account movements are likely to have negative consequences for the economy as well. Import restrictions, for instance, increase the input prices when some components are being imported, it may create distortions and hinder efficient allocation of resources, and it may open the doors for potential retaliations and pave the way for trade wars. That was exactly what happened after the great depression and protectionism caused the unit prices of internationally traded goods by about 55% within three years after depression began and destroyed the trade opportunities (Finger and

The economic argument for intervention hinges on the presence of market failure. If markets worked perfectly, they would, by assumption, achieve optimal resource allocation and there would be no economic justification for intervention. In this respect, in neoclassical approach there is no legitimate role for governments in correcting the market-driven allocation of resources between productive activities. Whether the government interventions do better compared to free markets depends on the overall circumstances and stage of development and *a priori* generalizations could be misleading.[19] But there is still considerable scope for legitimate industrial policy, especially in developing countries (Lall 2000).

From technical point of view, comparative advantage may lead developing countries to specialize in industries that use traditional technologies operated mostly by unskilled workers. Kraay and Ventura (2007) argue that these industries are more volatile and that this pattern of specialization can explain a substantial fraction of the difference in volatility between developed and developing countries. During crisis times, governments and other policy makers in developing economies will find themselves in searching for strategic sectors that are less volatile and more beneficial in achieving long term development goals. Though it is a tough question that which activities need to be specially promoted as engines of dynamic comparative advantage, governments may choose to do that without any intervention on international trade, namely by promoting skill and technology accumulation. The initiation of special incentives and subsidies for the firms operating in these sectors can be a major force in determining a country's prospective trade industrial and trade structure.

Schuknecht 1999). That further exacerbated the crisis by weakening corporate balance sheets and raising non-performing loans.

[19] As Stiglitz (1996) notes "Good decision-making by the government necessarily involves making mistakes: a policy that supported only sure winners would have taken no risks. The relatively few mistakes speak well of the government's ability to pick winners" (p.162).

3.5.4 Contraction of Income and Changing Consumption and Savings Behaviors

Concerning the demand side factors, the contraction of income is the most straightforward outcome of economic crisis and that naturally diminish the demands especially for the goods with higher demand elasticity. Lower equity and asset prices reduce households' net wealth and affect their consumption and saving behaviors. The welfare costs of economic crises are particularly large in developing countries.[20] These costs come from the direct welfare loss of deviating from a smooth path of consumption that is probably optimal for most people. Becker and Mauro (2006), for example, reports that consumption declines in developing countries in the first year of output shocks are more than twice compared to advanced countries and consumption continues to decline in the second year in developing countries. Economic crises, causing output volatility and contraction in income, are therefore reflected disproportionately in consumption volatility. Households respond to the income, welfare, and relative price effects of these crises by changing the composition of consumption basket, smoothing the consumption,[21] selling some physical assets

[20] On the welfare impacts of the financial crisis in Indonesia and Thailand in 1998, Friedman and Levinsohn (2002) and Bresciani et al. (2002) found that most households were affected by crisis, but the urban poor was affected worst; the self-sufficiency of poor rural households in producing basic foodstuff alleviated the adverse outcomes of the higher commodity prices. By contrast, the rural poor suffered heavily from the economic shock in Thailand, because of their relatively greater integration with the market economy than was the case in Indonesia. The financial crisis in Argentina in 2002 was also found to have had a striking impact on the real incomes of workers and households, with 63% of urban households experiencing real income falls of 20% or more within a year (McKenzie (2004)). Indonesia has experienced considerable changes in the consumption of expenditure; the share of staple foods increased from 23.1 to 31.7 percent, while that of non-food items declined. Household in Thailand increased their real expenditures for essentials (food, fuel, medical supplies, etc.) but reduced expenditures for other items (World Bank, 2000).

[21] Although poor and rich are both hurt by crisis, poor have less leeway to smooth their consumption in response to crises. Because of imperfect and segmented capital markets, credit facilities are typically not always available to the poor.

and acquiring others. And that will have immediate implications for the production and trade structure of the economies.[22]

Crises endanger costly reallocations of income and sharp declines in middle-class standards of living. In spite of the way of complexity that they come up, there are reasons to expect that financial crises have distributional effects. At times of crisis, wealth transfers take place between rich and poor, but also between domestic and foreign investors (and between investors with and without access to foreign financial systems) and between uninformed and informed investors. The rich (investors and households) are certainly better able to hedge ahead of crises and act quicker as crises approach. They are also likely to receive compensation when bank bailouts occur (Halac and Schmukler, 2004). Abnormally large contractions in average household income are associated by and large with growing inequality and the poor are usually disproportionately affected. Several studies have shown that financial crisis is responsible for change in income distribution, with especially strong effect on poor people (e.g., Baldacci et al. 2002).

As household budgets are squeezed and reallocated, consumers may be forced to change their consumption behavior. Such alterations in demand side are likely to force the firms to adjust their behaviors, either by searching new markets (upgrade to exporter status) or produce only a range of products that consumers are willing to buy (contract the range of production / specialize). Income (distribution) effect, when combined with credit constraints, may therefore cause some firms to lose their competitiveness against foreign and also domestic firms. This process may force some firms to exit and encourage others to enter (possibly into most promising sectors) with viable business ideas.

[22] The response of households in Indonesia to severe economic crisis was to increase the consumption as a share of income and increase the share of staple foods in their consumption baskets. Households in Korea and Malaysia responded by increasing the saving rate. By spending more on primarily essential items, the consumers changed the composition of consumption expenditures significantly (World Bank, 2000).

3.5.5 Summing up

All the factors discussed in this section carry potential to affect restructuring in an economy and in this process the particularly vulnerable are the firms that export at margin, depend on imported inputs, sell goods with high price elasticity, and operate in sectors with high financial dependence. Definitely some exporting and non-exporting firms will not survive and that may cause an expansion in the markets of surviving firms. Some exporting firms may find it more profitable to sell domestically as less productive firms are forced to exit. Similarly for other firms, though being productive, demand for their goods may not be sufficient to keep their production profitable and need to search for new markets after a crisis. That may push them to discover new export markets for their goods that were not being exported previously. Theoretical justification can also be found in heterogeneous-firms literature with productivity differences where not all firms in a sector export but only the ones which are relatively more productive and thus able to compete in foreign markets. Again some firms exit after a sharp depreciation due to import dependent inputs or other firm specific reasons, like non-hedged foreign exchange liabilities. When some economies, as a remedy, increase their protection in trade to help domestic firms to pick up faster, this may force some importing firms to enter to the market through FDI (tariff-jumping FDI), instead of importing, and stimulate new industries to emerge.[23] Table 3.4 provides a summary of channels and mechanisms that we discussed.

Evidently, there are factors in force that can significantly influence the behavior of firms in particular industries of a country in various ways and these factors can lead to restructuring in manufacturing and trade activities of that economy.[24] All these considerations, however, articulate only the possibility of

[23] Since most interventions have their own costs and risks, in such an intervention it has to be established that the benefits outweigh the costs.

[24] There are also some country specific empirical studies analyzing the effects of economic crises on the manufacturing sector and the real economy for the crisis economies. Among the many other studies, Thee (2000) analyzes the effects of 1997 crisis on Indonesian

Table 3.4: Identifying the Uncommon: Channels and Mechanisms	
Channel	**Mechanism**
Change in Relative Prices	1. Reversals of capital flows leads to depreciation of local currency 2. Depreciated currency increase the competitiveness of domestic firms
Trade Financing	1. Increased funding costs due to higher interest rates and lower equity prices reduce investment. 2. Tightened financial conditions reduce the size of credits available to firms 3. Higher risk aversion downsizes the credits for potentially risky investments.
Incentives and Protectionism	In order to avoid the impairment of strategic sectors during crisis and promote their expansion, special incentives and protectionism may intensify.
Changing consumption and saving patterns	Lower equity and property prices trim down households' net worth, altering their consumption and saving attitude.
Summing up: Fall in Confidence vs. New Challenges	1. Fall in consumer, business and investor confidence lead to a restraining of their activities 2. Good positioned firms and privileged sectors experience a new challenge in domestic and foreign markets.

changes but not the necessity of them. Relative strength of an economy and beliefs and expectations of market participants may lessen the potential impacts of a crisis on the real economy, regardless of the depth of the crisis. In this case, except some temporary adjustment, one should not observe any noteworthy adjustment even in the short-run economic indicators. This is especially expected to be the case for developed countries. For developing countries, the

manufacturing sector and emphasize the difficulty in obtaining trade financing as a major problem for many manufacturing firms, including export-oriented firms, thus hampering them from importing the raw materials, parts, and components needed to restart or maintain their production lines. Lee (2006) studies the post-crisis effects for Korea in the aim of indentifying the trade structure of manufacturing sector. Athukorala and Suphachalasai (2004) examine the post-crisis export performance of Thailand and state that real exchange rate depreciation has been a significant determinant of the post-crisis export recovery.

prospect of structural changes is more likely to happen, since the acquaintance and capability of these countries to absorb negative shocks is weaker.

3.6 ESTIMATING THE IMPACTS OF CRISES ON TRADE STRUCTURE

This section outlines the empirical methodology used in the estimation of trade impact of crisis and post crisis adjustments in trade structure. Main identification strategy is the matching estimation technique and we attempt to identify the potential links in two steps. In the first step, we estimate the probability of crisis under some observable covariates so that to find suitable matches by comparing the respective propensity scores (probability of being treated) of treatment and control units. In the second step, we conduct the analysis on the impacts of crises on trade structure. In some cases, however, matching estimation technique may provide only poor matches, usually due to small number of treated units. In order to avoid misinterpretation of the results in such cases, we additionally report the results of parametric estimation techniques. Below we discuss the alternative methods of estimation in comparison.

3.6.1 Estimation Strategy

In quantifying the causal linkage between crises and trade structure, we confront with two major obstacles. Though providing some clues, previous works in international trade literature do not provide what the exact determinants of trade structure are and in which way they affect the structure of trade. The same difficulty emerges in defining crisis as well. Therefore we need an estimation strategy that can avoid making strong assumptions about functional form, at the same time, cope with the possibility of non-random selection (experiencing crisis). In the present context, matching approach is a suitable empirical strategy to study the impacts for those countries that are treated (or hit by crisis).[25] Yet,

[25] Estimating average treatment effects has become important in the program evaluation literature, such as in the evaluation of active labor market policies, but the methods are

when the treated units are small in numbers and their probability to get the treatment is estimated to be large, then it is hard to find suitable control units, because the untreated units are likely to have low estimated propensity to be treated. That produces two major problems: one is the enormous gap in probability of experiencing crisis between the two groups when constructing the matches and the other is that the number of countries matched with a single untreated country can be high. Since we have seven different sets of treated countries under different crisis definition, some of them may require special treatments. Therefore, we may need a complementary estimation strategy for the sake of robustness, and fixed effect and feasible GLS (FGLS) estimations are the two alternative estimation techniques used for this purpose.

In general, running a regression like $TS_{it} = \alpha + \gamma C_{it} + \beta X_{it} + \varepsilon_{it}$ is the ordinary way of estimating the treatment impact. Here, X is a vector of control variables, C is a dummy for participation and γ measures the treatment effect. Composite error term includes time-invariant country fixed unobserved heterogeneity and a random / idiosyncratic term: $\varepsilon_{it} = \eta_i + \omega_{it}$. Higher η_i makes the countries more likely to experience a crisis, but it is also more likely to have impact on trade structure, so η_i is not independent of C_{it}. This unobserved effect[26] that vary from country to country makes it difficult to compare participants and non-

applicable when the explanatory variable of interest is any binary variable. Examples for usage of the matching method can be found in very diverse fields of study. Demirgüç-Kunt and Detragiache (2002) use a standard treatment effect model in examining the impact of the implementation of deposit insurance on the probability of a banking crisis. Hitt and Frei (2002) analyze the effect of online banking on the profitability of customers Hujer and Radic (2005) analyze the effects of subsidies on the innovation activities of firms in Germany.

[26] That may include cultural factors affecting the business attitudes and quality of institutions or other factors shaping the overall business environment and can be considered as country fixed effects influencing the process of trade structure formation with potential impact on generating crisis.

participants. The matching estimation techniques can deal with these problems.[27]

Using matching strategy instead of a regression provides some advantages. The basic idea in matching strategy is to choose comparison group members who are very similar to treatment group on the basis of observed characteristics. So we are still controlling only for observable characteristics. However, we do not need to impose a functional form anymore. We also compare only comparable country sets with the common support assumption made in matching estimation. In what follows, beginning with matching strategy, we discuss the alternative estimation methodologies in detail.

Let $Y_i(1)$ and $Y_i(0)$ denote the two potential outcomes for country i, C the treatment status (being hit by crisis, $C=1$, or not, $C=0$), and TS the trade structure. What we are interested in is the average treatment (or causal) effect of crisis on trade structure: $Y = E(TS_{1i} - TS_{0i} \mid C_i = 1)$, that is the difference between the level of trade structure obtained from the treatment and what it would have attained otherwise. Since the respective counterfactual is unobservable, the causal effect, defined as the difference of the two potential outcomes, cannot be estimated. This is not the same as comparing trade structure of the countries that did and did not experience a crisis, which is $D = E(TS_{1i} \mid C_i = 1) - E(TS_{0i} \mid C_i = 0) = Y + \lambda$ the treatment effect plus a bias and bias can be derived as $\lambda = E(TS_{0i} \mid C_i = 1) - E(TS_{0i} \mid C_i = 0)$.

If assignment to treatment is random, potential outcomes will be independent of the treatment status, $Y(1), Y(0) \perp C$. Randomization ensures that the sample selection bias is zero. But crises occur non-randomly, usually after deterioration of some fundamentals. As explained earlier, however, crisis can happen even in the absence of any macroeconomic imbalances and despite of sound economic

[27] For identification in matching estimation, the assignment to treatment should not be associated with any part of TS not determined by the treatment. This assumption does not work where units choose their value of C. In our case, we do not need to spend much effort to prove that none of the countries deliberately choose to have crisis.

fundamentals, which can be then considered as idiosyncratic shock. That may add some randomization, but does not suffice to claim that crisis episodes are all random. In observational data, therefore, several assumptions have to be made for identification, as carefully sketched out in the evaluation literature.[28] These are the conditional independence assumption, common support, and known propensity score. The most crucial assumption is the conditional independence assumption.

Assumption 1: *Conditional Independence Assumption (Selection on observables – Unconfoundedness):* Let X denote a matrix of predetermined treatment observable variables for each country, then

$$Y(1), Y(0) \perp C \mid X .$$

That is, the assignment is independent of the potential outcome conditional on the values of suitably chosen covariates. This assumption implies that the selection into treatment depends only on the observables vector X.

$$E\{Y_i(1) \mid C_i = 0, X\} = E\{Y_i(1) \mid C_i = 1, X\} = E\{Y_i(1) \mid X\}$$

Conditional on the vector of covariates (X) upon which observations are matched, expected value of trade structure should be the same for treated and untreated countries.[29]

Assumption 2: *Common Support Condition:* The counterfactual outcome is not identified for units outside the common support region. For that reason, those countries in the control (treatment) group that fall outside the support of the treatment (control) group are removed from the sample. The basic criterion of this approach is to delete all observations whose propensity score is smaller than the minimum and larger than the maximum in the opposite group

[28] See, e.g., Lechner (2001b), Heckman et al. (2000), and Dehejia and Wahba (1999) for more detailed discussions of matching estimators.

[29] When comparing the outcome means for participants and non-participants, it is assumed that all X's are observable, so that they can be controlled for. That leads to quasi-randomization conditional on the observables.

(Caliendo and Kopeinig, 2008). This condition ensures that countries with the same X values have a positive probability of being both treated and untreated. Heckman et al. (1997) point out that a violation of the common support condition is a major source of evaluation bias as conventionally measured. Therefore only the subset of the comparison group that is comparable to the treatment group should be used in the analysis.[30]

Assumption 3: *Known Propensity Score:* Rosenbaum and Rubin (1983) show that if unconfoundedness is valid and the two treatments are independent of the assignment conditional on X, then they are also independent conditional on specific functions of X that fulfill the so-called balancing score property. One commonly used balancing score, suggested by Rosenbaum and Rubin, is the propensity score. The propensity score is the conditional probability of receiving the treatment given the pre-treatment conditions, denoted as $p(x)$, which reduces the dimension of the conditioning vector X to one. The property of the propensity score implies that if $Y(1), Y(0) \perp C \mid X$, then $Y(1), Y(0) \perp C \mid p(x)$. This property implies that observations with the same propensity score, independent of their treatment status, have the same distribution of observable covariates.[31] The balancing property of the propensity score also implies that assignment to treatment is random for given propensity score and therefore treated and control units are approximately observationally the same.

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[30] Lechner (2001a), on the other hand, argues that imposing the common support restriction is not necessarily better, because some high quality matches may be lost at the boundaries of the common support and the sample may be considerably reduced.

[31] In a randomized experiment, every unit has an equal probability of receiving the treatment. Since random assignment is, by definition, independent of all conditioning variables, the propensity to receive a treatment is the same for all subjects regardless of whether we condition on X. Under the estimated propensity score, units with the same predicted probability of treatment but with different treatment status differ only on their error term in the propensity score estimation and this error term is assumed to be independent of the background attributes. This assumption eliminates the bias in the estimation.

Under these assumptions, there are alternative matching algorithms to use and match the sample.[32] From which we decide on using are nearest-neighbor and kernel matching estimators. In nearest-neighbor matching all units find a match but some of these matches can be fairly poor because of the significant differences in propensity scores between matched units. Kernel matching method offers a solution to this problem by using the weighted averages of all cases in the control group to estimate counterfactual outcomes. Weights are inversely proportional to the distance between the propensity scores of treated and control units.[33]

Especially in the case of macroeconomic crises, we have to work with only a few numbers of treated units, with potentially high differences in propensity scores with their comparison units. Therefore, with the common support assumption highlighted above, we may not find suitable matches for some of the countries. Even if we find a match, the quality of the matches may be poor and same match may have to be used repeatedly when using nearest-neighbor matching strategy. That is, the number of times that any observation i is used as a match for the observations of the opposite treatment group may be relatively high. That may cast doubt on the robustness of the results that we obtain. For this reason, we alternatively present parametric estimation results. In order to identify the appropriate regression techniques, we conduct several specification tests. We fist run the model using random effects and then tested this approach using the Breusch and Pagan Lagrangian multiplier test for random effects, which indicated that the null hypothesis of random effects is rejected. Then we test for serial correlation by using Wooldridge test for serial correlation in panel-data models. The null hypothesis of no first-order

[32] See Caliendo and Kopeinig (2008) for a discussion of alternative matching algorithms.

[33] The common support condition outlined above, as noted by Caliendo and Kopeinig (2008), is more important for the implementation of kernel matching than it is for the implementation of NN matching, because with kernel matching all untreated observations are used to estimate the missing counterfactual outcome, whereas with NN matching only the closest neighbor is used.

autocorrelation was rejected. Given these outcomes, we adopt fixed effect linear model with AR(1) disturbances. We additionally run the fixed effect regression and test the results for heteroscedasticity using the Wald test for groupwise heteroscedasticity,[34] which rejects the null hypothesis of constant variance. Therefore, we additionally adopted feasible generalized least squares (FGLS) estimation technique that can deal with heteroscedasticity and serial correlation in panels.[35]

It remains finally one critical issue to be determined. It is the selection of appropriate control variables which are crucial for identification. Beyond the determinants of crisis, determinants of trade structure are poorly known and empirically less established.[36] Depending on the economic theory, and in addition to proxies for factor endowments, it is considered to be appropriate to add the variables like openness ratio, average trade protection, and stock of natural resources as control variables. A measure of financial development is included because deficiency of financial markets is usually the main triggering source of crises and the level of financial sector development (and its recovery) is going to be decisive in post-crisis developments for both trade and growth. A good functioning financial system means transferring funds from agents with surplus of resources to agents whose investment opportunities exceed their current resources. Especially during and after crises, this may be heavily affected and previously mentioned credit borrowing constraints may arise.

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[34] The error process may be homoscedastic within cross-sectional units, but its variance may differ across units. This condition is known as groupwise heteroscedasticity.

[35] Stata commands *xtgls* and *xtpcse* estimate linear panel data models using feasible GLS and OLS estimates with panel-corrected standard errors, respectively. These commands allow estimation in the presence of autocorrelation within panels, as well as heteroscedasticity or cross-sectional correlation across panels. We estimated the impacts by using both of the commands and they provided similar results. So we present only FGLS estimation results.

[36] Although international trade literature provides important insights on the patterns of trade, we lack the vital understanding of the factors that cause to deviate from or converge to the patterns theoretically predicted.

The explanatory variables for predicting crisis are akin to those suggested by Demirgüç-Kunt and Detragiache (1997) and are as follows: GDP growth rate, depreciation rate of the currency, current account surplus, real interest rate, inflation rate, share of domestic credit provided by domestic banks in GDP, and an index of capital account openness. The main covariates used in our estimation of trade structure include per capita income, financial sector development index, trade openness, average trade protection rate, total population, value added in manufacturing, and ratio of food exports to merchandise exports. Barro (2001) finds evidence that a crisis has usually effect on the economy for the following five years and no further effect beyond five-year period. For this reason, we estimate the impacts of crisis for up to five consecutive years after a crisis.

3.6.2 Data

The focus on the measure of trade structure is only the manufacturing sector. Trade data obtained from UNIDO Industrial Statistics. 4-digit ISIC data (Rev.2) are used to construct various measures for trade structure. The remaining data are obtained from World Development Indicators (WDI) or Penn World Tables (PWT 6.2), if not otherwise stated. UNIDO statistics are available for about 87 countries and for some of these countries the data is not available for the whole sample period. So these countries are dropped from the sample. It remains only 55 countries with which we conduct our analysis.

Financial sector development index is obtained from Beck et al. (2000) and measured by the ratio of private credit by deposit money banks and other financial institutions to GDP. This index measures the activity of financial intermediaries and isolates credit issued to the private sector and by doing so; it measures the mobilized savings that are channeled to private firms (see Beck et al. 2000). Capital account openness index is obtained from Chinn and Ito (2008).[37] Tariff data is obtained from World Bank.

[37] See the website of Hiro for detailed information about the index, http://web.pdx.edu/~ito/.

3.7 FINDINGS

This section presents the findings of the estimations for each type of trade structure index under seven different crisis definitions. Our *a priori* conviction is that macroeconomic crisis should have more significant impacts compared to financial crisis, potentially destructive but improbably constructive. Especially ITI and TICA indexes are expected to change significantly with economic crisis, but not with financial crisis. Note however that it is not intended to quantify the exact impacts and exact times for each country. The paper is instead interested in the average or approximate impact on the trade structure, which can be a good guide in understanding the response of countries in terms of exported commodities.[38]

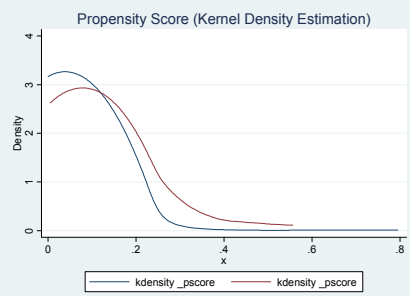
3.7.1 Propensity Score Estimation

As noted earlier, we employ three different matching algorithms, two of which rely on propensity score estimation. The propensity score is the conditional probability of receiving the treatment given the pre-treatment conditions. Therefore, proper estimation of the propensity score is required in matching the treated and untreated units. Main determinants of crises are provided in several studies in the literature (e.g., Kaminsky, 2006 and DKD, 1997). The major determinants used in this study are GDP growth rate, depreciation rate of the currency, current account surplus, real interest rate, inflation rate, share of domestic credit provided by domestic banks in GDP, and an index of capital account openness. Figure 3.4 presents kernel density estimation of two arbitrarily chosen types of crises.

[38] It should be noted that in Tables R1 to R9 matching estimators provide cumulative results, while regression estimators provide the results for each consecutive year after crisis.

Figure 3.4: Kernel Density Estimation of Propensity Score

Kernel Density Estimation (Sudden Stops)



Kernel Density Estimation (Banking Crises)

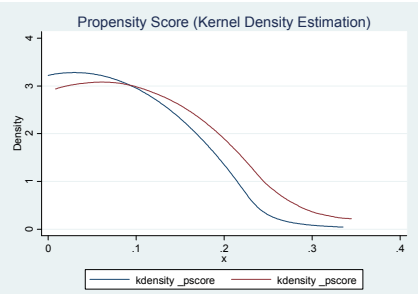


Table 3.5: Estimation of Propensity Score – Covariates

	Consumption Disasters	Banking Crises	Twin Crises
Real Interest Rate	0.029*	0.033+	0.031***
	(1.692)	(3.636)	(2.711)
Inflation (GDP deflator)	0.001	-0.001	-0.001
	(1.434)	(-0.564)	(-1.365)
GDP per capital growth	-0.033	-0.056*	-0.062*
	(-0.830)	(-1.837)	(-1.788)
Real depreciation rate	-0.001	0.005	0.011*
	(-0.564)	(0.976)	(1.929)
Current account balance (% of GDP)	-0.157**	-0.068**	-0.073**
	(-2.353)	(-2.183)	(-2.010)
Domestic credit by banking sector (% of GDP)	0.036+	0.002	0.006*
	(4.182)	(0.516)	(1.892)
Financial openness index (KAOPEN)	-0.500**	0.049	-0.028
	(-2.247)	(0.513)	(-0.251)
Constant	-11.303+	-2.894+	-3.338+
	(-7.299)	(-7.058)	(-6.014)

NOTES: Table reports the estimated coefficients for crisis variable. Propensity score is obtained by probit. T-statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001. Correlation matrix and descriptive statistics of the variables are given in Table 3A-4 and 3A-5 in appendix.

Before proceeding, we also present the propensity score estimation results for the economies experiencing economic (consumption disaster) and financial crises (banking and twin crises) (Table 3.5). Probit estimation method is used in estimating the propensity scores. Higher real interest rates, higher real depreciation of local currency, higher current account deficit, lower growth rate, lesser financial openness, and higher domestic credit provided by banking sector are all found to have positive impact on economic crisis. All these findings are in line with the common economic wisdom and previous findings. Now we turn to the discussion of the findings.

3.7.2 Macroeconomic Crisis

Under macroeconomic crises, we consider GDP disasters and consumption disasters. Both definitions rely on the analysis of Barro and Ursúa (2008).

3.7.2.1 GDP Disasters

GDP disasters reflect strong income and output contractions in economies and severely affect the real economic activities. Table R1 reports the findings for three different matching algorithms and two different parametric estimations. As outlined in section 3.4.2, trade dissimilarity index measures the similarity in an economy's export structure with world demand. Lower dissimilarity index means higher diversification and diversification into new export products protects economies against unstable price and terms of trade shocks and generates higher and more stable export earnings.[39] Matching estimation results reveal strong response to GDP disasters. Compared to stable economies, crisis-hit economies on average narrow the range of goods exported when crisis float up and continues until at least five years after the peak year of the crisis. These findings of kernel matching (KM) estimation are verified for t+1 and t+3 by nearest-neighbor matching (NNM) estimation, where t denotes the starting year of the crisis. Finally the regression results support the findings for t+2 and

[39] Although not presented here, we also tested the relation between diversification and income level and we found that TDI is negative and significant, confirming the preposition that lower dissimilarity or higher diversification is associated with higher income levels.

indicate that about half of the impact detected by matching estimators actually takes place at t+2. It is now fair to say that GDP disasters limit the economies' ability to match world demands and this effect is economically significant. The scale of downsizing is about 0.08, or about 2/5 of standard deviation (see Table 3.3 in section 3.4.2 for summary statistics).

Regarding the technological intensity of the goods exported, we observe similar pattern. As matching world demands become tougher, the technological intensity of the goods exported deteriorates as well. The impact is increasing during the first three years and then start diminishing, but persists until end of the time period considered. According to NNM and KM estimation, the size of deterioration is about 0.065, or about ½ of standard deviation, from t+1 to t+4. Fixed effect linear model with an AR(1) disturbances (FEAR) conform to these findings only for t+3 by estimating an impact of 0.026 for this particular year. Finally the impact on the TICA index is similar to that on ITI index, which is however not confirmed by regression estimation results. The estimated impact is on average about 0.06, or ½ of SD. Overall, the impact of GDP disasters on export structure reaches to its highest after 2-3 years and then starts diminishing gradually.

3.7.2.2 Consumption Disasters

Similar to GDP disasters, consumption disasters are defined in Barro and Ursúa (2008) as events in which peak-to-trough cumulative declines in consumption of is at least 10%. Severe contraction in consumption at home reduces the aggregate demand for domestic as well as imported goods. Consequently, the size of market shrinks, with direct implications for producers. Our estimation on the impact of trade structure is provided in Table R2.

NNM and KM estimation methods suggest strong negative impacts of crisis on the diversification of trade. The coefficients are in effect so high to suspect on the outcome. They indicate a decline in diversification about 0.2 points or about 1 standard deviation. There is evidently strong response to consumption disasters and the negative impact carries on up to five years after crisis. That implies that countries fail to manage to export the goods in more variety and in

proper proportion after being severely hit by macroeconomic crisis. Relatively strong impact of consumption can be explained by demand-side dynamics. Lower consumption due to lower equity prices or other factors reducing the income level of households leads to a reduction in demand for domestic and foreign products. Exporting firms having productivity advantage due to scale economies may lose their advantage after a sharp reduction in demand and limit their capability to serve export markets profitably. And that can explain part of the story.

Technological upgrade following crisis is only expected if some form of creative destruction in industrial activities comes to pass. Otherwise, in a severely hit economy we immediately expect that the productive sources of manufacturing industries are seriously damaged and the economy loses important competitiveness compared to other economies and also relative to previous periods. What we found is that countries fail to diversify their exports and thus concentrate on a narrower range of export products even after five years after crisis and that could result in reducing the export commodities into a basket with lower or higher technological intensity. We detect no improvement on the technological intensity of the goods exported but immediate and long-lasting impairment in the basket of these goods close to 1 standard deviation. The recovery also appears to be not in sight, at least after five years following an economic crisis. This is verified under NNM and KM estimation methods but not confirmed by other remaining estimation methods. Having this limitation in mind, we conclude that consumption disasters produce similar results as GDP disasters do and narrow the export basket and reduce the technological intensity of that basket at economically significant rates. As a result, we can also reject the hypothesis of creative destruction and say that countries, even if they are hit severely by economic crisis, do not experience any significant improvement in their technological intensity of exported goods.

3.7.3 Financial Crisis

In the previous section, we focused on the real economic activities and attempted to identify any significant impact of disasters in real economic

activities on trade structure. We now skip the crisis on that front and move to the crises in financial sectors. This area of research is conversely more dynamic compared to macroeconomic crises and there are quite a lot of measures of financial crises identified with more widespread methods. Four types of financial crises are considered in this paper: banking crises, currency crises, twin crises and sudden stops (see section 3.3.2 for more discussion).

3.7.3.1 Banking Crises

Banking crises are the instances in which financial sectors experience large numbers of defaults with institutions having serious difficulties in timely fulfilling their obligations. During such tense times, the number of non-performing loans increases with immediate outcome of capital shortages in the system. Sharp increases in real interest rates, capital flights, and depressed asset prices may accompany this situation and worsen the overall economic mood. Given this broad assessment of banking crises, literature provides several common definitions of banking crises. In this study, we consider two types of banking crises definition. Demirguc-Kunt and Detragiache (2005) consider a range of factors from non-performing assets to cost of rescue operations in identifying banking crises.[40] Laeven and Valencia (2008) provide an alternative definition of crises by concentrating on non-performing loans and banking system capital. The findings obtained from these two definitions of banking crises are reported in Table R3 and R4 respectively.

In general, though not as strong as economic crisis, there are still important arguments that financial crisis can have significant impact on the diversification of the export structure. Credit constraint and limited borrowing ability of firms constitute the most straightforward arguments in this context. Expectedly, we find positive impact on the diversification of exports and that takes place in the second year of the crisis (at t+1) at an economically significant rate of about

[40] The authors additionally provide the approximate duration of each crisis episodes. To make use of this information, we slightly alter the estimation method and exceptionally use a separate dummy variable for each year the crisis keeps on distressing, as opposed to lags of crisis used in the other crisis definitions.

0.088. No further impact is estimated by NNM and KM estimators for the following years. That is verified by FEAR estimator but at different rates. Thus, on average, countries tend to diversify the range of export commodities after one year after banking crises.

Regarding the other two indexes, the results are analogous. There is statistically and economically significant impact on ITI index right after one year of banking crises and in some cases even after five years. The impact appears to be more immediate in TICA index, which improves right at the year of crises as well as after one year. The purpose of this index is to analyze the post-crisis dynamics in goods in which countries have comparative advantage. As estimated by matching algorithms based on propensity score, the TICA index increases in the first and second year of the crisis, which is not confirmed by the parametric methods. These findings are in truth better than one would expect. A possible explanation can be as follows. Countries lose their comparative advantage in technologically less advanced products, because these products are easy to imitate and produced by other countries. Once the quantity and share of these goods in total export decreases, crisis-hit countries lose immediately their comparative advantage to other countries. This is however not the case for technologically intensive products. Even if crisis-hit countries experience a reduction in the exports, it will be difficult to imitate the same quality goods by other countries. That will cause a virtual increase in TICA index.

When estimated under the definition of Laeven and Valencia, we find rather different results. Although the direction of the impact is the same, time and strength of the impact vary noticeably. While matching algorithms provide no significant results, the parametric estimations reveal improvements in TDI and TICA indexes usually from t+3 to t+5.

As a result, banking crises do not harm the structure of trade. Instead, it improves the ability of economies in matching the world demands through higher diversification and upgrades the sophistication of the goods exported. This positive impact can be explained by the recovery in financial markets. With easing credit constraints and improved borrowing ability, firms recover from

banking crises by realizing the investment opportunities that they put off for some time. This realization materializes in a short-lived improvement in diversification and technological intensity of exports.

3.7.3.2 Currency Crises

In general, various events are used in characterizing a currency crisis and these include a sharp depreciation of the currency, a significant reduction of foreign exchange reserves, and a considerable deterioration in the capital account. We adopt two different definitions of currency crises that seem to be most common in the literature. First one is due to Kaminsky (2005) and the other is due to Hong and Tornell (2005). Kaminsky applies regression tree analysis to identify the varieties of crises. Hong and Tornell use more common approach and identify currency crises by using a weighted average of the depreciation of the real exchange rate and reserve losses. The estimated impact using these two definitions of currency crises are provided in Table R5 and R6. In general, a technological upgrade is hardly expected following currency crisis, because there is no reasonable explanation for significant restructuring in manufacturing sectors. And currency crises are expected to be less destructive compared to banking crises that additionally affect output by tightening credit channels.

As a general rule, currency depreciation provides a short-lived advantage to exporters. So, after currency crises, one might expect a slight improvement in ability to match world demands with advantageous local currency. What we found by using the definition of Kaminsky is a negligible improvement in trade structure. Though neither of matching algorithms provides significant estimation results, FGLS estimation provides minor enhancement in diversification at t+5, minor upgrading in technological intensity at t+3 and again minor advancement in technological intensity of the goods with comparative advantage from t+2 until t+4. These results are not economically significant. By using the definition of Hong and Tornell, we obtain comparable but yet slightly improved results. Except the TICA index, neither of the matching algorithms provides significant results but now both regression estimations yield statistically significant outcomes. A slight improvement in

diversification and in technological intensity is observed from t+2 until t+4 at around 0.02 points. Regarding the TICA index, which measures how valuable it is to have comparative advantage on certain industries, the improvement again concentrates in years between t+2 and t+4 and KM estimator reports an improvement at t+3 around 0.05 or almost half of the standard deviation. The estimated improvement is slightly smaller in FEAR and FGLS estimations.

Currency crises appear to provide small enhancements in trade structure about two years after crises until the end of the fourth year. These economically rather insignificant outcomes indicate, however, that these slight improvements take place in all of the indexes considered in this paper. These results also confirm that depreciation of local currency has no long-lasting impacts on trade structure. This finding is also in line with Hong and Tornell (2005), where authors find that economy almost fully recovers its tranquil-period average in less than three years. They also report that the share of the export sector is not systematically correlated with post-crisis growth and the real credit growth does not show any clear improvement over the post-crisis year that they consider. The insufficient improvement in real credits can principally explain the weak impact of currency crisis on export structure.

3.7.3.3 Systemic Sudden Stops

Sudden stops correspond to large and unexpected slowdowns in private capital inflows into economies and commonly described as periods where the yearly fall in capital flows remains at least two standard deviations below its sample mean (Calvo et al. 2004). As a national accounting rule, capital inflows must be equal to current account deficits plus international reserves. Sudden stops in capital inflows must be accommodated with either lower capital account deficits or reserve losses. Whichever takes place in practice, their impact may be harmful: reserve losses increase financial fragility and lower current account deficits due to a sharp decline in aggregate demand may even tighten the productive capacity in an economy. Some authors (e.g., Dornbusch et al. 1995) even argued that sudden stops of capital inflows can be highly disruptive and may result in costly adjustment processes.

In this paper, we adopt the definition of Calvo et al. (2008) whose indicator of sudden stop focuses on capital account reversals that coincide with sharp increases in aggregate interest rate spreads, which they call "systemic sudden stops", i.e., sudden stops with an exogenous trigger. The authors try to isolate episodes that are "largely unexpected", purely financial, and systemic in nature. The estimation results using systemic sudden stops definition is reported in Table R7.

Regarding the diversification index, no significant result is obtained by matching and parametric estimation techniques. Thus, no improvement in diversification is expected following systemic sudden stops. Concerning the technological intensity index, the number of significant outcomes increases and they imply an improvement in ITI index during the period [t+1, t+3] about 0.025 points, or about 0.18 of standard deviation. Finally, we observe improvements in TICA index at t+2 and t+3 estimated by FEAR and KM estimation techniques. Hence, the overall evidence implies potential improvements in trade structure beginning one year after the crises and for two consecutive years. These effects are, however, economically less significant. Sudden stops appear to be not disruptive with respect to their impact on trade structure, in contrast to the prediction of Dornbusch et al. (1995).

3.7.3.4 Twin Crises

A twin crisis is defined as an instance in which a banking crisis in year t is accompanied with a currency crisis during the period [t-1, t+1]. In twin crises, currency depreciation exacerbates banking sector problems through foreign currency exposures of banks, which are likely to emerge especially in countries with fixed exchange rate regimes. We previously found that both banking and currency crises have positive impact on trade structure, with the impact of banking crises slightly stronger than currency crises. Given parallel impacts of two components of twin crises, it would be reasonable to expect similar impact of twin crises on trade structure. The estimation results for twin crises are reported in Table R8.

As expected, the findings are similar to that obtained from banking and currency crises separately, however at a slightly later time periods. We found in banking crises that the impacts may take place faster, starting at t+1. NNM algorithm estimates strong diversification effect at t+4 and t+5, around 0.66 standard deviation and KM yields weaker diversification at t+3 and t+4. The estimation results for ITI and TICA indexes are rather weak. Though KM estimator for ITI index and FEAR estimator for TICA index provide significant improvements at t+3, these results are neither verified nor rejected by other estimators. The magnitudes are also close to what we found for currency crises, an improvement about 0.25 of standard deviation.

3.7.4 Dual Crisis

As a final experiment, we conduct the same analysis for countries that have experienced both macroeconomic (GDP disasters) and financial crises (banking and currency crises). The findings are reported in Table R9.

The results are remarkable and we observe opposite effects for the diversification index compared to GDP disasters reported in Table R1. All of the matching algorithms provide strong improvements in matching the world demands, especially after 1, 3, 4, and 5 years after the crisis. These are economically significant outcomes corresponding to alterations between ½ and 1 standard deviation. Moreover, no deterioration in ITI and TICA indexes are observed. Therefore only impact is on the diversification of export structure. A potential explanation for such an impact hinges on the duality of the crises. Though contraction of income and shortages of credit tighten the domestic market, firms exploit the short-lived advantage of depreciation by turning it into a stepping stone. Credit shortages hamper new investments and this explains the steadiness of technological intensity of the goods exported. However, depreciation does not limit the capacity of firms to serve more of foreign markets and this explains the expansion of capacity to meet world demands.

As a result, in dual crises there are counterweighing forces that balance the opposed impacts of various events and potentially improve some aspects of

trade structure. More concretely, in the presence of competitiveness advantages, dual crises do not contain all the productive sources for long term, thus firms find chance to pick up faster by improving their pre-conditions. And that primarily includes exporting more varieties in line with relative world demands.

3.7.5 Summary of the Findings and an Attempt of Rationalization

In general, productive sources of economies are severely damaged following economic crisis, but financial crisis gives the opportunity to reorganize and restructure once the financial constraints are eliminated. It may require quite long time to settle and recover once an economy go through real economic shocks, which not only causes financial constraints but also destroys the productive capacities. Therefore, we anticipated the impacts of economic crisis to be more substantial and analogously the impacts of economic crises are found to be more harmful compared to financial crises. The findings are summarized in Table 3.6.

Table 3.6 indicates the direction of the impact without providing information on the size of the impact. The impacts of financial crises are generally economically less significant compared to the impacts of economic crises. In what follows, we first summarize the main findings of the paper. Then we will try to provide an economically logical and sensible explanation for all the impacts that we obtained. Before discussing the outcomes, it should be, however, noted that the findings of this article are not related to the changes in the volume of exports. All types of crises considered in this paper may actually lead to reductions in total exports, but even in that case we cannot rule out the potential restructuring in the basket of export commodities.[41]

[41] Berman (2008), for instance, shows that currency crises have long-lasting negative effects on the volume of trade. This fact, however, does not rule out the change in the structure of exports.

Table 3.6: Summary of the Findings

	Macro-economic Crisis		Financial Crisis						Dual Crisis
	GDP	CNS	BK1	BK2	CR1	CR2	TW	SSS	DUAL
Diversification of Export	-	-!	+	+	.	+!	+	.	+!
Technological Intensity of Exported Goods	-	-	+!	.	.	+!	+!	+	.
Technological Intensity of Comparative Advantage	-!	-!	+	+	+!	+	+!	+	.

Notes: Positive sign (+) indicates improvement, negative sign (-) indicates worsening, and dot sign (.) indicates no change in trade structure. A sign with an exclamation (!) indicates that the result is not verified by both matching and regression estimations, even if it is verified by all estimators of matching or regression. GDP stands for GDP disasters, CNS stands for consumption disasters, BK1 stands for banking crises as defined by DKD, BK2 stands for banking crises as defined by Laeven and Valencia, CR1 stands for currency crises as defined by Kaminsky, CR2 stands for currency crises as defined by Hong and Tornell, TW stands for twin crises, SSS stands for systemic sudden stops, and finally DUAL stands for dual crises.

The overall findings indicate that it is hard to argue that there is some form of creative destruction following economic crises. We observe economically significant concentration of exports in a narrow range of goods during and after crisis and deterioration in technological intensity of export products. Following financial crisis, we found in most cases that countries tend to diversify their export structure towards the commodities in which demand exists. That is however not a clear indication of whether countries expand their exports in extensive margin or extensive margin. Investigation of this subject can be a topic for further research. It is estimated a downward shift in technological intensity of the exported goods following economic crisis, and the opposite effect is estimated following financial crisis. Following a severe economic crisis, such an outcome should be not so surprising. What is perhaps more surprising is the impacts of financial crisis on these indexes. Though in some cases, the result is not verified by both non-parametric and parametric estimations, we

observe an improvement in the technological intensity of the goods exported and in the goods countries have comparative advantage. Finally, dual crises potentially bring about improvements in trade diversification but do not alter the technological intensity and comparative advantage. The effect might be due to the countries identified in the sample of economic crisis are on average more developed and better acquainted in dealing with the outcomes of crises.

How should we interpret these results where different types of crises have different outcomes? The answer is naturally contained by the dynamics generating the crisis. In the case of economic disasters, Barro (2009) find large welfare costs due to disasters. An economy would be willing to reduce real GDP by as much as 20 percent each year in exchange of eliminating the chances of major economic collapses.[42] This logically explains the large impacts of macroeconomic shocks that we found in this paper. Macroeconomic crises at that scale naturally hinder the positive adjustments in trade structure. We found that macroeconomic crises have significant negative impact on diversification of export structure beginning right at the outset of crisis. That may reflect the downsizing of the firms (with probably loss of economies of scale) due to shrinking local demand and difficulty in financing foreign trade operations, thus restricting the range of goods exported for which there exists world demand. Similarly, economic crisis is found to have considerable impact on technologically intensity of the export goods and technological intensity of the goods that countries have comparative advantage. Technologically intensive products usually involve costly production procedure and in most cases depend considerably on external finance. A direct implication of economic crisis is curtailment in the financial sources of economy available for such costly production procedures. The consequence is a slowdown in the improvement of technological intensity of the export commodities. All the evidence combined, overall process following economic crises can be interpreted as a process where the range and the quality of the export commodities dwindle and experience a

[42] Regarding the welfare cost from usual economic fluctuations, Barro (2009) finds much smallar impact corresponding to lowering GDP by around 1.5 percent each year.

clear deterioration in trade structure and this contraction come along with a decline in the technological intensity of export commodities.

At the next step, we commonly find a positive impact of various types of financial crisis. Banking, currency, and twin crises and also sudden stops bring about slight improvements in trade structure, usually in 2 to 4 years after crises. Even though these impacts are economically less significant, the underlying factors leading to such an outcome need to be clarified. Since each type of financial crisis produces similar outcome, we will try to give a portrayal for the whole picture instead of separate considerations. In general, financial crises are not as contractionary as macro-economic crises.[43] Hence, most of the impact takes place due to financial considerations, such as limited borrowing capability for investment and trade financing.[44] Such constraints force agents to act more cost efficient than before and customize their product for export purposes. Whenever these restraints are eliminated, agents recover their pre-crisis conditions probably at a more efficient scale and implement their novel strategies when exporting their newly customized products. This process can potentially explain the improvements in trade structure starting 2 years after crisis.

The findings can also be related to theoretical models in the presence of sunk export market entry costs in entering foreign markets. Baldwin and Krugman (1989) show that with sunk entry costs, positive shocks that lead to entry may not produce exit when they are reversed. By using this framework, Tybout and Roberts (1997) find evidence that sunk costs are important in explaining entry

[43] Gupta et al. (2003), for instance, show that a large proportion of currency crises in their sample –more than 40 percent– has been expansionary in terms of output growth and the crises during the 1990s were typically not more contractionary than the previous two decades.

[44] The financial constraints caused by currency crisis are generally less critical compared to other types of crisis. It typically involves currency depreciation at large scale and this mostly harms the firms with high foreign exchange exposure. The optimal way of getting out of this trouble is to increase earnings in foreign currencies or higher exports. Therefore, though the impact of currency crises is significant, it is relatively less economically significant compared to other types of financial crisis.

into exporting by Colombian firms. There are several more papers estimating that the magnitude of sunk costs is important enough to generate large hysteresis effects related with export participation of a firm. This fact can explain the positive impact of financial crisis on trade structure: due to sunk entry costs they disburse, exporting firms presumably do not exit even they experience a negative shock.

Finally the estimated impacts of dual crisis, which combines elements of both macroeconomic and financial crises, indicate higher diversification without any significant change in other indices, as verified by all matching algorithms. As explained earlier, the duality of the crises explains most part of the story, since there are counterweighing forces that balance the opposed impacts of various events and potentially improve some aspects of trade structure. Though income contractions and credit shortages tighten the domestic market, firms exploit the short-lived advantage of depreciation by turning it into a stepping stone. Credit shortages may impede new investments, but depreciation characteristically improves the capability of firms to serve foreign markets at larger scale and this explains the expansion of capacity to meet world demands.

This paper provides the first evidence on the impact of various types of crises on trade structure. The main motivation was whether newly emerged trade structure can explain the post crisis recovery and development in crisis-hit economies but we have to be contented with this initial evidence at this stage. This paper additionally contributes to the literature on volatility and growth and our findings on the positive impact of financial crises are in line with recent evidences on the impact of volatility on growth. Rancière et al. (2008) document that countries experiencing occasional financial crises have grown faster on average and our results can partly comply with their results if we assume that the inferred improvements in trade structure are growth-inducing for crisis-hit economies.

3.8 CONCLUDING REMARKS

This article investigates the impacts of both economic and financial crises on trade structure and post-crisis adjustments in it. It is conjectured that some kind of restructuring in industrial activities may take place following crises and that can be mapped by three different trade structure indexes. These indexes measure the diversification level of exported goods, technological intensity of the all export commodities and of the goods in which countries have comparative advantage. By these indexes, it is aimed at determining the adjustments in trade structure that are driven by both relative world demand (TDI) and domestic industrial restructuring (ITI and TICA).

In sum, overall findings indicate that financial crises are not destructive as economic crises in shaping the trade structure of the crisis-hit economies and they may even contribute to improvements in trade structure. Economic crises, on the other hand, bring in disadvantages to an economy's export structure that may not be growth-inducing and may consequently delay recovery. These findings are true in diversification of trade structure, upgrading technologically the composition of the exported goods and gaining comparative advantage in technologically more intensive goods. Diversification of export structure reduces the vulnerability of countries to shocks in certain industries and that strengthens the economies in the long run. In this context, a study on the impact of post-crisis trade structure on the process of recovery would be another direction for further research.

APPENDIX

Table 3A.1: Industries and Groupings

ISIC Code	Definition	Index Value	Prod. Techn.	ISIC Code	Definition	Index Value	Prod. Techn.
311	Food products	1	Low	371	Iron and steel	2	Low-to-medium
313	Beverages	1	Low	372	Non-ferrous metals	2	Low-to-medium
314	Tobacco	1	Low	381	Fabricated metal products	2	Low-to-medium
321	Textiles	1	Low	390	Other manufactured products	2	Low-to-medium
322	Wearing apparel, except footwear	1	Low	3841	Ship building and repairing	2	Low-to-medium
323	Leather products	1	Low	351	Industrial chemicals	3	Medium-to-high
324	Footwear, except rubber or plastic	1	Low	385	Professional and scientific equipment	3	Medium-to-high
331	Wood products, except furniture	1	Low	352r	Other chemicals	3	Medium-to-high
332	Furniture, except metal	1	Low	382r	Machinery, except electrical	3	Medium-to-high
341	Paper and products	1	Low	383r	Machinery, electric	3	Medium-to-high
342	Printing and publishing	1	Low	384r	Transport equipment	3	Medium-to-high
355	Rubber products	2	Low-to-medium	3522	Man. of drugs and medicine	4	High
356	Plastic products	2	Low-to-medium	3825	Man. of office, computing and acc. machinery	4	High
361	Pottery, china, earthenware	2	Low-to-medium	3832	Man. of radio, TV, and comm. Equip. and apparatus	4	High
362	Glass and products	2	Low-to-medium	3845	Man. of aircraft	4	High
369	Other non-metal. mineral products	2	Low-to-medium	("r" at the end of the ISIC codes mean the "rest" of the product categories not included elsewhere.			

Table 3A.2: List of Countries Identified as Dual-Crisis Countries

	Country	Year	Contraction Rate	Real Depreciation Rate	Average Growth*	Standard Dev. of Growth*
1	Argentina	2002	-10.89	175.92	2.358	6.574
2	Ecuador	1999	-6.30	23.48	2.747	3.079
3	Indonesia	1998	-13.13	168.91	5.447	4.257
4	Italy	1993	-0.89	23.77	1.798	1.261
5	Rep. of Korea	1998	-6.85	41.50	6.456	3.822
6	Malaysia	1998	-7.36	31.00	6.202	3.928
7	Mexico	1995	-6.22	52.32	2.873	3.556
8	Sweden	1993	-1.99	30.63	2.215	1.758
9	Thailand	1998	-10.51	22.63	5.922	4.393
10	Turkey	1994	-4.67	66.53	4.372	4.268
11	Turkey	2001	-5.70	43.18	4.372	4.268
12	Uruguay	2002	-11.03	40.94	2.101	5.814

NOTES: Table lists the countries experienced real depreciation more than 20% in a given year and GDP fall more than two standard deviations away from mean growth rate. This experiment is conducted for 110 countries from 1980 to 2007. Countries selected if they fit the above mentioned criteria between 1985 and 2002 and experienced a banking crisis as identified in Demirguc-Kunt and Detragiache (2005).

* Calculated for the years between 1980 and 2007.

Table 3A.3: Financial Crisis Episodes (1980-2002) in Demirgüc-Kunt and Detragiache (2005).

	Country	Year (duration) of crisis		Country	Year (duration) of crisis
1	Algeria	1990 (3)	17	Madagascar	1988 (4)
2	Argentina	1980 (3), 1989 (2), 1995 (1), 2001 (2)	18	Malaysia	1985 (4), 1997 (5)
3	Bolivia	1986 (3), 1994 (4), 2001 (2)	19	Mexico	1982 (1), 1994 (4)
4	Cameroon	1987 (7), 1995 (4)	20	Nepal	1988 (4)
5	Chile	1981 (7)	21	Peru	1983 (8)
6	Colombia	1982 (4), 1999 (2)	22	Philippines	1981 (7), 1998 (5)
7	Costa Rica	1994 (4)	23	Portugal	1986 (4)
8	Ecuador	1995 (8)	24	Senegal	1983 (6)
9	El Salvador	1989 (1)	25	South Africa	1985 (1)
10	Finland	1991 (4)	26	Sri Lanka	1989 (5)
11	India	1991 (4)	27	Sweden	1990 (4)
12	Indonesia	1992 (4), 1997 (6)	28	Thailand	1983 (5), 1997 (6)
13	Italy	1990 (6)	29	Tunisia	1991 (5)
14	Japan	1992 (11)	30	Turkey	1982 (1), 1991 (1), 1994 (1), 2000 (3)
15	Jordan	1989 (2)	31	United States	1980 (13)
16	Korea	1997 (6)	32	Uruguay	1981 (5), 2002 (1)

Source: Demirgüc-Kunt and Detragiache (2005).

Notes: Some of the countries listed in Demirgüc-Kunt and Detragiache are dropped, because either the data is not available for these countries or these countries are deliberately dropped from the whole sample due to reasons listed in the paper. The countries not added to the above list but experienced crisis are: Benin, Brazil, Burkina Faso, Burundi, Central African Republic, Chad, Rep. of Congo, Dem. Rep. of Congo, Cote d'Ivoire, Ghana, Guinea, Guinea-Bissau, Guyana, Israel, Jamaica, Kenya, Lebanon, Liberia, Mali, Mauritania, Niger, Nigeria, Norway, Panama, Papua New Guinea, Paraguay, Sierra Leone, Swaziland, Taiwan, Tanzania, and Venezuela.

Table 3A.4: Correlation Matrix for selected variables

	TDI	ITI	TICA	RI	INF	GDP	RD	CAB	DC
ITI	-0.75	1							
TICA	-0.43	0.849	1						
Real Interest	0.144	-0.21	-0.19	1					
Inflation	0.100	-0.03	0.014	-0.36	1				
GDP	-0.07	0.110	0.092	-0.02	-0.12	1			
RD	0.294	-0.15	-0.02	0.122	-0.04	0.668	1		
CAB	-0.29	0.405	0.350	-0.07	-0.04	0.104	-0.06	1	
DC	-0.58	0.613	0.480	-0.12	-0.07	0.022	-0.29	0.281	1
Financial Op.	-0.53	0.433	0.251	0.077	-0.09	0.123	-0.09	0.284	0.43

Notes: CAB stands for current account balance, RI stands for real interest, GDP stands for GDP pc growth, RD stands for real depreciation and DC stands for domestic credit.

Table 3A.5: Descriptive statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
TDI	1280	0.519986	0.196411	0.142993	0.932993
ITI	1280	0.474474	0.136213	0.252577	0.852693
TICA	1280	0.353891	0.118256	0.150101	0.836291
Real Interest	1149	7.172266	11.28675	-97.8121	84.04781
Inflation	1376	35.06484	403.7905	-23.4789	12338.66
GDPpc Growth	1377	1.864553	3.672203	-16.5107	14.05639
Real Depreciation	1377	6.308749	4.543761	-10.0602	25.19249
Cur. Acc. Balance	1325	-1.67585	4.817897	-17.4411	23.7326
Domestic Credit	1362	76.06293	50.95786	-1.53483	313.4882
Financial Openness	1369	0.489231	1.619463	-1.81162	2.531836

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TABLE R1: Impacts of Macroeconomic Crisis on Trade Structure – GDP Disasters						
	TDI (t)	TDI (t+1)	TDI (t+2)	TDI (t+3)	TDI (t+4)	TDI (t+5)
NN Matching	0.056	0.077**	0.070	0.083*	0.058	0.057
	(1.274)	(2.029)	(1.352)	(1.820)	(1.345)	(1.048)
Kernel Matching	0.084***	0.093+	0.092+	0.084***	0.079**	0.072**
	(2.858)	(3.570)	(3.294)	(3.151)	(2.561)	(2.392)
Fixed Effect with AR(1)	0.009	-0.004	0.051***	-0.011	0.002	0.003
	(0.662)	(-0.272)	(3.148)	(-0.708)	(0.178)	(0.259)
FGLS	-0.004	-0.013	0.031***	-0.008	0.012	-0.004
	(-0.409)	(-1.401)	(2.734)	(-0.674)	(1.163)	(-0.450)
	ITI (t)	ITI (t+1)	ITI (t+2)	ITI (t+3)	ITI (t+4)	ITI (t+5)
NN Matching	-0.051	-0.059**	-0.072*	-0.082**	-0.068**	-0.047
	(-1.599)	(-1.977)	(-1.889)	(-2.388)	(-2.323)	(-1.336)
Kernel Matching	-0.064+	-0.066+	-0.069+	-0.067+	-0.059***	-0.047**
	(-4.058)	(-3.732)	(-4.196)	(-3.685)	(-3.208)	(-2.249)
Fixed Effect with AR(1)	-0.013	0.004	0.012	-0.026*	-0.010	-0.009
	(-0.995)	(0.278)	(0.814)	(-1.753)	(-0.821)	(-0.742)
FGLS	-0.002	0.003	-0.004	-0.006	-0.005	0.005
	(-0.410)	(0.475)	(-0.573)	(-0.909)	(-0.726)	(0.831)
	TICA (t)	TICA (t+1)	TICA (t+2)	TICA (t+3)	TICA (t+4)	TICA (t+5)
NN Matching	-0.050*	-0.058**	-0.071**	-0.079***	-0.070***	-0.052*
	(-1.915)	(-2.264)	(-2.391)	(-2.639)	(-2.808)	(-1.938)
Kernel Matching	-0.062+	-0.061+	-0.060+	-0.060+	-0.053+	-0.043***
	(-3.811)	(-4.556)	(-4.508)	(-4.429)	(-4.426)	(-3.180)
Fixed Effect with AR(1)	-0.021	0.004	0.031*	-0.027	-0.010	-0.012
	(-1.437)	(0.301)	(1.878)	(-1.643)	(-0.733)	(-0.874)
FGLS	-0.009	0.009	0.015	-0.009	0.004	-0.000
	(-1.099)	(1.208)	(1.500)	(-0.938)	(0.552)	(-0.024)

NOTES: Table reports the estimation results for the impacts of GDP disasters on trade structure. Propensity scores in NNM and KM are estimated using the following variables: real depreciation rate, real interest rate, inflation, GDP per capita growth rate, current account balance, domestic credit provided by banking sector (% of GDP), and financial openness index. Control variables in regression estimations are income level, financial development index, share of trade in GDP, share of food export in total merchandise export (end.), average trade protection rate, and value added in manufacture, and logarithm of total population. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

TABLE R2: Impacts of Macroeconomic Crisis on Trade Structure – Consumption Disasters						
	TDI (t)	TDI (t+1)	TDI (t+2)	TDI (t+3)	TDI (t+4)	TDI (t+5)
NN Matching	0.203+	0.219+	0.221+	0.223+	0.240+	0.224+
	(4.251)	(3.772)	(4.661)	(4.855)	(5.723)	(5.547)
Kernel Matching	0.171+	0.181+	0.188+	0.196+	0.203+	0.206+
	(7.884)	(8.470)	(9.739)	(9.134)	(9.034)	(13.261)
Fixed Effect with AR(1)	0.008	0.001	0.017	0.010	0.007	0.015
	(0.539)	(0.059)	(1.180)	(0.651)	(0.442)	(1.100)
FGLS	-0.006	-0.007	0.013	0.013	-0.000	0.003
	(-0.592)	(-0.645)	(1.264)	(1.128)	(-0.028)	(0.264)
	ITI (t)	ITI (t+1)	ITI (t+2)	ITI (t+3)	ITI (t+4)	ITI (t+5)
NN Matching	-0.133+	-0.140+	-0.155+	-0.154+	-0.155+	-0.149+
	(-4.552)	(-4.317)	(-5.180)	(-4.487)	(-4.690)	(-4.849)
Kernel Matching	-0.091+	-0.097+	-0.103+	-0.105+	-0.105+	-0.102+
	(-7.549)	(-8.121)	(-8.239)	(-8.744)	(-7.729)	(-7.452)
Fixed Effect with AR(1)	-0.009	0.003	-0.012	0.013	-0.007	-0.008
	(-0.661)	(0.232)	(-0.880)	(0.924)	(-0.519)	(-0.609)
FGLS	0.000	0.008	-0.011*	0.000	-0.003	-0.002
	(0.018)	(1.243)	(-1.814)	(0.006)	(-0.527)	(-0.259)
	TICA (t)	TICA (t+1)	TICA (t+2)	TICA (t+3)	TICA (t+4)	TICA (t+5)
NN Matching	-0.107+	-0.108***	-0.115+	-0.112***	-0.116***	-0.116***
	(-4.190)	(-2.906)	(-3.481)	(-3.140)	(-3.227)	(-3.028)
Kernel Matching	-0.071+	-0.070+	-0.068+	-0.065+	-0.061+	-0.055+
	(-4.838)	(-5.126)	(-4.987)	(-6.278)	(-5.019)	(-4.586)
Fixed Effect with AR(1)	-0.011	0.003	0.003	0.013	-0.008	-0.012
	(-0.734)	(0.181)	(0.186)	(0.828)	(-0.475)	(-0.870)
FGLS	-0.000	0.013*	0.003	0.015**	-0.004	-0.003
	(-0.005)	(1.798)	(0.432)	(2.142)	(-0.528)	(-0.409)

NOTES: Table reports the estimation results for the impacts of consumption disasters on trade structure. Propensity scores in NNM and KM are estimated by using the variables: real depreciation rate, real interest rate, inflation, GDP per capita growth rate, current account balance, domestic credit provided by banking sector (% of GDP), and financial openness index. Control variables in regression estimations are income level, financial development index, share of trade in GDP, share of food export in total merchandise export (end.), average trade protection rate, and value added in manufacture, and logarithm of total population. T statistics are in parentheses. Statistical significance are denoted by * $p<0.10$, ** $p<0.05$, *** $p<0.01$, + $p<0.001$.

TABLE R3: Impacts of Macroeconomic Crisis on Trade Structure – Banking Crises -1						
	TDI (t)	TDI (t+1)	TDI (t+2)	TDI (t+3)	TDI (t+4)	TDI (t+5)
NN Matching	-0.016	-0.088*	-0.035	-0.027	-0.007	-0.018
	(-0.295)	(-1.656)	(-0.660)	(-0.525)	(-0.127)	(-0.259)
Kernel Matching	-0.030	-0.088***	-0.005	-0.021	-0.034	-0.070
	(-1.136)	(-2.742)	(-0.167)	(-0.815)	(-0.860)	(-1.579)
Fixed Effect with AR(1)	-0.005	-0.005	-0.009	-0.016*	-0.002	0.004
	(-0.660)	(-0.565)	(-1.063)	(-1.899)	(-0.275)	(0.547)
FGLS	-0.001	0.003	-0.004	-0.006	-0.000	0.001
	(-0.234)	(0.432)	(-0.679)	(-1.234)	(-0.064)	(0.215)
	ITI (t)	ITI (t+1)	ITI (t+2)	ITI (t+3)	ITI (t+4)	ITI (t+5)
NN Matching	0.052	0.085**	0.026	0.052	0.039	0.039
	(1.251)	(2.007)	(0.768)	(1.144)	(0.648)	(0.621)
Kernel Matching	0.051	0.091***	0.019	0.040	0.060*	0.077*
	(1.447)	(2.868)	(1.036)	(1.397)	(1.657)	(1.901)
Fixed Effect with AR(1)	-0.001	-0.002	0.005	0.007	-0.007	-0.011*
	(-0.200)	(-0.287)	(0.559)	(0.781)	(-0.857)	(-1.664)
FGLS	0.004	0.002	0.004	0.009*	-0.001	-0.001
	(0.940)	(0.508)	(0.944)	(1.920)	(-0.313)	(-0.240)
	TICA (t)	TICA (t+1)	TICA (t+2)	TICA (t+3)	TICA (t+4)	TICA (t+5)
NN Matching	0.078*	0.089**	0.027	0.070	0.073	0.056
	(1.907)	(2.134)	(0.997)	(1.549)	(1.288)	(0.984)
Kernel Matching	0.065**	0.091***	0.029	0.050*	0.070**	0.087*
	(2.251)	(2.578)	(1.250)	(1.956)	(2.359)	(1.843)
Fixed Effect with AR(1)	0.002	0.003	0.007	0.015	-0.002	-0.004
	(0.285)	(0.357)	(0.742)	(1.568)	(-0.195)	(-0.470)
FGLS	0.008	0.008	0.011	0.021***	0.007	0.005
	(1.345)	(1.144)	(1.495)	(3.124)	(1.127)	(0.946)

NOTES: Table reports the estimation results for the impacts of banking crises (as defined by DD05) on trade structure. Propensity scores in NNM and KM are estimated using the following variables: real depreciation rate, real interest rate, inflation, GDP per capita growth rate, current account balance, domestic credit provided by banking sector (% of GDP), and financial openness index. Control variables in regression estimations are income level, financial development index, share of trade in GDP, share of food export in total merchandise export (end.), average trade protection rate, and value added in manufacture, and logarithm of total population. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

TABLE R4: Impacts of Macroeconomic Crisis on Trade Structure – Banking Crises – 2						
	TDI (t)	TDI (t+1)	TDI (t+2)	TDI (t+3)	TDI (t+4)	TDI (t+5)
NN Matching	0.000	-0.026	0.018	0.006	0.021	0.011
	(0.005)	(-0.424)	(0.265)	(0.110)	(0.400)	(0.180)
Kernel Matching	0.042	0.036	0.053	0.051	0.040	0.039
	(1.059)	(1.140)	(1.381)	(1.507)	(1.294)	(1.110)
Fixed Effect with AR(1)	-0.011	-0.011	-0.015	-0.022**	-0.013	-0.004
	(-1.326)	(-1.076)	(-1.525)	(-2.292)	(-1.426)	(-0.531)
FGLS	-0.004	-0.001	-0.007	-0.013*	-0.009	-0.002
	(-0.576)	(-0.080)	(-0.921)	(-1.777)	(-1.313)	(-0.448)
	ITI (t)	ITI (t+1)	ITI (t+2)	ITI (t+3)	ITI (t+4)	ITI (t+5)
NN Matching	0.037	0.039	0.022	0.037	0.042	0.024
	(0.937)	(1.037)	(0.580)	(0.808)	(1.024)	(0.572)
Kernel Matching	-0.003	-0.003	-0.007	-0.001	0.007	0.007
	(-0.104)	(-0.087)	(-0.202)	(-0.039)	(0.201)	(0.191)
Fixed Effect with AR(1)	-0.003	-0.007	0.005	0.014	0.006	-0.003
	(-0.373)	(-0.728)	(0.537)	(1.489)	(0.666)	(-0.428)
FGLS	0.004	-0.003	0.000	0.007	0.008	0.002
	(0.858)	(-0.467)	(0.009)	(1.185)	(1.425)	(0.462)
	TICA (t)	TICA (t+1)	TICA (t+2)	TICA (t+3)	TICA (t+4)	TICA (t+5)
NN Matching	0.031	0.035	0.032	0.043	0.035	0.037
	(0.940)	(1.127)	(0.839)	(1.049)	(0.987)	(1.081)
Kernel Matching	0.005	0.005	0.012	0.016	0.018	0.029
	(0.227)	(0.179)	(0.470)	(0.749)	(0.670)	(1.232)
Fixed Effect with AR(1)	-0.006	-0.002	0.007	0.019*	0.003	0.003
	(-0.707)	(-0.192)	(0.680)	(1.814)	(0.323)	(0.357)
FGLS	0.002	-0.001	0.003	0.011	-0.000	0.006
	(0.250)	(-0.070)	(0.317)	(1.323)	(-0.039)	(1.003)

NOTES: Table reports the estimation results for the impacts of banking crises (as defined by Laeven and Valencia 2008) on trade structure. Propensity scores in NNM and KM are estimated using the following variables: real depreciation rate, real interest rate, inflation, GDP per capita growth rate, current account balance, domestic credit provided by banking sector (% of GDP), and financial openness index. Control variables in regression estimations are income level, financial development index, share of trade in GDP, share of food export in total merchandise export (end.), average trade protection rate, and value added in manufacture, and logarithm of total population. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

TABLE R5: Impacts of Macroeconomic Crisis on Trade Structure – Currency Crises -1						
	TDI (t)	TDI (t+1)	TDI (t+2)	TDI (t+3)	TDI (t+4)	TDI (t+5)
NN Matching	0.007	0.007	-0.002	0.010	0.004	-0.004
	(0.133)	(0.111)	(-0.049)	(0.210)	(0.078)	(-0.076)
Kernel Matching	-0.029	-0.014	-0.023	-0.020	-0.024	-0.032
	(-0.914)	(-0.461)	(-0.756)	(-0.851)	(-1.052)	(-0.912)
Fixed Effect with AR(1)	-0.007	-0.000	-0.005	-0.008	-0.001	-0.000
	(-0.810)	(-0.021)	(-0.556)	(-1.050)	(-0.120)	(-0.064)
FGLS	-0.003	0.004	-0.001	0.001	0.001	0.009*
	(-0.510)	(0.754)	(-0.101)	(0.129)	(0.225)	(1.723)
	ITI (t)	ITI (t+1)	ITI (t+2)	ITI (t+3)	ITI (t+4)	ITI (t+5)
NN Matching	0.006	0.006	0.013	0.010	0.013	0.015
	(0.175)	(0.158)	(0.349)	(0.300)	(0.346)	(0.384)
Kernel Matching	0.019	0.012	0.020	0.019	0.020	0.029
	(0.809)	(0.456)	(0.893)	(0.815)	(0.872)	(1.182)
Fixed Effect with AR(1)	0.004	-0.007	0.010	0.011	0.000	-0.006
	(0.460)	(-0.845)	(1.233)	(1.469)	(0.056)	(-1.002)
FGLS	0.003	-0.003	0.003	0.006*	0.000	-0.001
	(0.770)	(-0.798)	(0.720)	(1.684)	(0.066)	(-0.430)
	TICA (t)	TICA (t+1)	TICA (t+2)	TICA (t+3)	TICA (t+4)	TICA (t+5)
NN Matching	0.008	0.019	0.018	0.015	0.020	0.027
	(0.296)	(0.644)	(0.515)	(0.512)	(0.617)	(0.772)
Kernel Matching	0.006	0.014	0.010	0.008	0.009	0.015
	(0.273)	(0.788)	(0.610)	(0.335)	(0.507)	(0.668)
Fixed Effect with AR(1)	0.003	-0.001	0.007	0.012	0.004	-0.005
	(0.343)	(-0.105)	(0.777)	(1.406)	(0.442)	(-0.695)
FGLS	0.005	0.006	0.010*	0.016***	0.012**	0.002
	(0.802)	(1.068)	(1.812)	(3.245)	(2.426)	(0.618)

NOTES: Table reports the estimation results for the impacts of currency crises (as defined by Kaminsky 2006) on trade structure. Propensity scores in NNM and KM are estimated using the following variables: real depreciation rate, real interest rate, inflation, GDP per capita growth rate, current account balance, domestic credit provided by banking sector (% of GDP), and financial openness index. Control variables in regression estimations are income level, financial development index, share of trade in GDP, share of food export in total merchandise export (end.), average trade protection rate, and value added in manufacture, and logarithm of total population. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

TABLE R6: Impacts of Macroeconomic Crisis on Trade Structure – Currency Crises – 2						
	TDI (t)	TDI (t+1)	TDI (t+2)	TDI (t+3)	TDI (t+4)	TDI (t+5)
NN Matching	-0.009	-0.009	-0.029	-0.023	-0.011	-0.001
	(-0.157)	(-0.148)	(-0.480)	(-0.450)	(-0.160)	(-0.013)
Kernel Matching	-0.003	-0.017	-0.020	-0.022	-0.004	0.012
	(-0.083)	(-0.589)	(-0.534)	(-0.611)	(-0.097)	(0.322)
Fixed Effect with AR(1)	-0.001	-0.021	-0.042+	-0.031***	-0.020**	-0.010
	(-0.063)	(-1.620)	(-3.603)	(-2.811)	(-2.044)	(-1.350)
FGLS	-0.003	-0.010	-0.022**	-0.012	-0.019**	-0.007
	(-0.287)	(-1.011)	(-2.250)	(-1.250)	(-2.321)	(-1.112)
	ITI (t)	ITI (t+1)	ITI (t+2)	ITI (t+3)	ITI (t+4)	ITI (t+5)
NN Matching	0.042	0.031	0.036	0.049	0.037	0.025
	(1.094)	(0.711)	(0.669)	(1.024)	(0.835)	(0.535)
Kernel Matching	0.040	0.034	0.033	0.040	0.032	0.015
	(1.144)	(1.100)	(0.851)	(1.118)	(1.001)	(0.503)
Fixed Effect with AR(1)	0.004	0.002	0.023**	0.029***	0.016*	0.007
	(0.379)	(0.138)	(2.135)	(2.794)	(1.771)	(0.959)
FGLS	-0.001	-0.000	0.012*	0.015**	0.009	0.002
	(-0.098)	(-0.056)	(1.685)	(2.167)	(1.464)	(0.465)
	TICA (t)	TICA (t+1)	TICA (t+2)	TICA (t+3)	TICA (t+4)	TICA (t+5)
NN Matching	0.029	0.024	0.020	0.040	0.015	0.014
	(0.676)	(0.566)	(0.385)	(0.934)	(0.378)	(0.349)
Kernel Matching	0.038	0.039	0.033	0.053*	0.028	0.020
	(1.205)	(1.118)	(0.918)	(1.931)	(1.127)	(0.692)
Fixed Effect with AR(1)	0.009	0.015	0.024*	0.037***	0.011	0.009
	(0.714)	(1.106)	(1.939)	(3.239)	(1.027)	(1.125)
FGLS	0.010	0.019**	0.023***	0.030+	0.015**	0.012**
	(1.020)	(2.147)	(2.828)	(3.656)	(2.033)	(2.228)

NOTES: Table reports the estimation results for the impacts of currency crises (as defined by Hong and Tornell 2005) on trade structure. Propensity scores in NNM and KM are estimated using the following variables: real depreciation rate, real interest rate, inflation, GDP per capita growth rate, current account balance, domestic credit provided by banking sector (% of GDP), and financial openness index. Control variables in regression estimations are income level, financial development index, share of trade in GDP, share of food export in total merchandise export (end.), average trade protection rate, and value added in manufacture, and logarithm of total population. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

TABLE R7: Impacts of Macroeconomic Crisis on Trade Structure – Systemic Sudden Stops						
	TDI (t)	TDI (t+1)	TDI (t+2)	TDI (t+3)	TDI (t+4)	TDI (t+5)
NN Matching	-0.026	-0.028	-0.017	-0.003	0.002	0.002
	(-0.683)	(-0.700)	(-0.483)	(-0.101)	(0.040)	(0.042)
Kernel Matching	0.005	0.007	0.008	0.012	0.018	0.017
	(0.188)	(0.264)	(0.373)	(0.551)	(0.752)	(0.775)
Fixed Effect with AR(1)	0.006	0.002	-0.001	0.002	0.001	-0.001
	(0.974)	(0.358)	(-0.215)	(0.244)	(0.118)	(-0.239)
FGLS	0.003	0.004	-0.001	0.001	0.002	0.002
	(0.582)	(0.933)	(-0.245)	(0.181)	(0.448)	(0.446)
	ITI (t)	ITI (t+1)	ITI (t+2)	ITI (t+3)	ITI (t+4)	ITI (t+5)
NN Matching	0.002	0.016	0.026	0.028	0.034	0.024
	(0.046)	(0.584)	(0.817)	(0.832)	(1.185)	(0.879)
Kernel Matching	0.013	0.020	0.031*	0.033	0.028	0.028
	(0.586)	(1.007)	(1.892)	(1.580)	(1.179)	(1.311)
Fixed Effect with AR(1)	0.007	0.007	0.019***	0.017***	0.006	0.003
	(1.121)	(1.161)	(3.289)	(2.990)	(1.036)	(0.544)
FGLS	-0.002	-0.004	0.005	0.006	-0.001	-0.003
	(-0.652)	(-1.161)	(1.128)	(1.362)	(-0.268)	(-0.847)
	TICA (t)	TICA (t+1)	TICA (t+2)	TICA (t+3)	TICA (t+4)	TICA (t+5)
NN Matching	-0.007	0.008	0.024	0.029	0.028	0.020
	(-0.231)	(0.276)	(0.749)	(0.946)	(0.924)	(0.795)
Kernel Matching	0.017	0.025	0.034	0.040*	0.031	0.031
	(0.958)	(1.045)	(1.441)	(1.767)	(1.498)	(1.224)
Fixed Effect with AR(1)	0.008	0.002	0.016**	0.018***	0.009	0.007
	(1.273)	(0.283)	(2.448)	(2.816)	(1.383)	(1.203)
FGLS	0.001	-0.001	0.007	0.009*	0.007	0.004
	(0.349)	(-0.216)	(1.545)	(1.862)	(1.492)	(0.819)

NOTES: Table reports the estimation results for the impacts of systemic sudden stops on trade structure. Propensity scores in NNM and KM are estimated using the following variables: real depreciation rate, real interest rate, inflation, GDP per capita growth rate, current account balance, domestic credit provided by banking sector (% of GDP), and financial openness index. Control variables in regression estimations are income level, financial development index, share of trade in GDP, share of food export in total merchandise export (end.), average trade protection rate, and value added in manufacture, and logarithm of total population. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

TABLE R8: Impacts of Macroeconomic Crisis on Trade Structure – Twin Crises						
	TDI (t)	TDI (t+1)	TDI (t+2)	TDI (t+3)	TDI (t+4)	TDI (t+5)
NN Matching	-0.071	-0.087	-0.085	-0.103	-0.125**	-0.132**
	(-0.940)	(-1.087)	(-1.220)	(-1.404)	(-2.405)	(-2.100)
Kernel Matching	-0.006	-0.022	-0.012	-0.030	-0.017	-0.028
	(-0.173)	(-0.578)	(-0.298)	(-0.678)	(-0.483)	(-0.616)
Fixed Effect with AR(1)	-0.003	0.004	-0.004	-0.014	-0.015	0.004
	(-0.255)	(0.254)	(-0.292)	(-0.943)	(-1.109)	(0.404)
FGLS	-0.011	-0.005	-0.005	-0.010	-0.014	0.007
	(-1.252)	(-0.505)	(-0.505)	(-0.984)	(-1.360)	(0.822)
	ITI (t)	ITI (t+1)	ITI (t+2)	ITI (t+3)	ITI (t+4)	ITI (t+5)
NN Matching	0.008	0.014	0.031	0.033	0.063	0.085
	(0.137)	(0.207)	(0.506)	(0.533)	(1.009)	(1.226)
Kernel Matching	0.020	0.021	0.028	0.037	0.037	0.050
	(0.571)	(0.487)	(0.721)	(1.037)	(0.965)	(0.918)
Fixed Effect with AR(1)	0.003	-0.002	0.010	0.018	0.017	0.003
	(0.238)	(-0.170)	(0.697)	(1.327)	(1.290)	(0.272)
FGLS	0.005	-0.007	-0.004	-0.001	0.003	-0.005
	(0.790)	(-0.986)	(-0.595)	(-0.182)	(0.475)	(-0.775)
	TICA (t)	TICA (t+1)	TICA (t+2)	TICA (t+3)	TICA (t+4)	TICA (t+5)
NN Matching	-0.026	-0.039	-0.013	-0.001	0.008	0.040
	(-0.402)	(-0.612)	(-0.204)	(-0.021)	(0.105)	(0.518)
Kernel Matching	0.001	-0.020	0.009	0.027	0.012	0.035
	(0.039)	(-0.480)	(0.186)	(0.707)	(0.267)	(0.655)
Fixed Effect with AR(1)	-0.002	-0.001	0.004	0.030*	0.011	0.012
	(-0.136)	(-0.091)	(0.260)	(1.960)	(0.751)	(1.015)
FGLS	-0.001	-0.008	-0.006	0.016	0.004	0.012
	(-0.117)	(-0.809)	(-0.549)	(1.563)	(0.401)	(1.628)

NOTES: Table reports the estimation results for the impacts of twin crises on trade structure. Propensity scores in nearest-neighbor (NN) and Kernel matching are estimated using the following variables: real depreciation rate, real interest rate, inflation, GDP per capita growth rate, current account balance, domestic credit provided by banking sector (% of GDP), and financial openness index. Control variables in regression estimations are income level, financial development index, share of trade in GDP, share of food export in total merchandise export (end.), average trade protection rate, and value added in manufacture, and logarithm of total population. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

TABLE R9: Impacts of Macroeconomic Crisis on Trade Structure – Dual Crises						
	TDI (t)	TDI (t+1)	TDI (t+2)	TDI (t+3)	TDI (t+4)	TDI (t+5)
NN Matching	-0.143	-0.168*	-0.176**	-0.169**	-0.162**	-0.190*
	(-1.473)	(-1.868)	(-2.286)	(-2.299)	(-2.130)	(-1.924)
Kernel Matching	-0.075	-0.118*	-0.127	-0.123**	-0.116*	-0.152*
	(-1.214)	(-1.676)	(-1.613)	(-2.080)	(-1.708)	(-1.754)
Fixed Effect with AR(1)	0.006	-0.000	-0.013	-0.011	-0.007	-0.002
	(0.443)	(-0.027)	(-0.835)	(-0.725)	(-0.433)	(-0.172)
FGLS	-0.000	0.001	-0.006	-0.007	0.003	-0.005
	(-0.080)	(0.174)	(-0.903)	(-1.123)	(0.456)	(-0.923)
	ITI (t)	ITI (t+1)	ITI (t+2)	ITI (t+3)	ITI (t+4)	ITI (t+5)
NN Matching	0.121	0.143	0.143	0.140	0.142	0.164
	(0.850)	(0.947)	(1.161)	(1.221)	(1.130)	(1.164)
Kernel Matching	-0.043	0.010	0.019	0.017	0.018	0.055
	(-0.344)	(0.090)	(0.155)	(0.154)	(0.145)	(0.454)
Fixed Effect with AR(1)	-0.021	0.000	0.014	0.011	0.017	0.005
	(-1.636)	(0.001)	(0.987)	(0.756)	(1.150)	(0.453)
FGLS	-0.008	-0.010	-0.007	-0.007	-0.004	-0.006
	(-1.319)	(-1.447)	(-0.822)	(-0.910)	(-0.473)	(-0.859)
	TICA (t)	TICA (t+1)	TICA (t+2)	TICA (t+3)	TICA (t+4)	TICA (t+5)
NN Matching	0.024	0.039	0.047	0.050	0.052	0.076
	(0.211)	(0.307)	(0.444)	(0.532)	(0.456)	(0.621)
Kernel Matching	-0.090	-0.063	-0.046	-0.047	-0.045	-0.010
	(-0.851)	(-0.635)	(-0.430)	(-0.500)	(-0.457)	(-0.098)
Fixed Effect with AR(1)	-0.006	-0.009	0.007	0.008	0.019	0.004
	(-0.395)	(-0.605)	(0.406)	(0.499)	(1.132)	(0.271)
FGLS	0.000	-0.008	-0.004	-0.007	0.002	-0.004
	(0.036)	(-0.850)	(-0.350)	(-0.590)	(0.197)	(-0.413)

NOTES: Table reports the estimation results for the impacts of dual crises on trade structure. Propensity scores in nearest-neighbor (NN) and Kernel matching are estimated using the following variables: real depreciation rate, real interest rate, inflation, GDP per capita growth rate, current account balance, domestic credit provided by banking sector (% of GDP), and financial openness index. Control variables in regression estimations are income level, financial development index, share of trade in GDP, share of food export in total merchandise export (end.), average trade protection rate, and value added in manufacture, and logarithm of total population. T statistics are in parentheses. Statistical significance are denoted by * p<0.10, ** p<0.05, *** p<0.01, + p<0.001.

Table 3A.6: List of Crisis Episodes

	Country	Year	GDP Disaster	Cons. Disaster	Currency Crises (HT05)	Currency Crises (K03)	Systemic Banking Crises	Systemic Sudden Stops	Twin Crises (K3)
1	Algeria	1990	0	0	0	0	1	0	0
2	Algeria	1991	0	0	1	0	0	0	0
3	Argentina	1981	1	1	1	1	0	0	0
4	Argentina	1982	1	1	0	1	0	0	0
5	Argentina	1983	1	1	0	0	0	0	0
6	Argentina	1984	1	1	0	0	0	0	0
7	Argentina	1985	1	1	1	0	0	0	0
8	Argentina	1986	1	1	0	0	0	0	0
9	Argentina	1987	1	1	0	1	0	0	0
10	Argentina	1988	1	1	0	0	0	0	0
11	Argentina	1989	1	1	0	1	1	0	1
12	Argentina	1990	1	1	0	1	0	0	0
13	Argentina	1991	0	0	1	0	0	0	0
14	Argentina	1995	0	0	1	0	1	1	0
15	Argentina	1999	1	0	0	0	0	1	0
16	Argentina	2000	1	1	0	0	0	0	0
17	Argentina	2001	1	1	0	0	1	0	1
18	Argentina	2002	1	1	0	1	0	0	0
19	Argentina	2003	1	1	0	0	0	0	0
20	Argentina	2004	0	1	0	0	0	0	0
21	Austria	1992	0	0	0	0	0	1	0
22	Bangladesh	1987	0	0	0	0	1	0	0
23	Bolivia	1981	0	0	1	0	0	0	0
24	Bolivia	1982	0	0	0	1	0	0	0
25	Bolivia	1983	0	0	0	1	0	0	0
26	Bolivia	1985	0	0	1	1	0	0	0
27	Bolivia	1986	0	0	0	0	1	0	0
28	Bolivia	1994	0	0	0	0	1	0	0
29	Bolivia	2000	0	0	0	0	0	1	0
30	Cameroon	1987	0	0	0	0	1	0	0
31	Cameroon	1994	0	0	1	0	0	0	0
32	Cameroon	1995	0	0	0	0	1	0	0
33	Chile	1981	0	1	0	0	1	0	1

34	Chile	1982	0	1	0	1	0	0	0
35	Chile	1983	0	1	0	0	0	0	0
36	Chile	1984	0	1	0	1	0	0	0
37	Chile	1985	0	1	1	0	0	0	0
38	Chile	1986	0	1	0	0	0	0	0
39	Chile	1987	0	1	0	0	0	0	0
40	Chile	1995	0	0	0	0	0	1	0
41	Chile	1996	0	0	0	0	0	1	0
42	Chile	1998	0	0	0	0	0	1	0
43	Chile	1999	0	0	0	0	0	1	0
44	Colombia	1982	0	0	0	0	1	0	1
45	Colombia	1983	0	0	0	1	0	0	0
46	Colombia	1985	0	0	0	1	0	0	0
47	Colombia	1995	0	0	0	1	0	0	0
48	Colombia	1997	0	0	0	1	0	0	0
49	Colombia	1998	0	0	0	1	1	1	1
50	Colombia	1999	0	0	0	1	0	1	0
51	Colombia	2000	0	0	0	0	0	1	0
52	Colombia	2002	0	0	0	1	0	0	0
53	Costa Rica	1981	0	0	1	0	0	0	0
54	Costa Rica	1987	0	0	0	0	1	0	0
55	Costa Rica	1994	0	0	0	0	1	0	0
56	Costa Rica	1998	0	0	0	0	0	1	0
57	Costa Rica	1999	0	0	0	0	0	1	0
58	Costa Rica	2000	0	0	0	0	0	1	0
59	Denmark	1993	0	0	0	1	0	0	0
60	Ecuador	1982	0	0	1	1	1	0	0
61	Ecuador	1983	0	0	0	1	0	0	0
62	Ecuador	1986	0	0	0	1	0	0	0
63	Ecuador	1988	0	0	0	1	0	0	0
64	Ecuador	1995	0	0	0	0	0	1	0
65	Ecuador	1996	0	0	0	0	0	1	0
66	Ecuador	1998	0	0	0	0	1	0	0
67	Ecuador	1999	0	0	1	0	0	1	1
68	Ecuador	2000	0	0	0	1	0	1	0
69	Egypt	1989	0	0	1	0	0	0	0

70	El Salvador	1986	0	0	1	0	0	0	0
71	El Salvador	1989	0	0	0	0	1	0	0
72	El Salvador	1990	0	0	1	0	0	0	0
73	El Salvador	1999	0	0	0	0	0	1	0
74	Finland	1982	0	0	0	1	0	0	0
75	Finland	1991	0	0	0	1	1	0	1
76	Finland	1992	0	0	0	1	0	0	0
77	France	1992	0	0	0	0	0	1	0
78	Greece	1993	0	0	0	0	0	1	0
79	Honduras	1990	0	0	1	0	0	0	0
80	Honduras	1995	0	0	0	0	0	1	0
81	Honduras	1996	0	0	0	0	0	1	0
82	Hong Kong, China	1998	0	0	0	0	0	1	0
83	Hong Kong, China	1999	0	0	0	0	0	1	0
84	India	1993	0	0	0	0	1	0	0
85	Indonesia	1983	0	0	1	1	0	0	0
86	Indonesia	1986	0	0	0	1	0	0	0
87	Indonesia	1997	0	0	1	1	1	0	1
88	Indonesia	1998	0	0	0	1	0	1	0
89	Indonesia	2000	0	0	0	0	0	1	0
90	Japan	1997	0	0	0	0	1	0	0
91	Jordan	1989	0	0	0	0	1	0	0
92	Jordan	1995	0	0	0	0	0	1	0
93	Jordan	1998	0	0	0	0	0	1	0
94	Jordan	1999	0	0	0	0	0	1	0
95	Korea, Rep.	1997	0	0	1	0	1	1	0
96	Korea, Rep.	1998	0	0	0	0	0	1	0
97	Madagascar	1987	0	0	1	0	0	0	0
98	Madagascar	1988	0	0	0	0	1	0	0
99	Madagascar	1994	0	0	1	0	0	0	0
100	Malaysia	1995	0	0	0	0	0	1	0
101	Malaysia	1997	0	0	1	1	1	0	1
102	Malaysia	1998	0	0	0	1	0	0	0
103	Mexico	1981	0	0	0	0	1	0	0
104	Mexico	1982	0	1	1	1	0	0	1

105	Mexico	1983	0	1	0	0	0	0	0
106	Mexico	1984	0	1	0	0	0	0	0
107	Mexico	1985	0	1	0	0	0	0	0
108	Mexico	1986	0	1	0	0	0	0	0
109	Mexico	1987	0	1	0	0	0	0	0
110	Mexico	1988	0	1	0	0	0	0	0
111	Mexico	1994	0	0	1	1	1	1	0
112	Mexico	1995	0	0	0	0	0	1	0
113	Nepal	1988	0	0	0	0	1	0	0
114	Nepal	1998	0	0	0	0	0	1	0
115	Nepal	1999	0	0	0	0	0	1	0
116	Pakistan	1995	0	0	0	0	0	1	0
117	Pakistan	1998	0	0	0	0	0	1	0
118	Peru	1983	0	0	0	0	1	0	0
119	Peru	1987	1	0	1	1	0	0	0
120	Peru	1988	1	1	0	1	0	0	0
121	Peru	1989	1	1	0	0	0	0	0
122	Peru	1990	1	1	0	0	0	0	0
123	Peru	1991	1	1	0	0	0	0	0
124	Peru	1992	1	1	0	0	0	0	0
125	Peru	1993	1	1	0	0	0	0	0
126	Peru	1997	0	0	0	0	0	1	0
127	Peru	1999	0	0	0	0	0	1	0
128	Philippines	1983	1	0	0	1	1	0	0
129	Philippines	1984	1	0	0	1	0	0	0
130	Philippines	1985	1	0	0	0	0	0	0
131	Philippines	1986	1	0	0	1	0	0	0
132	Philippines	1987	1	0	0	0	0	0	0
133	Philippines	1988	1	0	0	0	0	0	0
134	Philippines	1995	0	0	0	0	0	1	0
135	Philippines	1997	0	0	1	1	1	1	1
136	Philippines	1998	0	0	0	0	0	1	0
137	Philippines	1999	0	0	0	0	0	1	0
138	Portugal	1992	0	0	0	0	0	1	0
139	Portugal	1993	0	0	0	0	0	1	0
140	Romania	1990	0	0	0	0	1	0	0

141	Romania	1991	0	0	1	0	0	0	0
142	Romania	1999	0	0	1	0	0	0	0
143	Senegal	1988	0	0	0	0	1	0	0
144	Senegal	1994	0	0	1	0	0	0	0
145	South Africa	1984	1	0	0	0	0	0	0
146	South Africa	1985	1	0	0	0	0	0	0
147	South Africa	1986	1	0	0	0	0	0	0
148	South Africa	1987	1	0	0	0	0	0	0
149	South Africa	1988	1	0	0	0	0	0	0
150	South Africa	1989	1	0	0	0	0	0	0
151	South Africa	1990	1	0	0	0	0	0	0
152	South Africa	1991	1	0	0	0	0	0	0
153	South Africa	1992	1	0	0	0	0	0	0
154	South Africa	1993	1	0	0	0	0	0	0
155	South Africa	1994	1	0	0	0	0	0	0
156	Spain	1982	0	0	0	1	0	0	0
157	Spain	1992	0	0	0	1	0	1	0
158	Spain	1993	0	0	0	1	0	1	0
159	Sri Lanka	1989	0	0	0	0	1	0	0
160	Sri Lanka	1995	0	0	0	0	0	1	0
161	Sri Lanka	1996	0	0	0	0	0	1	0
162	Sri Lanka	1998	0	0	1	0	0	0	0
163	Sweden	1981	0	0	0	1	0	0	0
164	Sweden	1982	0	0	0	1	0	0	0
165	Sweden	1991	0	0	0	0	1	0	1
166	Sweden	1992	0	0	0	1	0	1	0
167	Thailand	1981	0	0	0	1	0	0	0
168	Thailand	1983	0	0	0	0	1	0	1
169	Thailand	1984	0	0	0	1	0	0	0
170	Thailand	1996	0	0	0	0	0	0	1
171	Thailand	1997	0	0	1	1	1	1	0
172	Thailand	1998	0	0	0	1	0	1	0
173	Thailand	1999	0	0	0	1	0	0	0
174	Thailand	2000	0	0	0	1	0	0	0
175	Trinidad & Tb	1985	0	0	1	0	0	0	0
176	Trinidad & Tb	1993	0	0	1	0	0	0	0

177	Tunisia	1991	0	0	0	0	1	0	0
178	Turkey	1982	0	0	0	0	1	0	0
179	Turkey	1994	0	0	1	1	0	1	1
180	Turkey	1998	0	0	0	0	0	1	0
181	Turkey	1999	0	0	0	0	0	1	0
182	Turkey	2000	0	0	0	0	1	0	0
183	Turkey	2001	0	0	0	1	0	0	1
184	United States	1988	0	0	0	0	1	0	0
185	Uruguay	1981	1	1	0	0	1	0	0
186	Uruguay	1982	1	1	1	0	0	0	0
187	Uruguay	1983	1	1	0	1	0	0	0
188	Uruguay	1984	1	1	0	0	0	0	0
189	Uruguay	1985	1	1	0	0	0	0	0
190	Uruguay	1986	1	0	0	0	0	0	0
191	Uruguay	1999	0	0	0	0	0	1	0
192	Uruguay	2000	1	1	0	0	0	1	0
193	Uruguay	2001	1	1	0	0	0	0	0
194	Uruguay	2002	1	1	0	1	1	0	1
195	Uruguay	2003	1	1	0	0	0	0	0
196	Uruguay	2004	0	1	0	0	0	0	0
197	Zimbabwe	1991	0	0	1	0	0	0	0
198	Zimbabwe	1992	0	0	0	0	0	1	0
199	Zimbabwe	1993	0	0	0	0	0	1	0
200	Zimbabwe	1994	0	0	0	0	0	1	0
201	Zimbabwe	1995	0	0	0	0	1	0	0
202	Zimbabwe	1997	0	0	1	0	0	1	0
203	Zimbabwe	1998	0	0	0	0	0	1	0
204	Zimbabwe	1999	0	0	0	0	0	1	0
205	Zimbabwe	2000	0	0	0	0	0	1	0
206	Zimbabwe	2001	0	0	0	0	0	1	0

CHAPTER 4

EXPORT DIVERSIFICATION AND PRODUCTIVITY GROWTH

ABSTRACT

Exporting firms are more productive, but they do not know initially where their productive capacity lies; overall productivity level increases as firms discover their productive potentials; and economic growth entails concentration in relatively high productive activities, but initial discovery process may require diversification of production structure. Given these evidences from empirical and theoretical analyses, we investigate the impact of export diversification on productivity by using four alternative measures of productivity and three measures of diversification and test whether diversification really helps discover productive capacities. We additionally introduce an index of within-diversification for empirical purposes. In general, we find no significant relationship between the structure of export and productivity. The results are robust to alternative measures of productivity,

diversification, aggregation of the data, and estimation methods. Allowing for heterogeneity with respect to degree of development and sectoral classification, however, provides important insights. Low and lower middle income countries tend to suffer from within-diversification (or benefit from within-specialization) in manufacturing industries. Lower-middle income countries benefit from higher specialization in chemicals and related products, mineral products and in sector classified as other manufacturing articles. These findings confirm the previous findings on the impact of specialization on productivity for lower income countries.

KEY WORDS: Diversification, Specialization, Productivity, Within Diversification.

JEL: F14, F43, O47, C23, Y4.

4.1 INTRODUCTION

There are strong theoretical and empirical reasons to believe that structure of trade is important for economic growth and development. The existing trade and growth literature suggests a number of channels through which trade may affect an economy's economic performance. Grossman and Helpman (1991), Rivera-Batiz and Romer (1991) emphasize the role of endogenous growth in the presence of R&D investments in examining the relationship between trade and growth, while Stokey (1991) studies the relationship between trade and human capital accumulation. Other most commonly referred channels include economies of scale, increased capacity utilization, efficiency gains due to competitive exposure in world markets, and learning-by-doing. Besides trade itself, some authors argue that composition of trade might also be important for economic performance. Young (1991) develops a model in which the effect of trade on technical progress and growth will depend upon whether static comparative advantage leads an economy to specialize in goods in which learning by doing has mostly exhausted or in goods in which learning by doing still proceeds. Recent empirical studies in this field confirm the argument that in which products economies specialize and what they export matters for economic performance (e.g., Hausmann, Hwang, and Rodrik 2007, Plümper and Graff 2001, Dalum et al. 1999, Crespo-Cuaresma and Würz 2005, Amable 2000, Lewer and Van den Berg 2003).

Standard international trade theory suggests that economies should specialize in products in which they have comparative advantage. Through increasing returns to specialization, international trade may increase an economy's growth rates, but as economies grow, patterns of comparative advantage will possibly change as well. However, Redding (1999) argues, parallel to Young (1991), that an economy may face a trade-off between specializing according to existing pattern of comparative advantage and entering in sectors where it lacks a comparative advantage, since in the second case a country may acquire an advantage as a result of the potential for productivity growth. Maximizing the benefits from

trade specialization in an economy requires specialization pattern to be adjusted along the lines of the most dynamic sectors promising productivity growths, but not to stick on constant set of products in which productivity potentials steadily deteriorate. This in turn requires an economy to diversify its export structure so that to discover such sectors in certain stages of development.

In this context, a robust relationship between trade and growth has been established, despite the dynamic structure of trade patterns. Countries tend to specialize in different products at different times and take advantage of increasing returns to specialization to benefit from productivity growth in future. In this perspective, this paper aims to investigate the potential productivity effects of export structure by using a panel dataset covering 83 countries over 40 years. This paper is built on the presumption that economies potentially benefit more by diversifying their exports instead of specializing in a certain range of products and specialization is only beneficial if it happens in sectors in which there exists high potential for productivity growth. Since every country retains different level of economic and social development with diverse historical background, the sectors in which these countries specialize to get the highest productivity should not be necessarily the same across countries. In this framework, this paper tests whether countries discover their productive capacities through diversifying their export structure and whether specialization and diversification at certain stages of development play any significant role in productivity growth. The robustness of the initial findings is then examined with alternative productivity and diversification measures, aggregation levels and estimation methods.

This chapter is organized as follows. We first provide a review of literature and some theoretical considerations. In section 4.3, we discuss the importance of export structure for economic development and alternative measures of diversification. We introduce an index of diversification in order to capture the recent evidence on within diversification in exports. In the following section, we describe how to measure the productivity and how to relate it to export structure. In section 4.5, we discuss the empirical methodology and data.

Section 4.6 presents the main findings and subsequent robustness checks. To finish, we estimate the relationship for different sectors and income groups. Finally, section 4.8 concludes the chapter.

4.2 REVIEW OF LITERATURE

The traditional approach passed on from Smith/Ricardo emphasizes the role of specialization in international trade which increases operating efficiency and thus total productivity. In this approach, export is said to promote economic growth through higher specialization in sectors in which a country has a comparative advantage. This is due to the reallocation of resources from relatively inefficient sectors to more productive export sectors. Similarly, Helpman and Krugman (1985) argue that larger economies of scale due to increased exports can increase productivity. Despite the channels identified in classical approaches between trade and productivity, the impact of specialization on the long run growth remained dubious to many scholars. Sachs and Warner (1997), for instance, report a negative impact of a comparative advantage in raw materials on economic growth.

In the new growth theory literature, some authors, including Rivera-Batiz and Romer (1991), stress the role of learning-by-doing and economies of scale by arguing that countries specialize in a range of products when they open up to trade and benefit from increasing returns to scale. Some others, like Grossman and Helpman (1991), stress the importance of different rates of productivity growth in different industries. In these models, countries will perform better to achieve higher growth rates if they specialize in industries with high potential productivity growth. Though it remained ambiguous how to identify such industries, the implication was that the nature of the export specialization matters, which found supporting evidence in recent empirical studies, as stated earlier. With this implication in mind, the industrial policy and strategic trade policy literature widely defended the view that a government could increase the growth perspectives of the country by promoting technological change in the most promising industries. At the time when value of export structure was not

recognized (or within specialization was not a widespread phenomenon), the so-called export-led growth hypothesis attracted considerable attention in the seventies and eighties in testing the growth effects of exports and indeed many authors have found a positive relationship (e.g., Balassa 1978, Feder 1983, Michaely 1977, Levine and Renelt 1992, Jung and Marshall 1985).

Specialization is a dynamic process and its effect on productivity depends on the circumstances in which industries operate. That is, similar specialization patterns may give rise to different productivity and growth rates at different points of time.[1] In this regard, specialization (depending on the comparative advantage approach) is regarded as being endogenous and some authors (e.g., Grossman and Helpman 1991) defined this phenomenon as 'dynamic comparative advantage'. As pointed out by Redding (1999), this may lead some countries to face a trade-off over which industries or products to specialize in. By focusing on comparative advantage, Bernard et al. (2007) developed a new theoretical model and found that intra- and inter-industry reallocations of resources following trade liberalization improve average industry productivity and sectoral firm output, but relatively more so in industries with a comparative advantage than those with comparative disadvantages. If countries successfully diversify within industries in which they have a comparative advantage, they will benefit more in terms of productivity and output.[2]

[1] As noted by Acemoglu and Zilibotti (2001), "many technologies used by the LDCs are developed in the OECD economies and are designed to make optimal use of the skills of these richer countries' workforces. Differences in the supply of skills create a mismatch between the requirements of these technologies and the skills of LDC workers, and lead to low productivity in the LDCs. Even when all countries have equal access to new technologies, this technology- skill mismatch can lead to sizable differences in total factor productivity and output per worker."

[2] As noted by Schott (2004, p.), "the existence of within-product specialization is an important consideration for understanding the impact of globalization on firms and workers, the evolution of total factor productivity, and the likelihood of long-run income convergence".

The nature of diversification at different income levels may well be different and it is not required for economies to follow similar pattern over the path of development. Empirically, Imbs and Wacziarg (2003) study the change of sectoral concentration in relation to the level of per capita income by using a nonparametric approach. Their findings suggest a U-shaped pattern of sectoral concentration between export diversification and economic development. Countries first diversify and at some level of income they start specializing again and this level is found to be around $9,000.[3] This finding provides some implications on the behavior of economies in determining the range of goods in which to specialize at different income groups. As also predicted in recent works in growth theory, specialization at low income levels can play an inhibiting role in per capita income convergence (e.g., Acemoglu and Ventura 2002). As an implication, sophistication of export structure should matter more than scaling up what countries have been producing.

The distinction between specialization across goods (horizontal dimension) and within goods (vertical dimension) is well documented in empirical research. Vertical dimension represents the quality aspect of the goods exported. Schott (2004) finds no evidence of endowments-driven specialization across products but finds that capital- and skill-abundant countries use their endowment advantage to produce vertically superior varieties. This is also in line with the quality ladder model of Grossman and Helpman (1991), which has high-wage leader countries with an endowment driven comparative advantage in innovation continually developing improved varieties to replace those copied by low-wage followers. Among others, Hummels and Klenow (2005) and Khandelwal (2009) have also shown strong evidence of the importance of the quality dimension in characterizing current international trade. In line with this new evidence, Schott (2004, p.649) suggests that 'our thinking about

[3] As specialization depends on the level of income, an analysis on the effects of specialization on growth or productivity would be subject to simultaneity bias. As described in section 4.5 in detail, it is another advantage of the empirical methodology used in this paper in dealing with endogeneity in left-hand-side variables.

international specialization must shift away from industries and toward varieties within industries'. Empirical and theoretical studies, however, consider only one dimension of specialization. Recently, by building an integrated model, Alcalá (2009) combines the both dimensions and analyzes the connection between them. He finds that the country with the absolute advantage in an industry produces the highest quality in that industry. He also shows that the factors that create absolute and comparative advantages across goods can also play an important role in the vertical specialization within goods.

Despite the voluminous literature on trade and growth, empirical studies on growth impacts of both trade specialization and export usually ignore the channels through which economic growth is spurred. Productivity increase is one of the most important channels through which economies grow and that is true for export specialization as well. Weinhold and Rauch (1999) is the first empirical paper that analyzes the relationship between openness, specialization, and productivity. By using a model associating openness and the level of specialization in a learning-by-doing framework, the authors find positive relationship between specialization and productivity for less developed countries. As being closely related empirical study to the present paper, Alcalá and Ciccone (2004) try to identify the productivity effects of trade by using cross-sectional data for the year 1985 and find positive effect of trade on productivity. Their theoretical approach is straightforward but not completely appropriate for the empirical analysis in this paper. By using a dynamic panel data model, instead of cross-sectional analysis, it will be possible to control for possibly correlated, time invariant heterogeneity without observing it. This procedure has also the advantage of taking into account the capacity of workers or firms to absorb technological and organizational knowledge.

Apart from the considerations at macro level, following the theoretical works predicting higher productivity for exporters (e.g., Melitz 2003 and Bernard et al. 2003), it emerged a considerably large literature studying the productivity impacts of export at the firm level. It is now fairly established that, on average, exporting firms are more productive than non-exporting firms and high

productivity firms self-select into export market. In a survey of literature with more than 40 studies, Wagner (2007) concludes that the effects of exporting on productivity are mixed and unclear. Although the exporters are more productive than non-exporters, exporting does not necessarily increase the productivity. Martins and Yang (2009) conduct a meta-analysis of more than 30 papers and find that the impact of exporting on productivity is higher at developing countries compared to the impact at developed countries. These findings indicate that developing countries have more absorptive capacity that learning-by-doing can promote with exporting.

Similar to Redding (1999), Hausmann and Rodrik (2003) and Hausmann, Hwang, and Rodrik (2007, HHR hereafter) highlight the importance of discoveries of new productive sectors against the existing comparative advantage. Hausmann and Rodrik (2003) emphasize the role of entrepreneur in discovering new products, called cost discovery, when there is uncertainty about what a country is good at producing. Three important arguments cited in Hausmann and Rodrik are the followings:

i. There is much randomness in the process of discovering what one can be good at. More likely, existing patterns of specialization are the consequence of historical accidents and serendipitous choices by entrepreneurs.
ii. For most economies, industrial success entails concentration in a relatively narrow range of high-productivity activities. However, the specific product lines that eventually prove to be the most productive are typically highly uncertain and unpredictable.
iii. Enterprises may not be able to predict if, when, how, and at what cost they would learn enough to become fully competitive, even when the technology is well known and mature elsewhere (Lall, 2000, pp. 17).

The approach developed by HHR identifies a relationship between the type of goods that an economy specializes in and its rate of economic growth. In this framework "anything that pushes the economy to specialize in good(s) with higher productivity levels sets forth a dynamic (if temporary) process of

economic growth." HHR conclude that the type of goods in which a country specializes has direct implications for the economic performance of that country. Export of goods with higher productivity potentials bring about higher growth rates and this is achieved by transferring resources from low-productivity to the higher-productivity activities by the entrepreneurial cost-discovery process. In HHR model, each firm has two options, either produce own products with productivity level θ_i or imitate what others discovered at a fraction of the productivity level of the inventor, $\alpha\theta_i^{\max}$. Firm will decide by comparing the respective productivity levels and stick to his own project if $\theta_i > \alpha\theta_i^{\max}$, and imitate if otherwise. The productivity level at which the firms operate will range then from $\alpha\theta_i^{\max}$ to $\theta_i^{\max}$. $\theta_i^{\max}$ shows the productivity level of the most productive goods that has been discovered. Their approach is, therefore, useful in understanding the role of export diversification in discovering the productive capacities in export markets.

Altogether we know that exporting firms are more productive, but firms do not know initially where their productive capacity lies; overall productivity level increases as firms discover their productive potentials; and economic growth entails concentration in relatively high productive activities, but initial discovery process may require diversification of production structure. Within this framework, what remains to be resolved is the appropriate level of specialization required in converging to the quality frontiers in those products and level of development at which countries should start diversifying or specializing to reach to the highest productivity level. Despite the fact that it is impossible to convey a precise pattern between level of specialization and productivity at every income level, this paper will attempt to provide some insightful observation on these issues.

4.3 EXPORT STRUCTURE: DIVERSIFICATION VS. SPECIALIZATION

Previous sections highlight some of the important findings on the importance of what countries export. In this section, we take a different route and provide deeper discussion of how diversification and specialization measured and under which circumstances they are thought to be contributing to development. In addition to existing measures of diversification, we propose a new index to measure the diversification within industries.

It is useful to remember the distinction between growth and development before discussing the role of diversification in economic development with an example in biology: interpretation of the development of an embryo. As noted by Ellerman (2005), the process of change from an embryo to a mature organism was interpreted in two ways. Early thinkers (e.g., Aristotle) considered the embryo as a tiny version of the mature organism, but the Epigenesist School considered the process of change as a process of differentiation and transformation. According to the first approach, the whole process is only a quantitative growth; but according to the second approach, it is more a qualitative process generated by higher diversification and continuous transformation. These views respectively reflect the growth and development aspects in a fairly plain way. In our understandings, therefore, economic development involves not just quantitative growth but diversification and the continuing transformations of different products and different tasks as reflected in export structure.

Unlike the development of an embryo, there is no blueprint for the optimal export diversification path for an economy to develop faster. In general, countries may benefit from specialization due to its impact on economies of scale (Romer 1987), or from diversification due to its impact on technology spillover and discovery of productive and competitive sources. It is often argued that dependence on natural resource and primary goods based exports is not conducive to development. They are not only inapt to technological

progress, but also vulnerable to terms of trade shocks. In the 1960s, two development economists, Prebisch and Singer, argued in their natural resource hypothesis that the overwhelming dominance of a natural resource was a curse for developing countries as it hindered technological change and dampened export and income growth. Empirically, Sachs and Warner (1995) found supportive evidence for this hypothesis.

Early studies on trade structure and growth considered both export and import structure of an economy. Baldwin (1992) demonstrated how an increase in international trade increases the real value of production by combining Solow growth with the gains from comparative advantage. By critically examining Baldwin's model, Mazumdar (1996) indicated that medium-run growth depends on the composition of trade. Mazumdar argued that if the consumption good is the import and the capital good is the export, then trade will not lead to growth, although there might be substantial income gains.[4] Lee (1995) suggested similarly that capital-importing countries benefit from trade because trade causes the cost of capital to fall. Lewer and Van den Berg (1998) find supportive evidence for this hypothesis. Later studies, including Hausmann, Hwang, and Rodrik (2007), Plümper and Graff (2001), Dalum et al. (1999), Crespo-Cuaresma and Würz (2005), and Amable 2000, concentrated mostly on export side of the issue and analyzed the importance of export structure for better economic performance. The outcome of these studies is that it matters what countries export.

The measurement of the quality or sophistication of the goods exported was a real concern. Lacking such crucial information, it was challenging to come up with policy relevant propositions on how to diversify. Recently, HHR developed an index that can take into account some of the concerns in measuring the quality of the goods with respect to relative income levels. This index, called the 'EXPY' index, became a relatively popular index and was used in recent studies. The EXPY is the weighted sum of the 'PRODY's of all

[4] The reason is that the relative price of the investment good rises as a result of trade, thereby counteracting any effect trade might have had on savings or the rental price of capital.

products that it exports (the weights are the export shares of each product) and the PRODY of a product is a weighted average of the per capita GDPs of countries exporting that product. Therefore the EXPY index links the total value of the export basket of a country to its income level.[5] In this framework, diversification alone is not sufficient for catch-up in less developed countries. They need to export high PRODY products. In this sense, it has similar implications as of studies in productivity differences. A direct implication of these studies (including Ventura 1997 and Acemoglu and Ventura 2002) was that otherwise identical late developers may not be able to catch up the first movers, even if they finally catch the product mix of the early developers. Thus, the EXPY index provided an important contribution to the literature.

High-tech industries are usually the area of specialization of leading industrialized countries and low-skill industries are the area of concentration of the least developed countries (see, e.g., Stokey 1991 and Schott 2004). As they progress, developing countries usually diversify their production and export structure in order to attain higher economic growth. Successful diversifiers reap the benefits in terms of better economic performance and faster development. The countries that cannot diversify and are taken captive by limited infertile industries (those specialize in primary commodities) will not be able to jump to the era of higher economic growth.[6] Therefore, as a policy outcome, recommending least developing countries to specialize in what they currently

[5] PRODY is constructed as: $PRODY_k = \sum_j \frac{(x_{jk}/X_j)}{\sum_j (x_{jk}/X_j)} Y_j$. EXPY is then obtained as: $EXPY_i = \sum_l (\frac{x_{il}}{X_i}) PRODY_l$. Thus, EXPY is in effect the sum of the revealed comparative advantage (RCA) of each country's export products weighted by its per capita income.

[6] The question is that should the countries producing coffee-beans be the best coffee beans producer and ignore the other industries. The answer should not be that difficult, but what usually recommended to such countries is generally the opposite (see, e.g., Stockey 1988).

doing best may not necessarily help them to achieve long run sustainable growth.[7]

Questions like 'what determines productivity, the comparative advantage, and productive advantage' and 'under which circumstances does convergence take place' are beyond the scope of this paper. What matters in our context is how to know the right industries in which countries have these advantages. Even though we know that specialization patterns are determined in part by idiosyncratic elements and partly due to fundamentals, as suggested by HHR, we cannot ignore the intrinsic elements hidden within countries stemmed through historical events that can alter the formation of comparative advantages at present and future. Some countries may obtain comparative advantage in certain industries just because of being first-mover. Whenever other countries with potential 'productive advantage' enter into the export markets, comparative advantage will potentially force the first movers to specialize within products instead of across products.

Discovering productive advantage requires significant diversification. Successful discoveries will not only increase overall productivity levels but also number of products in which to have comparative advantage. Acemoglu and Zilibotti (2001), Hall and Jones (1999), Klenow and Rodríguez-Clare (1997), and Parente and Prescott (2000) have established that differences in total factor productivity (TFP) account for a large fraction of the variation in output per worker across countries. Therefore, higher productivity growth achieved by successful diversification may also reduce the income variations between the countries. In the same fashion, Hall and Jones (1999) conjecture that differences in observed TFP are driven by differences in the institutions and government policies they collectively refer to as 'social infrastructure'. Better social infrastructure eases the process of discovering productive capacities and paves the way for higher productivity growth.

[7] For instance, though no one would regard India, a low-income developing country, to have comparative advantage in technology intensive industries, the country showed remarkable success in information technology sector.

When diversifying their export structure, a rather challenging task for countries is whether to diversify at both industry and product level or diversify at only product level while specializing at industry level. The recent evidence suggests that the importance of within-goods specialization increases in characterizing the current patterns of trade. By using US trade data, Schott (2004) provides the first empirical evidence on the nature of trade within and across industries. A major challenge is, however, how to measure the within diversification across industries. Below, we attempt to contribute to the literature by proposing a new index of diversification that can measure within diversification across industries.

4.3.1 A New Index of Diversification: Within Diversification Index

In the literature, there are two commonly used diversification indices. First available index is used to be constructed by considering the reverse of a specialization index as diversification, such as the Herfindahl index, as they are thought to be complementary. The other one is obtained by using the differences in the export shares of particular goods in total country and world export.[8] However, these approaches do not provide much information about the particular patterns of the diversification.[9] The first one tells only that countries diversify by exporting from everything preferably at even shares, without paying attention to relative world demands. The second one does not provide any insights on the diversification of the countries within industries

[8] Trade dissimilarity (or diversification) index (TDI) measures the similarity in an economy's pattern of trade with world demand. It is defined as difference between the share of one particular industry (j) in country's exports and the share of that industry in total world export. It is constructed as: $TDI = \frac{1}{2}\sum_{j=1}^{N}\left|\frac{X_{ijt}}{X_{it}} - \frac{X_{jt}}{X_t}\right|$. Lower dissimilarity index indicates higher diversification. It also evaluates if a change in the exports behavior is oriented towards more dynamic products demanded by the rest of the world.

[9] Other alternative measures of diversification used in the literature include entropy, Gini, and RCA indexes. These indexes are also alone insufficient in measuring within diversification.

when matching the world demands and does not take into account the relative comparative advantages.

As evidenced in recent studies, countries diversify within products instead of across products (see, e.g., Schott 2004). In this paper, we suggest a new index of diversification by taking within-industry dynamics into account. This index will be called Within Diversification Index (WDI) and will be constructed in several steps. The main purpose of the index will be to measure how well diversify countries their exports within industries. We use revealed comparative average as a metric to compare the abilities of countries in matching world demand, both at industry and product level. To do this we first calculate the weighted average of RCA at industry level and then at product level. Then we obtain an expression what we called MARCA, or ability to match revealed comparative advantage:

$$MARCA_c = \frac{\sum_{i=1}^{M}\left(RCA_i^y * S_M^y\right)}{\sum_{i=1}^{M}\left(\sum_{j=1}^{N} RCA_j^z * S_N^z\right) * S_M^y}$$

S_M^y is the export share of industry (y) in total export of all industries (M) and S_N^z is the export share of product (z) in total export of particular industry (N). Superscripts y and z indicate the relative disaggregation level, with $y < z$. M indicates the total number of industries (i) at level y, and N and K indicate the number of products (j) at subgroup z and cumulated over y, respectively. The numerator can be regarded as average RCA at level y, denominator as average RCA at level z through level y.

Then we improve the index by fine-tuning MARCA. Fine-tunings involve corrections for data discrepancy and specialization at aggregate level. In the first case, MARCA can be misleading if countries report trade statistics at aggregated level but not at sufficiently disaggregated level. To correct for this problem, we estimate the discrepancy ratios between 2 and 4 digit trade data (these are respectively the corresponding values for y and z) for each country and calculated the corresponding weighted index values. To do this, we obtain the total export at four-digit and two-digit, and then take the ratio of the values. We

find that the countries are relatively successful in reporting the data at disaggregated level; only in less than 4.7% of the cases, this ratio is less than 0.99 and in less than 2.5% of the cases, the ratio is less than 0.98.

Then we obtain the second step version of our index as:

$$WDIX_c = MARCA_c * \left[\frac{\sum_{i=1}^{M} X_i^y}{\sum_{h=1}^{K} X_h^z}\right]$$

Moreover, without correcting specialization at industry level, the index may yet again be misinterpreted. A country may well diversify within a particular industry but may be highly specialized in that industry. In that case the index will generate very high values for such countries. In order to take into account the across industry specialization, we correct the index by multiplying WDIX by the relative Herfindahl specialization index at two-digit level.[10]

Finally we obtain the within-diversification index for a country (c) at a year in the following form:[11]

$$WDI_c = WDIX_c * \left[1 - \sum_{i=1}^{M} \left(S_M^y\right)^2\right]$$

[10] Another approach in correcting for industry level specializations would be to use dispersions from average specialization index. That would require equal treatment for countries at equal distance but at different directions to average. As an experiment, we used the deviations as an alternative measure but obtained highly correlated outcomes. The correlation coefficient of two indexes obtained from alternative corrections for industry level specialization is 0,9997.

[11] The WDI index can be expressed as: $WDI_c = \frac{\sum_{i=1}^{M}\left(RCA_i^y * \frac{x_i^y}{\sum_{i=1}^{M} x_i^y}\right)}{\sum_{i=1}^{M}\left(\sum_{j=1}^{N} RCA_j^z * \frac{x_j^z}{\sum_{j=1}^{N} x_j^z}\right) * \frac{x_i^y}{\sum_{i=1}^{M} x_i^y}} * \left[\frac{\sum_{i=1}^{M} X_i^y}{\sum_{h=1}^{K} X_h^z}\right] * \left[1 - \sum_{i=1}^{M}\left(\frac{X_i^y}{\sum_{i=1}^{M} X_i^y}\right)^2\right]$. X in general refers to export value. RCA is Balassa's Revealed Comparative Advantage index, used intensively in the empirical literature and measured as $\frac{X_{cht}}{\sum_{h=1}^{P} X_{cht}} \Big/ \frac{\sum_{c=1}^{C} X_{cht}}{\sum_{c=1}^{C}\sum_{h=1}^{P} X_{cht}}$ for country c and product h.

The index measures how well countries are able to diversify their export within industries so that they keep their relative advantage in certain sectors compared to other countries. Regarding the boundaries of the index, two corollaries follow:

Corollary I: *Complete within-diversification.* In each $i \in M$, if $RCA_j = RCA_i$ for every $j \in N$, then $\sum_{j=1}^{N} RCA_j * \frac{X_j}{\sum_{j=1}^{N} X_j} = RCA_i$ for every $N \in M$ and $WDI_c = 1$.

In this extreme case, a country diversifies its products in line with relative world demands so that it maintains the revealed comparative advantage it has at industry level. If a country has revealed comparative advantage only in a subset of goods within an industry but that does not contribute to get the same advantage in industry level, the index will give small values. The index will approach to one, as countries diversify their export commodities in line with relative world demands. Now it follows the second corollary.

Corollary II: *WDI is bounded with 1.* That is, if $RCA_j \neq RCA_i$ for any $j \in N$ in any $i \in M$, then $\sum_{j=1}^{N} RCA_j^z * \frac{X_j^z}{\sum_{j=1}^{N} X_j^z} > RCA_i^y$ and $WDI_c < 1$.

Proof: Let $\delta_j = RCA_j^z$ and $\mu_j = \frac{X_j^z}{\sum_{j=1}^{N} X_j^z}$, with $\bar{\mu}$ indicating required ratio to keep $\sum_{j=1}^{N} RCA_j^z * \frac{X_j^z}{\sum_{j=1}^{N} X_j^z} = RCA_i^y$ and $\tilde{\mu}$ indicating the realization. If $\tilde{\mu}_j > \bar{\mu}_j$ for any $j \in N$, then $\tilde{\delta}_j > \bar{\delta}_j$. This requires for at least one $j \in N$ that $\tilde{\mu}_j < \bar{\mu}_j$ and $\tilde{\delta}_j < \bar{\delta}_j$, and also $\sum_{j=1}^{N} \tilde{\mu}_j \tilde{\delta}_j > \sum_{j=1}^{N} \bar{\mu}_j \bar{\delta}_j$. This implies that $\sum_{j=1}^{N} \mu_j \delta_j > RCA_i^y$ and $WDI_c < 1$.

For $N = 2$, $\tilde{\mu}_1 > \bar{\mu}_1$ requires that $\delta_1^z > \delta_1^z$, and also $\tilde{\mu}_2 < \bar{\mu}_2$ and $\tilde{\delta}_2 < \bar{\delta}_2$. It follows that $\sum_{j=1}^{2} \tilde{\mu}_j \tilde{\delta}_j > \sum_{j=1}^{2} \bar{\mu}_j \bar{\delta}_j$. This implies that $\sum_{j=1}^{2} \mu_j \delta_j > RCA_i^y$ and $WDI_c < 1$. ■

Finally due to non-negativity constraint, it directly follows that the index ranges between 0 and 1.

Naturally, the index has both strengths and weaknesses. A weakness of the index is that it provides no direct information whether the pattern of diversification materializes in a beneficial way. It only tells that, irrespective of the level of comparative advantage at industry level, whether countries diversify at product level in a way to maintain the current level of comparative advantage at industry level. As the shares of goods in total export changes from year to year for all countries, comparative advantages will change from year to year as well. If any country sticks to previous trade structure, the index value for that country will shrink. An advantage of the index is therefore to measure whether countries catch up the changes in world demands.

The data we work with in this paper contain only four-digit level data from 1962 to 2000.[12] We take $y = 2$ and $z = 4$, aiming to measure the comparative advantage at industry level (y) and product level (z). It is certainly not sufficiently disaggregated to propagate that they are really at product level, but even at this aggregation level, we have around 1.5 million data points.[13] Table 4.1 shows the list of countries with highest and lowest index values for the year 1995. It indicates that the developed countries not only exports more and diversified products, they also export in proportion to world demands at product level. The countries on the right panel are mostly the developing countries failing to match world demands. Matching relative world demands is, however, not necessarily done by developed countries. For instance, Uruguay had index values around 0.8 in early 1980's, but it later shrank to around 0.3.

In short, the WDI index ranges from zero to one, with higher values indicating higher degree of diversification. Whatever the quantity produced, if the index

[12] Martin and Mitra (2001) find that the rate of productivity growth in agriculture is higher than in manufacturing both on average and for groups of countries at different stages of development. Since productivity growth can take place in agricultural industries as well, we do not restrict the sample only to manufacturing sector.

[13] Data at higher disaggregation levels will surely make the calculation somewhat messy. When conducting only country-specific analysis, however, data at higher disaggregation levels can be easily used and the index will produce more appropriate values for measuring within-product diversification.

value increases, the level of specialization decreases and diversification within products in proportion to world demand rises; but if it decreases over the time, then it indicates an increasing specialization within products.

Table 4.1: WDI index for countries with highest and lowest values

Year	Country	WDI	WDIX	MARCA	Country	WDI	WDIX	MARCA
1995	Germany	0.811	0.856	0.856	Nepal	0.014	0.022	0.022
1995	US	0.764	0.798	0.799	Zambia	0.030	0.190	0.190
1995	France	0.733	0.764	0.764	Niger	0.036	0.145	0.145
1995	Japan	0.719	0.787	0.787	Senegal	0.044	0.062	0.062
1995	UK	0.688	0.716	0.716	Gabon	0.080	0.179	0.179
1995	Hong Kong	0.640	0.716	0.716	Mongolia	0.091	0.125	0.125
1995	Belgium	0.638	0.672	0.672	Bolivia	0.098	0.107	0.107
1995	Netherlands	0.626	0.647	0.647	Cyprus	0.105	0.120	0.121
1995	Italy	0.615	0.642	0.642	Jamaica	0.107	0.140	0.140
1995	Sweden	0.604	0.642	0.643	Mali	0.108	0.380	0.380
1995	China	0.599	0.646	0.646	Malawi	0.115	0.230	0.231
1995	Canada	0.581	0.623	0.623	Ghana	0.119	0.148	0.148
1995	Spain	0.551	0.599	0.599	Madagascar	0.121	0.148	0.148
1995	Taiwan	0.544	0.590	0.590	Uganda	0.122	0.462	0.462
1995	Switzerland	0.543	0.571	0.571	Jordan	0.125	0.163	0.163

Notes: MARCA lists the countries with highest and lowest WDI index values, without correcting for data discrepancies at different aggregation levels and specialization at industry level. WDIX and WDI reports the respective values after correcting for discrepancy and specialization at industry level. Countries with highest and lowest values are reported primarily for WDI.

4.3.1.1 Income and Within Diversification

As clearly observed from the table, higher income countries have higher diversification within products and low-income countries fail to diversify within products. Figure 4.1 displays the overall relationship between income and within diversification from 1962 to 2000. When all countries considered together, it emerges a slightly curved line. When the countries for different income levels considered separately, this relationship becomes more visible: countries tend to diversify at a decreasing rate, slightly specialize as they get out of low-income trap and then diversify again as they become richer.[14] This

[14] We intuitively classified the countries with per capita income less than 5,000 USD as low-income countries, between 5,000-15,000 as middle-income countries and more than 15,000 USD as rich countries.

descriptive evidence is markedly in contrary to the findings of Imbs and Wacziarg (2003) based on overall diversification instead of within-diversification.

Figure 4.1 depicts the relationship between income and within diversification when we pool the countries over the whole period. The pattern at specific point in time is similar to the pooled data (Figure 4.2). In Figure 4.2, we randomly take the years 1980 and 1995 and check the cross-country relationship between per capital income and within diversification. Overall within diversification is always higher in richer countries. The line of fitted values is still slightly curved, confirming the previous results that we derived from pooled cross-country sample.

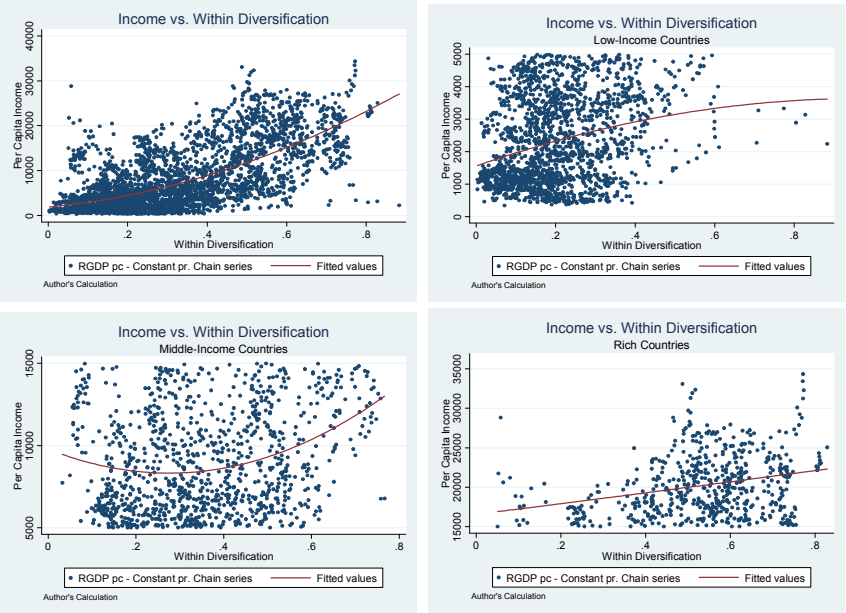

Figure 4.1: Income vs. Within Diversification (Pooled data)

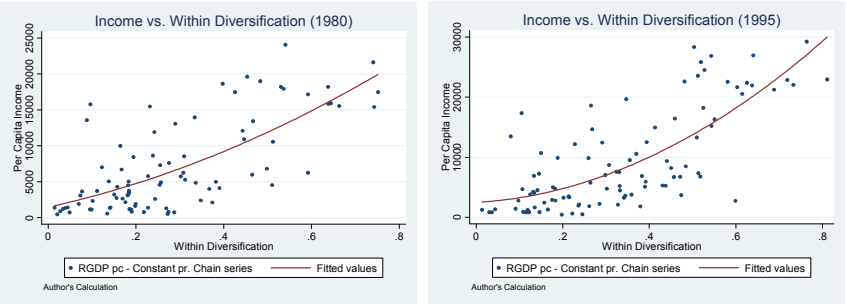

Figure 4.2: Income vs. Within Diversification (Cross-country data)

4.3.1.2 Distinct Paths of Development in Comparison

In order to be able to understand the role of within diversification, we compare the WDI index with standard diversification index TDI. We consider six countries in three groups: Spain and Netherlands from developed countries, Brazil and Malaysia from developing countries, and Bangladesh and Nepal from low-income countries. The pattern of specialization that these countries follow provides important insights on the significance of indexes. The changes in per capital income and diversification indexes over time are given in Figure 4.3. We observe similar pictures brought by different indexes for Spain and Netherlands. In Malaysia and Brazil, two diversification indexes depict different patterns of diversification, at least until some point of time. Finally, a large discrepancy between the two indexes prevails for low-income countries. These differences facilitate to understand the underlying differences between the two indexes.

Both indexes, WDI and TDI, measure the level of diversification by taking into account the relative shares of goods compared to relative world demands. However, WDI additionally takes into account the level of diversification at industry level through the distribution at product level. In practice, no country will completely diversify or specialize. There will be some sectors in which countries specialize and some others in which they diversify. If matching relative world demands at industry level and product level differs significantly, it

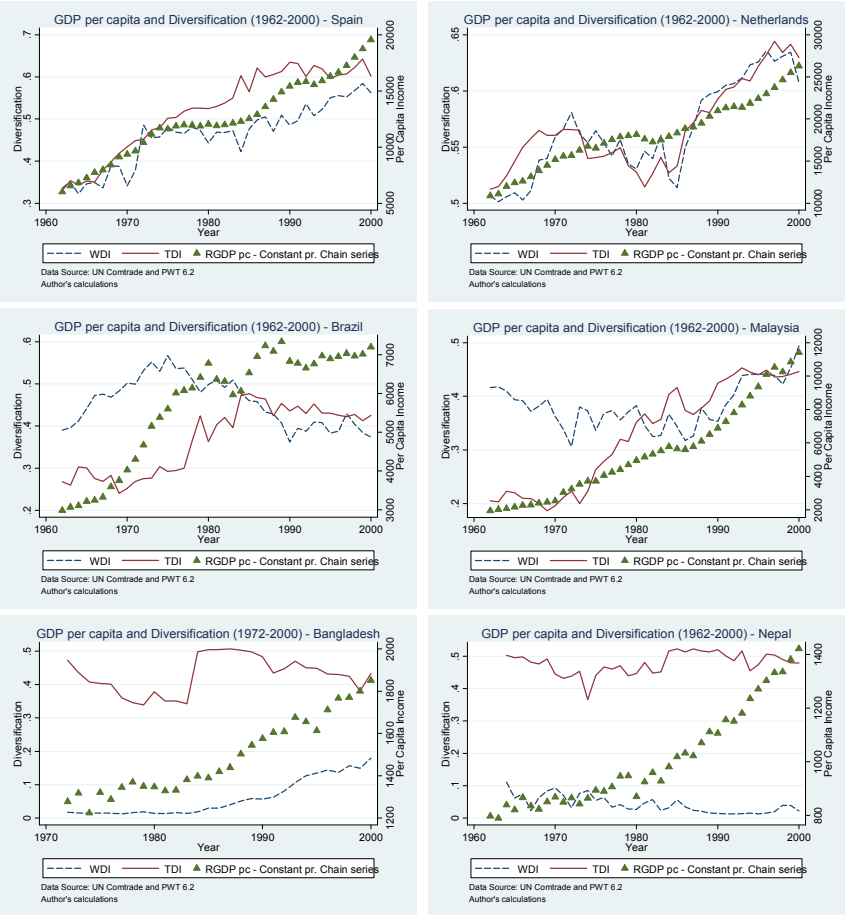

Figure 4.3: Distinct Paths of Development and WDI in Comparison

will imply higher specialization in WDI index, but may have no implications for TDI index. That is the case for Malaysia and Brazil. These countries were diversified at product level compared to industry level during their early stages of development, then specialized quickly in some of these sectors and diversified again. That is not captured with standard diversification index of TDI. Only starting in 1980's, they commence to diversify both within and across. We additionally consider two low-income countries, Bangladesh and

Nepal. Although standard diversification index predicts higher diversification in these countries, they are in fact poorly diversified when it comes to within diversification of export products.

On the other hand, Spain and Netherlands increased the level of diversification steadily over time, as indicated by both of the indexes. In effect, Spain continued to decrease the level of specialization both within and across industries. And that is the crucial difference between two groups of countries, and also between WDI and TDI indexes. First group of countries initially specialized within products but diversified across industries, but second group of countries diversified both within and across industries during the sample period. Therefore it is a clear advantage of WDI index in detecting the distinct paths of diversification and development compared to standard indexes.

4.3.2 X-Factor in Development

The association between diversification and per capital income appears to be U-shaped. There is also negative correlation between overall specialization and income level. Many countries diversify their exports as they become richer and the picture that comes out probably figures out the secrecy in their development. This negative relationship between specialization and per capita income generates a rather interesting figure (see Figure 4.4). For developing countries around 1980's and for developed countries usually around 1970's, we observe a clear diminution in specialization that prevailed in their early stages of development and increase in income levels and this magic is depicted with a sign of 'X'.[15] Though these figures provide no direct implication beyond a nice

[15] One might have rather strange question in mind at this stage. If countries benefit from higher diversification in early stages of development, as stated frequently, what should we understand from late stages of development? Or, is there really a stage where all the countries specialize in goods in which they have real comparative advantage, as proposed in theoretical applications. As countries develop and their incomes converge, they may diversify within products instead of across products. And complete specialization is probably the ultimate destination when the human beings come to an end in improving the way they exploit the universe. As long as mankind finds a "better" way of doing things, the enjoyment of in which industries to diversify or specialize will continue.

illustration of the relationship, they improve the way we visualize the relationship between overall specialization and income.

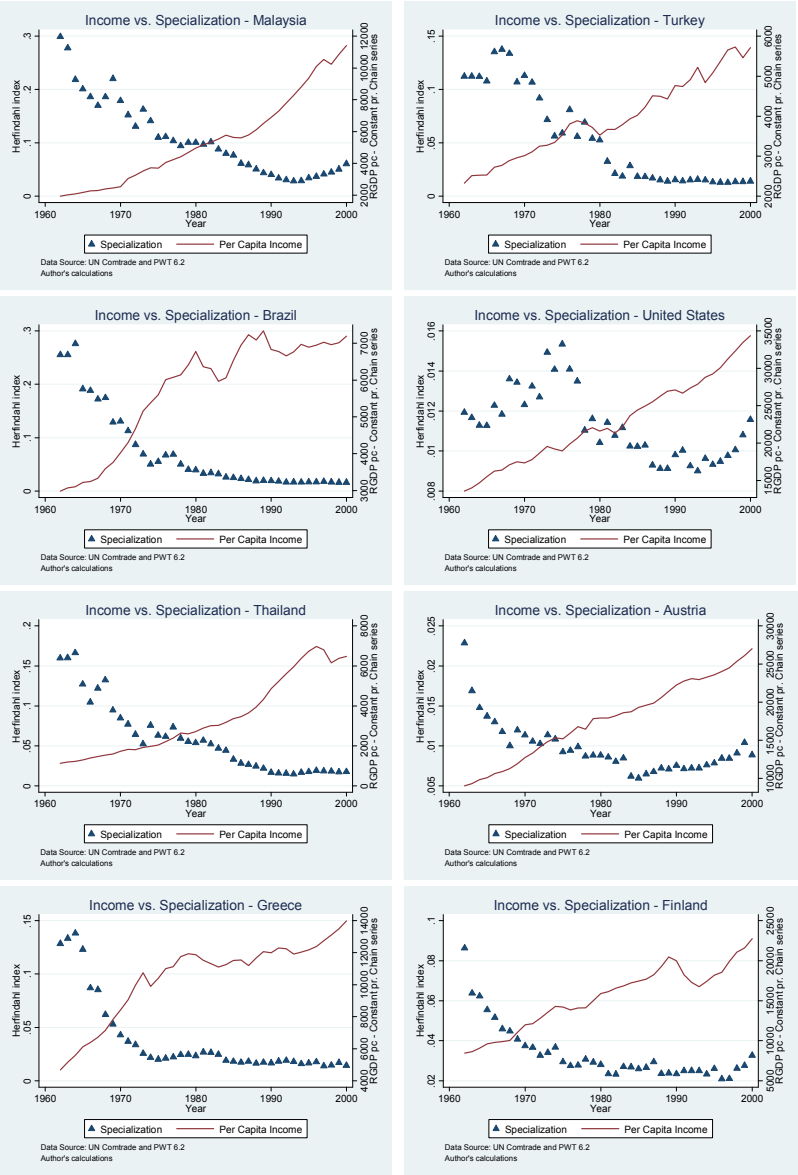

Figure 4.4: Income vs. Specialization: X-Factor

4.4 MEASURING PRODUCTIVITY AND LINKING TO EXPORT STRUCTURE

The objective of productivity measurement is to identify output differences that cannot be explained by input differences. In trade theories, international productivity differences are used to explain the patterns of trade and specialization. The single factor Ricardian model of old trade theory implies product specialization as a result of international productivity differences (e.g., Dornbusch et al. 1977). Productivity differences among producers within industries are also major components of new trade theory, which is based additionally upon imperfect competition and consumers' love for variety. Under these assumptions, price of a product is settled by a constant markup over productivity-adjusted marginal cost. A direct implication of new trade theory is that varieties from countries with high productivity should have a higher price than varieties from countries with low productivity, which is found to be inconsistent by Schott (2004).[16] Finally, the recent studies with firm heterogeneity embark on productivity differences at firm level in explaining the entry into export markets (e.g., Melitz 2003 and Bernard et al. 2004).

Since international and domestic productivity differences play such a significant role in international trade, at least theoretically, some part of the differences in trade structure of countries may be explained by international productivity differences. Additionally, trade is in itself a source of productivity improvement through learning-by-doing and technological spillover (e.g., Alcalá and Ciccone 2004). A subtle difference, however, avoids us to claim a mutual causality. Productivity differences might theoretically play a role in shaping trade structure, but it is the overall trade openness that is found to improve productivity, not trade structure. Since the measures of export structure in

[16] Schott (2004) also notes that in new trade theory, within-product specialization is horizontal: variety price varies inversely with producer productivity. In old trade theory, within-product specialization is vertical: varieties are related both to exporter endowments and to exporter production techniques.

searching for the potential impacts of export composition on productivity changes are neutral to productivity differences, we do not confront causality problem for the moment.

In general, two different productivity measures are considered: labor productivity (LP) and total factor productivity (TFP). LP is preferred in the literature (e.g., Alcalá and Ciccone 2004), as it relates to the most important factor of production and it is relatively easy to measure. LP is however only a partial productivity measure and measured simply dividing the total GDP to total labor force. A more appropriate option is to use total factor productivity (TFP) measure. Improvements in TFP have been recognized as an important source of economic growth and convergence, as the variation in incomes across the world is explained by differences in TFP (Klenow and Rodriguez-Clare 1997, Hall and Jones 1999). In contrary to LP, it is rather difficult to estimate accurate measures of TFP from available data. TFP is broadly calculated in two different ways. One way is to calculate econometrically as a Solow residual after accounting for the contributions of various factors of production. Klenow and Rodriguez-Clare, for instance, calculate TFP by decomposing the variance of income into that attributable to differences in factors of production and to differences in TFP.[17] While this approach does not require any assumption on the extent of returns to scale, endogeneity of the input variables may become a

[17] Two other important methods in TFP estimation are suggested by Edwards (1998) or Hall and Jones (1999). Edwards (1998) measures the TFP by using the estimated factor share from the formula $g_{jt} = \alpha dlogK_{jt} + \beta dlogL_{jt} + \lambda + \zeta_j + \varepsilon_t + \xi_{jt}$ to construct yearly estimates of TFP. More explicit definition of the formula can be found in Edwards (1998). As also used in Frankel and Romer (1999), Hall and Jones (1999) estimate the equation $\ln\left(\frac{Y_i}{N_i}\right) = \frac{\alpha}{1-\alpha}\ln\left(\frac{K_i}{Y_i}\right) + \phi(\mathrm{S_i}) + \ln\mathrm{A_i}$ by assuming that α=1/3 and productivity (A) is obtained as a residual as the output (Y), capital (K), labor (N) and schooling (S) are obtained directly from the data. TFP thus can be estimated by calculating the portion of contribution made other than by capital and labor (Solow residual) from actual growth. Data on physical capital is difficult to find, but Loening (2005) and Nehru and Dhareshwar (1993) suggest some methods to construct capital stock.

real concern and require finding good instrumental variables.[18] The other way is to estimate TFP under some underlying assumptions about the production function and its parameters. In this approach it is common to assume constant returns to scale and perfect competition. Even though it appears implausible to assume constant returns to scale, we prefer the second approach in estimating TFP growth. However, we will check the robustness under different sets of assumptions about the production function and its parameters. In what follows, we largely draw on Hall and Jones (1999) and Ghosh and Kraay (2000) in estimating TFP growth.

Assume the following Cobb-Douglas production function[19] with two factors, physical capital (K) and human capital-augmented labor (H):

$$Y = \psi(K^{\alpha}H^{1-\alpha})^{\beta}, \tag{4.1}$$

where ψ is TFP, α measures the share of capital in output and β measures the degree of returns to scale. Taking logarithms and differentiating the equation (1) with respect to time, we obtain the conventional growth accounting equation $g_Y = g_\psi + \beta[\alpha g_K + (1-\alpha)g_H]$, with g indicating the growth rate of each variable. Thus, we obtain the equation for TFP as:

$$g_\psi = g_Y - \beta[\alpha g_K + (1-\alpha)g_H] \tag{4.2}$$

In addition to data on the growth rates of output, physical capital and human capital, we need information on the parameters of the production function. The data on GDP growth rates is easy to access, but data on physical capital and human capital growth is difficult. The parameters of the production function are not directly observable and it is ordinary to make some assumptions.

[18] Countries providing incentives for higher physical and human capital accumulation are likely to use their inputs more productively.

[19] Hall and Jones (1999) use Solow method instead of Cobb-Douglas production function, however, as they note, they produce similar results and Cobb-Douglas does not produce any significant bias. In Cobb-Douglas technology, factor shares are assumed to be the same for all countries.

However, the estimates of TFP growth might be highly sensitive to these assumptions.

The data on physical capital stock is usually obtained using the perpetual inventory method (e.g., Hall and Jones 1999). Knowing that the data can be very sensitive to the assumptions about initial capital-output ratio and depreciation rate, we use the data generated by Nehru and Dhareshwar (1993) and extended by Mahajan (2002) through 2000. The capital stock is calculated using the perpetual inventory method as: $K_t = (1-\delta)\mathrm{K}_{t-1} + \mathrm{I}_{t-1}$, with δ measuring geometric depreciation rate and I gross capital formation. It has been established a strong relationship between gross fixed capital formation and economic growth and that has led many authors (e.g., De Long and Summers 1991) to conclude that the rate of physical capital formation determines the rate of a country's economic growth. Similarly, Eaton and Kortum (2001) attribute part of cross-country difference in productivity to the access to capital goods as reflected by capital goods prices and barriers inhibiting trade in equipment.

The data on human capital is constructed by adjusting the number of workers for their years of schooling (S) by assuming that each additional year increases productivity of workers by a given percentage. Human capital is then calculated as $\mathrm{H} = \mathrm{L}.\, \mathrm{e}^{\pi(\mathrm{S})}$, with L measuring the total labor force between the ages 15-64, $\pi(S)$ the return to education, and S is the average schooling per worker (a proxy for the stock of education in the economy). The derivative $\pi'(S)$ measures the impact of additional year of schooling on a worker's efficiency. Better education improves the production process in several ways. Educated, or skilled, workers are able to perform complex tasks and thereby contribute to producing more technologically sophisticated products. Especially in developing countries, skilled workers increase the absorptive capacity of the country by acquiring and implementing the foreign knowledge and technology, which is of crucial importance in successful diversification.

Various estimates in the literature suggest different rates of return to education, usually between 7 and 13 percent, due to the fact that the return to education

may be nonlinear. With decreasing marginal return to human capital accumulation, the productivity impacts of basic education can be higher than that of advanced education. Psacharopoulos (1994) provides cross-country evidence on Mincerian rates of return[20] consistent with decreasing marginal returns to education. Psacharopoulos reports that the average Mincerian rate of return is 13.4 per cent in Sub-Saharan Africa (with average number of years of schooling around four), 10.1 per cent for the world as a whole (with average number of years of schooling around eight) and 6.8 per cent for OECD countries. Then, the average Mincerian rates of return can be considered to be around 13.4 per cent for the first four years of education, 10.1 per cent on the next four years, and 6.8 per cent for the education above eight, as was also assumed by Hall and Jones (1999).[21] Therefore, the return to education, $\pi(S)$, will be assumed to be piecewise linear. In the benchmark case, we consider it to be 10 per cent for simplicity.

Regarding the parameters of the production function, it is common to assume constant returns to scale, $\beta = 1$, with the share of capital stock (α) between 0.3 and 0.5. Higher income countries tend to have higher share of capital stock. Following Hall and Jones, we take $\alpha = 1/3$ in our benchmark case. Estimates of TFP growth are again very sensitive to these assumptions. Ghosh and Kraay show that estimated TFP falls with increasing returns to scale, because part of the increase in output attributed to productivity growth is now attributed to scale economies. As they note, if there are increasing returns to scale at low levels of development and decreasing returns to scale at high levels of development, we would be better able to identify how much of measured TFP growth is likely to be sustained over the long run.

Taking into account the sensitivity of the estimation to the underlying assumptions, we define three alternative sets of assumption in estimating TFP

[20] Following famous labor economist Jacob Mincer, Mincerian returns measure the percentage increase in wages resulting from an additional year of education.

[21] See Coulombe and Tremblay (2008) for a survey of evidence on the return to education.

growth.[22] The first one will be used as the benchmark measure of TFP and the others will be used in checking the robustness.[23] These are listed in Table 4.2.

Table 4.2: Sets of Assumptions for Alternative TFP Growth Estimations

	Returns to Scale	Returns to Education	Share of Capital Stock	Description
TFP1	$\beta = 1$	$\pi = 0.1$	$\alpha = 1/3$	Standard estimation with constant returns to scale
TFP2	$\beta = 1$	$\pi = 0.134$ if $S \leq 4$ $\pi = 0.101$ if $4 < S \leq 8$ $\pi = 0.068$ if $S > 8$	$\alpha = 1/3$	Higher returns to education at lower levels
TFP3	$\beta = 1$	$\pi = 0.134$ if $S \leq 4$ $\pi = 0.101$ if $4 < S \leq 8$ $\pi = 0.068$ if $S > 8$	$\alpha = 0.4$	Higher share of capital stock and higher returns to education at low levels

NOTES: In constructing the capital stock using perpetual inventory method, following Hall and Jones, we assume a depreciation rate of 6 per cent.

The literature records two major factors essential to productivity growth: human capital development (Wolff [2000]) and capital investments (Mankiw et al. [1992] and Romer [1986]).[24] Additionally level of financial development and quality of institutions and infrastructure are also considered as important

[22] Instead of estimating TFP in levels, we estimate the growth rate of TFP. TFP in levels is in general less informative compared to growth in TFP. Hall and Jones also admit that they find relatively large residuals in levels, indicating the potential problems in interpretation of TFP in levels. We thereby avoid comparing numbers with huge differences. In longitudinal calculations, it additionally makes the interpretation of the results easier.

[23] More flexible cases could be constructed under different sets of assumptions, including different returns to scale and different share of capital stock at different income levels. Since it is not settled yet at which levels of income countries exploit increasing returns to scale and obtain higher shares of capital stock, we skip such flexible assumptions.

[24] Romer (1986) showed in a model of endogenous technological change that technological innovation and physical capital are such strong complements that an increase in the rate of growth of physical capital necessarily leads to an increase in the rate of technological change. In his later works (Romer 1990b), however, Romer found that an increase in the investment share has no long-run effect on the growth rate of the technology or output.

elements in productivity performance. In empirical studies, there are many other factors ranging from inflation (Fischer 1992) to demographic age structure (Kogel 2005) linked to productivity growths.

The main factor that links export structure to productivity is reallocation of production factors, which has been considered mostly in economic growth literature. Young (1995), for instance, demonstrated that inter-sectoral reallocations of labor drove a large part of TFP growth in East Asia from the 1960s to the early 1990s. Depending on the relative performance of the firms in foreign markets, diversification of export structure lays the ground for potential reallocation of resources. If exporting firms successfully handle in foreign markets and maintain their competitive advantages, this will increase the investment in the sectors these firms operate by reallocating the production factors. Theoretical support for this line of reasoning can be found in Romer (1990a). Romer models an economy consisting of three sectors: a final goods sector, an intermediate goods sector, and a researcher sector. The research sector improves technological capacities for the intermediate goods sector and thus increases the variety of intermediate goods produced. This diversification of goods enhances the productivity of the final good sector.

In linking productivity to export diversification, we also focus on the technological spillover potential of industries. Spillover potential of industries may vary significantly, with high-tech industries carrying more potential for technology spillover when countries trade in these industries. Relative importance of diversification comes from trading in as many industries as possible, because it may be a priori unobservable in which industries and products countries obtain the technology suitable to their absorptive capacity. Without exporting any quantity, countries will not be able to experience whether they are ready to utilize the knowledge generated elsewhere in a specific sector. That recalls again the cost-discovery process in industrial production. If certain industries fail to absorb and exploit the foreign technology, they will not survive in export markets.

The strength of the impacts of common channels used in trade literature, such as technology spillover and learning-by-doing, on productivity depends, however, on the absorptive capacity of countries. Absorptive capacity in turn depends to a degree on the range of products produced in a country, because ability to produce more variety is an obvious sign of ability to learn quickly and adapt to new demand formations.[25] Therefore, the degree of diversification should be considered one of the major channels in improving the productivity. Since the form of diversification changes as countries develop, the necessity to use alternative measures of diversification to take into account diversification at various forms is present.

4.5 EMPIRICAL METHODOLOGY

Empirical approach of this paper is based on a dynamic panel data method. It is dynamic because the productivity at one period is necessarily related to the productivity at the next period. This is especially comprehensible if we think the process in a learning-by-doing framework: as workers gain knowledge of better production techniques at each period, they will be able to increase their productivity at the next period. The question is whether this learning process and the resulting productivity can be attributed partly to what these workers produce and export, namely to export structure.

Apart from the dynamic nature of the model, several benefits are expected from using longitudinal data against time series or cross-sectional data. One of them

[25] The role of absorptive capacity can be understood with one of the best case studies in the field. In cotton textile industry, despite the transfer of same technology to the world from Britain in 1940s, the productivity and profitability in other countries, such as in India, remained a fraction of the levels in Britain. See Hausmann and Rodrik (2003) for more detailed discussion of the issue. As Evenson and Westphal (1995, pp.2214) put it: "A stream of investments over time is typically required to overcome tacitness and thus achieve mastery. Not only is much technology tacit, so too is much knowledge about the specifics of local circumstances and about the ways that differences in circumstances affect the productivity of particular techniques. Tacit knowledge can only be acquired through investments in learning."

is to be able to control for individual heterogeneity. Time series or cross-sectional studies may yield biased results when not controlled for this heterogeneity. To illustrate that, consider the fact that countries differ with respect to their work ethics, values, institutions, etc., which might affect the productivity invariant of time. This heterogeneity needs to be controlled in order to avoid any biased results. Another benefit is its superiority with respect to time series and cross-sectional data in indentifying and measuring the effects which are otherwise would not be detectable. In determining the productivity impacts of export diversification, observing changes in patterns of diversification by holding at the same time individual characteristics constant may improve the estimation results. A further benefit expected from panel data is to reach to more reliable parameter estimates as it provides more informative data, less collinearity, more degrees of freedom and more efficiency (Baltagi 2006). There are some limitations of panel data as well. An important limitation in empirical studies is short time span. In such cases, asymptotic arguments would crucially depend on the number of countries tending to infinity (Arellano 2003). Although the sampling period in this paper is sufficiently long (1962-2000), when it is averaged over several years it decreases drastically (for example with five years averages we have only 8 time spans) – as it is common in growth regressions to use time spans of around 5 years averages.[26] Other common problems attributed to panel data like self-selectivity and attrition are not expected to arise.

A standard approach in dynamic panel data estimation in much of the recent literature is to use GMM estimators. Especially to address the common problems in growth models like endogeneity, measurement error and omitted variables problems, the GMM estimator developed by Arellano and Bond (1991) considered to be suitable in panel data estimation. Arellano and Bond suggest an approach based on first differenced generalized method of moments

[26] In some cases there might be once-and-for-all productivity shocks due to sudden shifts in trade structure or any other reason. Averaging the data controls for such movements and avoids to a large extent the potential misleading estimation.

estimator so that permanent unobserved heterogeneity can be removed and lagged levels of the series can be used as instruments for the endogenous or predetermined variables. A problem with the original "difference GMM" estimator is that lagged levels are often poor instruments for first differences (Blundell et al. 2000). Blundell and Bond (1998) show that first-differenced GMM estimators may also be subject to a large downward finite-sample bias when the number of time periods is small. Arellano and Bover (1995) and Blundell and Bond (1998) suggest later a "system GMM" estimator which exploits a further assumption on the initial conditions to obtain moments conditions. Blundell and Bond augment difference GMM estimator by assuming that first differences of instrumental variables are uncorrelated with the fixed effects. This allows introduction of additional instruments and can markedly improve efficiency. They articulate the necessary assumptions for this system estimator more precisely and test it with Monte Carlo simulations. More rigorous survey of these estimators can be found in Blundell, Bond and Windmeijer (2000).

The GMM estimator is considered to be a distinctly strong approach to obtain consistent estimates even in the presence of measurement error and endogenous right-hand side variables (Bond et al. 2001). From endogenous growth theory, some of the variables included as control variables, such as the investment ratio, are endogenous and the use of GMM estimators allows dealing with this endogeneity problem. Consequently, and by taking into consideration the recent developments in the field, the preferred GMM approach will be system GMM estimator.

In this regard, to inspect the association between productivity and export structure, following benchmark equation will be estimated:

$$PD_{it} = \gamma PD_{it-1} + \delta ES_{it} + X_{it}\beta + \alpha_t + \varphi_i + \upsilon_{it} \tag{4.3}$$

Dependent variable PD is the productivity growth. Among the right-hand-side variables, PD_{it-1} is the lag of productivity growth and ES is the diversification index for export structure, whose coefficient is of primary interest. X is a matrix

of control variables with a column β of coefficients. The unobserved country-specific time invariant effects φ_i in the estimation reveal differences in the initial level of efficiency and the time-specific intercepts α_t reflect the productivity changes common to all countries, for whatever reason. As it is common in empirical growth literature, the time series are averaged over several time periods to avoid the short-run effects like short term business-cycle effects and provide enough time for dynamic adjustment.

Although that is a straightforward extension of the specification used in Alcalá and Ciccone (2004), it differs from their model specification. Our specification is a dynamic estimation and it takes the dynamic adjustments into account and thus estimates the model by using panel data, contrary to cross-sectional estimation used in Alcalá and Ciccone (2004). Weinhold and Rauch (1999) also use dynamic panel estimation but their sample covers only 35 developing countries.[27] Their productivity measure was based on labor productivity instead of total factor productivity. Harrigan (1997) also considers a dynamic specification in estimating the joint impacts of factor endowments and level of technology on international specialization.

We use four different definitions of productivity growth and three different measures of export diversification. The alternative definitions of TFP are provided in section 4.4. These include one labor productivity and three TFP measures. Regarding the proxies for the export structure index, three different indexes to be used in estimating the impact of export diversification on productivity are as follows: The Herfindahl Specialization Index (HSI), Within Diversification Index (WDI), and Trade Diversification Index (TDI). The

[27] However they use a LSDV approach instead of a GMM estimator. In a dynamic model, the least squares dummy variable (LSDV) estimator used by Weinhold and Rauch (1999) might still be problematic because estimates are obtained by OLS to a model expressed in deviations from time means may eliminate one possible source of inconsistency (correlation between explanatory variable(s) and unobserved individual effects) but there might be a correlation between demeaned variables (mean error contains observations which are correlated with lag dependent variable) and for small T estimator will be inconsistent. It is in turn the strength of system GMM with small T and large N to produce consistent estimates.

Herfindahl index will be used to measure the overall degree of international trade specialization. This index will help to study the effect of the degree of specialization on productivity. The Herfindahl index is defined as $S_{it} = \sum_{k=1}^{j}\left(x_{it}^{k}/\sum_{k=1}^{j} x_{it}^{k}\right)^{2}$, where x_{it}^{k} is country i's export of good k in year t and j is the total number of industries in the country's economy. The value ranges from zero to one with higher values indicating higher specialization. Two factors that can lead to a lower value of the Herfindahl index: an increase in the number of products or a more even distribution of the shares of the products being exported, or both. The definitions of other two indexes are provided in section 4.3.2.

The main covariates take account of factor endowments and level of technology and include human capital development, capital investments, population in working age, level of infrastructure development,[28] openness, [29] and an indicator for macroeconomic stability.[30] Human capital development is captured by average schooling, capital investments by gross fixed capital investments, and level of infrastructure development by the number of telephone lines per hundred people. Moreover, inflation is considered as a measure of macroeconomic stability and openness is captured by the share of total trade to GDP. Finally, to control for potential impacts associated with higher income levels, we include a dummy variable for OECD countries. Descriptive statistics, correlation matrix and list of countries are given in appendix.

Finally, concerning the dataset, diversification indexes are calculated by using trade flows on 4-digit standard international trade classifications (SITC) which is obtained from World Trade Flows (WTF, UN-NBER) dataset, prepared and

[28] Better infrastructure may increase productivity by reducing the costs of production.

[29] The underlying logic is that more open economies are more likely to benefit from technology diffusion (see, e.g., Edwards 1998).

[30] Harrigan (1997) estimates the neoclassical model of production and finds that technology level and factor endowments are important determinants of patterns of specialization.

updated by Feenstra et al. (2005).[31] The dataset covers the period from 1962 to 2000 with 5-year time intervals, giving 8 time spans. The data for GDP, investment rates, total workforce, and other control variables are obtained from World Development Indicators (WDI) of the World Bank, if not otherwise indicated. Schooling data has been obtained from Barro and Lee (2000).

4.6 FINDINGS

In order to control for the impacts of short-term shocks and other factors contributing to cyclical movements, data has been averaged over 5 and 3-year periods from 1962 to 2000, giving totally 8 and 13 time spans for 83 countries, respectively.[32] We first present the initial findings and then check the robustness of these results by providing the findings obtained under different productivity measures and estimation techniques. In this section, we do not take into account the productivity differences due to levels of development and sectoral heterogeneity. In the next section, we will allow for these impacts and seek to indentify productivity impacts applicable for different levels of development under various industrial classifications.

4.6.1 Initial Findings

The initial estimation results are presented in Table 4.3. They suggest that diversification of export structure has no statistically significant effect on productivity growth. That is true for within diversification, overall diversification and Herfindahl specialization indexes. Thus, neither diversification nor specialization is significantly associated with an improvement

[31] The original trade data of WTF covers more than 150 countries, but in order to minimize the impacts of unusual factors, major oil exporting countries, newly independent central Asian and some east European countries, countries having population less than 500,000, countries reporting on too few product groups in a given year (to avoid the aggregation bias), and countries having long-lasting fatal conflicts (such as Rwanda and Sudan) have been excluded from the dataset.

[32] For 5-year averaged data, the period between 1962 and 1965 is exceptionally averaged over four years in calculating diversification indexes.

in total factor productivity in an economy. This result is contrary to what is originally postulated in this paper; that is, more diversified economies are potentially expected to benefit in terms of higher productivity growths. This proposition finds no empirical support at this stage and it seems that diversifying export structure does not help to discover industries with higher productivity potentials.

A brief discussion on the role and significance of control variables is in order. Empirical studies of cross-sectional growth (e.g., Mankiw, Romer, and Weil 1992) report typically an important role for the investment. Therefore it is probably the most natural one to include into the system estimation. Its level of significance verifies this proposition. Concerning the human capital accumulation, we previously emphasized the role of absorptive capacity in linking the impact of diversification on productivity. This capacity to utilize new production techniques is built up over longer terms, as compared to other control variables; therefore we include the current and previous values of schooling variable to the estimation. The results confirm this approach: lag of schooling positively affects the overall productivity. Fischer (1992) reports robust relationship between inflation and productivity, so we included inflation to the model. An increase in the inflation rate by 100 per cent is associated with a decline in the rate of productivity growth of 0.2 per cent per annum. If the population is growing, then a portion of the economy's investment is used to provide capital for new workers rather than to raise capital per worker. For this reason, a higher population growth rate would have a negative effect on capital per worker. This view has been also confirmed by the estimation results, where the coefficients are negative. Most of the other control variables enter only insignificantly to the system. Inclusion of openness does not seem to affect the findings significantly and this result is in line with the theoretical explanation of Alcalá and Ciccone (2004) where authors argue that higher openness is not necessarily associated with higher labor productivity.

Table 4.3: Productivity Effects of Export Diversification – Initial Findings

	5-Year Averages			3-Year Averages		
	WDI	TDI	HRF	WDI	TDI	HRF
TFP (t-1)	0.280**	0.285**	0.274**	0.154	0.138	0.154
	(2.569)	(2.451)	(2.336)	(1.520)	(0.690)	(0.830)
Diversification	**0.377**	**-3.089**	**-2.212**	**-0.811**	**8.082**	**0.938**
	(0.064)	(-0.336)	(-0.900)	(-0.189)	(0.467)	(0.482)
Investment	11.599***	11.614+	10.998+	10.944***	11.368*	11.223
	(3.125)	(3.586)	(3.519)	(2.804)	(1.770)	(1.542)
Schooling	-0.262	-0.245	-0.255	-8.736**	-8.808*	-8.768
	(-1.347)	(-1.214)	(-1.283)	(-2.346)	(-1.920)	(-1.469)
Schooling (t-1)	0.396*	0.387*	0.374*	8.540+	8.159**	8.716**
	(1.874)	(1.793)	(1.775)	(3.568)	(2.129)	(2.373)
Inflation	-0.002**	-0.002**	-0.002**	-0.004**	-0.004**	-0.004**
	(-2.175)	(-2.031)	(-2.025)	(-2.379)	(-2.492)	(-2.552)
Infrastructure	-0.119	-0.123	-0.098	-0.022	-0.024	-0.018
	(-1.261)	(-1.296)	(-0.944)	(-0.368)	(-0.515)	(-0.428)
Population	-14.809*	-14.494*	-15.538*	-20.493**	-20.129	-20.151
	(-1.774)	(-1.728)	(-1.897)	(-2.385)	(-1.353)	(-1.424)
Openness	0.121	0.122	0.122	0.116	0.118	0.115
	(1.581)	(1.611)	(1.596)	(1.306)	(0.646)	(0.682)
OECD dummy	7.230	6.461	5.867	11.222	8.418	8.546
	(0.641)	(0.565)	(0.450)	(0.908)	(0.617)	(0.882)
Constant	34.265	25.889	56.228	75.740	68.386	67.243
	(0.274)	(0.201)	(0.442)	(0.820)	(0.411)	(0.477)
AR2(p)	0.1811	0.1959	0.2076	0.7945	0.9145	0.8111
Sargan	0.354	0.3386	0.3598	0.6275	0.738	0.6685

Notes: Dependent variable is Total Productivity Growth (TFP1). Diversification is log of respective trade structure index, investment is log of gross fixed capital formation, schooling is percentage of secondary school complete in the total population, inflation is GDP deflator, infrastructure is number of phone subscribers per 100 people, population is log of working age population, openness is ratio of total trade to GDP, and OECD is a dummy for OECD countries. All equations include period dummies. Two-step system GMM estimation results. Windmeijer-corrected robust t-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. Sargan provides the p values for the over-identifying test of Sargan with null hypothesis that the instruments are valid. AR2(p) shows p values for the Arellano-Bond second order autocorrelation test and it is required not to reject the test.

At this stage, we additionally estimate the same by using non-overlapping 3-year averages of the data. The findings are reported in the last three columns of Table 4.3. The results do not change significantly. A diversified or specialized export structure again has no statistically significant impact on productivity growth. OECD dummy becomes significant in certain cases, which controls for productivity improvements associated with higher income levels. Initial results, therefore, suggest no significant relationship between export structure and productivity. We now check the robustness of these results to alternative productivity measures and estimation techniques.

4.6.2 Robustness Checks

At this stage, we continue estimating the significance of export diversification by using the aggregated data and neglect the potential impacts for countries at different income levels and for different industries. We test the robustness of the initial results across productivity measures and estimation techniques. Table 4.4 and 4.5 provide the results for alternative productivity measures and Table 4.6 provides the results obtained from alternative estimation methods. Table 4.4 reports the outcomes under alternative productivity measures estimated with 5-year averages and Table 4.5 reports the outcomes with 3-year averages.

The findings reported in Table 4.4 confirm the previous results and we obtain no statistically significant outcome on the impact of export diversification on productivity growth. Only statistically significant result is reported in Table 4.5, under labor productivity measure; however, in this estimation, hypothesis of no second order autocorrelation is rejected. The GMM estimator is not consistent if there is second-order serial correlation in the error term of the first-differenced equation.[33] Thus, using alternative productivity measures does not alter the initial findings on the relationship between diversification and productivity.

[33] Note that the full disturbance is presumed autocorrelated as it contains fixed effects and the estimators are designed to eliminate this source of trouble. But if the idiosyncratic disturbance term is serially correlated of order 1, we need to restrict the instrument set to deeper lags.

Table 4.4: Impacts of Diversification on Productivity – Alternative Productivity Measures (5-Year Averages)

Productivity:	TFP2			TFP3			LP		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Productivity (t-1)	0.327***	0.330***	0.316***	0.327***	0.327***	0.317***	0.302**	0.302**	0.291**
	(3.157)	(3.059)	(2.965)	(3.015)	(2.937)	(2.845)	(2.219)	(2.270)	(2.128)
Diversification	**0.718**	**0.715**	**-2.998**	**0.749**	**2.685**	**-3.032**	**0.005**	**0.111**	**-0.011**
	(0.120)	(0.070)	(-1.180)	(0.121)	(0.257)	(-1.155)	(0.101)	(1.229)	(-0.416)
Investment	10.47***	10.71***	10.094+	8.597**	8.812**	8.191**	0.162+	0.159+	0.159+
	(2.806)	(3.200)	(3.343)	(2.165)	(2.434)	(2.545)	(5.172)	(5.192)	(5.255)
Schooling	-0.51***	-0.53***	-0.51***	-0.500**	-0.522**	-0.51***	-0.001	-0.001	-0.001
	(-2.649)	(-2.606)	(-2.674)	(-2.542)	(-2.494)	(-2.619)	(-0.745)	(-0.827)	(-0.666)
Schooling (t-1)	0.260	0.249	0.254	0.266	0.246	0.263	0.001	0.001	0.001
	(0.953)	(0.830)	(0.912)	(0.962)	(0.829)	(0.948)	(0.921)	(0.776)	(0.935)
Inflation	-0.002**	-0.003**	-0.002***	-0.003***	-0.003***	-0.003***	-0.000	-0.000	-0.000
	(-2.473)	(-2.450)	(-2.637)	(-2.971)	(-2.998)	(-3.186)	(-1.132)	(-0.987)	(-1.197)
Infrastructure	-0.039	-0.044	-0.025	-0.029	-0.031	-0.011	0.000	0.000	-0.000
	(-0.403)	(-0.445)	(-0.255)	(-0.281)	(-0.302)	(-0.108)	(0.054)	(0.137)	(-0.062)
Population	-6.416	-6.612	-8.613	-5.547	-5.679	-7.731	-0.195**	-0.189**	-0.19***
	(-0.768)	(-0.843)	(-1.118)	(-0.657)	(-0.717)	(-1.021)	(-2.508)	(-2.424)	(-2.578)
Openness	0.194***	0.198***	0.191***	0.205***	0.209***	0.200***	0.000	0.000	0.000
	(2.876)	(3.044)	(2.921)	(2.915)	(3.042)	(2.947)	(0.483)	(0.320)	(0.352)
OECD	11.228	11.759	8.533	10.046	10.684	7.542	-0.085	-0.057	-0.075
	(1.011)	(1.119)	(0.677)	(0.952)	(1.069)	(0.623)	(-0.474)	(-0.326)	(-0.407)
Constant	-111.24	-113.15	-66.299	-88.968	-90.679	-43.795	0.468	0.457	0.493
	(-0.846)	(-0.897)	(-0.511)	(-0.700)	(-0.744)	(-0.357)	(0.346)	(0.345)	(0.366)
AR2(p)	0.3855	0.4065	0.4176	0.3729	0.3923	0.4168	0.4274	0.39	0.4321
Sargan	0.6262	0.5767	0.7122	0.4062	0.372	0.4966	0.3581	0.3199	0.2805

Notes: System GMM estimation results obtained from 5-years averages. Definitions of alternative productivity measures are provided in Table 4.2. All equations include period dummies. Two-step system GMM estimation results. Windmeijer-corrected robust t-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. Sargan provides the p values for the over-identifying test of Sargan with null hypothesis that the instruments are valid. AR2(p) shows p values for the Arellano-Bond second order autocorrelation test and it is required not to reject the test.

Table 4.5: Impacts of Diversification on Productivity – Alternative Productivity Measures (3-Years Averages)

Productivity:	TFP2			TFP3			LP		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Productivity (t-1)	0.151**	0.16***	0.16***	0.144**	0.151**	0.142**	0.014**	0.014**	0.016**
	(2.565)	(2.580)	(2.687)	(2.491)	(2.522)	(2.096)	(2.173)	(2.060)	(2.208)
Diversification	**0.876**	**4.454**	**0.416**	**0.927**	**6.070**	**0.485**	**-0.041**	**0.141***	**0.002**
	(0.163)	(0.496)	(0.239)	(0.128)	(0.614)	(0.336)	(-1.128)	(1.744)	(0.157)
Investment	8.330*	8.442*	6.370	7.804	7.980	8.253	0.123+	0.114+	0.110+
	(1.755)	(1.883)	(1.598)	(1.123)	(1.224)	(1.128)	(4.722)	(4.494)	(4.157)
Schooling	-6.88+	-7.19+	-7.09+	-6.41***	-6.73***	-6.62+	0.000	-0.006	0.001
	(-3.367)	(-3.394)	(-3.485)	(-3.172)	(-3.287)	(-3.478)	(0.012)	(-0.239)	(0.032)
Schooling (t-1)	4.323*	4.621**	4.705*	3.990	4.264*	3.716	-0.032	-0.028	-0.032
	(1.829)	(2.075)	(1.774)	(1.511)	(1.935)	(1.485)	(-1.384)	(-1.228)	(-1.285)
Inflation	-0.004*	-0.004*	-0.004*	-0.004	-0.004	-0.004	-0.000**	-0.000**	-0.000**
	(-1.736)	(-1.840)	(-1.854)	(-1.410)	(-1.389)	(-1.353)	(-2.126)	(-2.355)	(-2.052)
Infrastructure	-0.058	-0.054	-0.048	-0.048	-0.046	-0.059	-0.000	0.000	0.000
	(-0.817)	(-0.960)	(-0.839)	(-0.766)	(-0.820)	(-0.961)	(-0.260)	(0.391)	(0.125)
Population	-8.851	-9.522	-6.669	-8.735	-9.647	-9.143	-0.14+	-0.13***	-0.12***
	(-0.677)	(-0.826)	(-0.679)	(-0.445)	(-0.513)	(-0.368)	(-3.357)	(-2.953)	(-2.643)
Openness	0.132	0.123	0.135*	0.128	0.117	0.124	0.001	0.000	0.000
	(1.284)	(1.289)	(1.952)	(0.968)	(0.869)	(0.888)	(0.824)	(0.391)	(0.468)
OECD	2.330	4.504	5.293	2.343	5.074	4.829	-0.067	-0.052	-0.082
	(0.177)	(0.639)	(1.138)	(0.151)	(0.505)	(0.361)	(-0.864)	(-0.975)	(-1.184)
Constant	-34.396	-24.789	-27.242	-25.203	-11.985	-25.412	-0.545	-0.304	-0.454
	(-0.274)	(-0.229)	(-0.287)	(-0.142)	(-0.067)	(-0.099)	(-1.187)	(-0.569)	(-1.016)
AR2(p)	0.9223	0.9429	0.8325	0.9168	0.9515	0.9394	0.037	0.0369	0.0315
Sargan	0.4703	0.483	0.6198	0.5012	0.5384	0.5792	0.745	0.6763	0.6554

Notes: Two step system GMM estimation results obtained from 3-years averages. Definitions of alternative productivity measures are provided in Table 4.2. All equations include period dummies. Windmeijer WC-robust t-statistics are in parenthesis. The significance of coefficients are denoted as: *: p<.10, **: p<.05, ***: p<.01. Sargan provides the p values for the over-identifying test of Sargan with null hypothesis that the instruments are valid. AR2(p) shows p values for the Arellano-Bond second order autocorrelation test and it is required not to reject.

Table 4.6: Impacts of Diversification on Productivity – Alternative Estimation Methods (5-Years Averages)

Est. Method:	Difference GMM			FE with AR(1)			FGLS with AR(1)		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Productivity (t-1)	0.211*	0.218*	0.207*						
	(1.890)	(1.819)	(1.779)						
Diversification	**-0.138**	**-1.502**	**-2.263**	**-3.820**	**5.421**	**-0.438**	**0.068**	**4.730**	**-0.397**
	(-0.025)	(-0.162)	(-1.023)	(-1.444)	(0.636)	(-0.271)	(0.051)	(1.270)	(-0.495)
Investment	13.63+	13.62+	13.35+	8.333+	7.53***	7.47***	1.230	1.274*	1.101
	(3.486)	(3.708)	(3.753)	(3.459)	(3.193)	(3.125)	(1.425)	(1.736)	(1.360)
Schooling	-0.270	-0.253	-0.277	-0.317*	-0.346*	-0.333*	-0.32**	-0.34**	-0.32**
	(-1.519)	(-1.389)	(-1.565)	(-1.770)	(-1.920)	(-1.853)	(-2.268)	(-2.362)	(-2.274)
Schooling (t-1)	0.360*	0.356*	0.352*	0.138	0.125	0.138	0.343**	0.336**	0.341**
	(1.743)	(1.726)	(1.741)	(0.800)	(0.717)	(0.794)	(2.251)	(2.200)	(2.238)
Inflation	-0.002**	-0.002**	-0.002**	-0.003*	-0.003*	-0.003*	-0.005***	-0.005***	-0.005***
	(-2.399)	(-1.999)	(-2.180)	(-1.868)	(-1.907)	(-1.873)	(-2.925)	(-2.967)	(-2.919)
Infrastructure	-0.097	-0.093	-0.060	-0.080	-0.052	-0.052	-0.091*	-0.084*	-0.089*
	(-0.708)	(-0.674)	(-0.437)	(-1.199)	(-0.789)	(-0.761)	(-1.822)	(-1.682)	(-1.779)
Population	-17.715	-17.815	-18.372	-11.42***	-9.59***	-9.87***	0.772	0.915	0.780
	(-1.161)	(-1.122)	(-1.196)	(-3.181)	(-2.719)	(-2.842)	(0.841)	(1.038)	(0.876)
Openness	0.106	0.105	0.108	0.099*	0.085	0.084	0.038	0.042*	0.037
	(1.345)	(1.345)	(1.373)	(1.731)	(1.517)	(1.496)	(1.626)	(1.792)	(1.565)
OECD	13.017*	13.319*	12.953*	0.785	1.195	0.517	1.165	2.397	0.913
	(1.787)	(1.751)	(1.719)	(0.137)	(0.204)	(0.090)	(0.529)	(1.011)	(0.403)
Constant	45.945	47.717	58.933	42.258	30.031	33.403	-39.86***	-41.82+	-38.18***
	(0.150)	(0.152)	(0.193)	(0.891)	(0.633)	(0.708)	(-2.954)	(-3.626)	(-3.093)
AR2(p)	0.1151	0.1164	0.1276						
	0.1297	0.1266	0.1564						

Notes: System GMM estimation results obtained from 5-years averages. Productivity measure is TFP1. Difference GMM is computed by the two step estimator. Fixed effect estimation with an AR(1) disturbance is estimated by using two step estimation of correlation. All equations include period dummies. T-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. AR2(p) shows p values for the Arellano-Bond second order autocorrelation test and it is required not to reject the test.

In search of alternative estimation techniques, we conduct several specification tests, which include the Breusch and Pagan Lagrangian multiplier test for random effects and Wooldridge test for serial correlation in panel-data models. According to the test results, the null hypothesis of random effects and is no first-order autocorrelation are rejected. Under these outcomes, we implement fixed effect model with AR(1) disturbances. We additionally run the fixed effect regression and test the results for heteroscedasticity using the Wald test for groupwise heteroscedasticity, which rejects the null hypothesis of constant variance. Therefore, we additionally adopted feasible generalized least squares (FGLS) estimation technique that can deal with heteroscedasticity and serial correlation in panels.

As a result, in order to test the sensitivity of the results to the estimation methodology, we alternatively use difference GMM, fixed effect estimation with an AR(1) disturbance and feasible generalized least square method in the presence of AR(1) autocorrelation within panels. Once again, using alternative estimation methods does not alter the initial findings: diversification has no statistically significant impact on productivity growth (Table 4.6).

4.7 EXTENSIONS

Aggregation of sectors and countries with different income levels apparently provide no significant relationship between diversification and aggregate productivity growth. We explored the impacts for both agricultural and manufacturing industries together, without paying attention to diversities that these two sectors can contribute to aggregate productivity. It may be more instructive to examine the impacts of sectoral diversification separately. We also did not distinguish between income levels of countries and ignore the capacity to increase productivity under better economic circumstances. In this section, we investigate the linkage for different sectors and income levels.

In what follows, we first categorize all industries into two groups: manufacturing and agricultural industries. Then we further disaggregate the data

to provide the best possible evidence on the relationship between export structure and productivity growth. The details of classification are provided in Table 4.7.

Table 4.7: Sectoral Disaggregation

Industry Groups	Sectoral Disaggregation	SITC Codes
Agricultural and Mining Industries	1. Food and Live Animals Chiefly for Food + Animal and Vegetable Oils, Fats and Waxes	00-09, 40-49
	2. Beverages And Tobacco	10-19
	3. Crude Materials, Inedible + Mineral Fuels, Lubricants and Related Materials	20-39
Manufacturing Industries	4. Chemicals and Related Products	50-59
	5. Manufactured Goods Classified Chiefly by Material	60-69
	6. Machinery and Transport Equipment	70-79
	7. Miscellaneous Manufactured Articles (incl. scientific and optical goods, furniture etc.)	80-89

Finally, in grouping the countries according to their income levels, we use the classification method of the World Bank. According to this method, countries with per capital income below $975 are considered as low income countries, with per capita income between $976 and $3,855 are lower-middle income countries, with per capita income between $3,856 and $11,905 are upper-middle income countries and finally with per capita income more than $11,906 are considered high income countries.

4.7.1 Sectoral Investigation

By pooling agricultural and manufacturing industries, we failed to detect any significant relationship between diversification and productivity growth. However, the rate of productivity growth can be different in each sector and that may cancel out the aggregate impact, which can be an explanation for zero effect. In line with this proposition, Martin and Mitra (2001) find different the rate of productivity growth in agricultural and manufacturing industries. In

reporting the findings in this section, we ignore the control variables due to space limitations.

Table 4.8: Impacts of Diversification on Productivity – Agricultural Industries (5-Years Averages)

Productivity:	TFP1			TFP2			TFP3		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Diversification	1.299	2.763	-1.715	1.349	2.364	-2.264	1.382	2.038	-2.105
	(0.522)	(0.586)	(-0.777)	(0.433)	(0.403)	(-0.963)	(0.429)	(0.346)	(-0.887)
AR2(p)	0.193	0.1693	0.2104	0.4022	0.3848	0.4186	0.389	0.3738	0.4137
Est. Method:	Difference GMM			FE with AR(1)			FGLS with AR(1)		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Diversification	1.940	1.327	-2.453	-1.619	-2.450	-0.445	-0.002	-0.353	0.302
	(0.773)	(0.287)	(-1.097)	(-0.575)	(-0.420)	(-0.220)	(-0.002)	(-0.105)	(0.343)
Impacts of Diversification on Productivity – Agricultural Industries (3-Years Averages)									
Productivity:	TFP1			TFP2			TFP3		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Diversification	0.405	6.873	1.756	2.799	3.734	0.494	2.476	3.977	0.699
	(0.100)	(1.031)	(0.793)	(0.728)	(0.425)	(0.176)	(0.663)	(0.427)	(0.309)
AR2(p)	0.8069	0.8344	0.8114	0.9167	0.9206	0.944	0.9001	0.9244	0.9415
Est. Method:	Difference GMM			FE with AR(1)			FGLS with AR(1)		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Diversification	-0.128	5.140	2.748	-2.672*	-0.994	2.176*	-1.029	0.423	0.760
	(-0.045)	(1.100)	(1.523)	(-1.776)	(-0.341)	(1.914)	(-1.545)	(0.225)	(1.486)

Notes: System GMM estimation results obtained from 3 and 5-years averages. Definitions of alternative productivity measures are provided in Table 4.2. All equations include period dummies. Two-step system GMM estimation results. Windmeijer WC-robust t-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. AR2(p) shows p values for the Arellano-Bond second order autocorrelation test and it is required not to reject the test.

Table 4.8 reports the findings for agricultural and mining industries. The silence of export structure persists for agricultural and mining industries. In these industries, export specialization and diversification have typically no impact on productivity growth. Only significant outcome is obtained from fixed effect

estimation for the WDI and Herfindahl specialization index by using 3-years averages, according to which higher specialization spurs productivity growth in agricultural and mining industries, but higher within-diversification reduces productivity benefits.

Table 4.9: Impacts of Diversification on Productivity – Manufacturing Industries (5-Years Averages)

Productivity:	TFP1			TFP2			TFP3		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Diversification	-4.81**	-1.082	-2.829	-4.72**	0.838	-3.054	-5.19**	3.202	-3.067
	(-2.200)	(-0.106)	(-1.449)	(-2.072)	(0.075)	(-1.531)	(-2.229)	(0.301)	(-1.406)
AR2(p)	0.2045	0.192	0.2222	0.4036	0.4135	0.496	0.3962	0.3986	0.4749
Est. Method:	Difference GMM			FE with AR(1)			FGLS with AR(1)		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Diversification	-6.55***	-1.157	-3.005	-3.001**	8.863	-1.624	-1.691*	4.649*	-0.613
	(-2.667)	(-0.103)	(-1.642)	(-2.076)	(1.244)	(-1.162)	(-1.926)	(1.702)	(-0.852)
Impacts of Diversification on Productivity – Manufacturing Industries (3-Years Averages)									
Productivity:	TFP1			TFP2			TFP3		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Diversification	-1.771	-3.569	0.831	-2.05**	-1.333	0.667	-2.04**	-1.583	0.777
	(-1.208)	(-1.096)	(0.514)	(-1.971)	(-0.261)	(0.333)	(-2.051)	(-0.347)	(0.388)
AR2(p)	0.9123	0.7811	0.817	0.9469	0.9669	0.9319	0.9554	0.9568	0.9304
Est. Method:	Difference GMM			FE with AR(1)			FGLS with AR(1)		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Diversification	-1.162	-3.473	1.393	-1.23**	0.038	1.177	-0.80**	-0.082	0.545
	(-1.475)	(-1.389)	(1.040)	(-2.095)	(0.021)	(1.295)	(-2.103)	(-0.095)	(1.197)

Notes: System GMM estimation results obtained from 3 and 5-years averages. All equations include period dummies. Two-step system GMM estimation results. Windmeijer WC-robust t-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. AR2(p) shows the p values for the Arellano-Bond second order autocorrelation test and it is required not to reject the test.

Regarding the manufacturing industries, we obtain relatively promising results (Table 4.9). While no particular significant impacts of TDI and Herfindahl indexes are found, impacts of WDI is found to be pretty significant. On average, within diversification is found to be negatively associated with productivity growth and this is confirmed by all estimators under different productivity measures. One per cent reduction in within-diversification in manufacturing industries boosts the productivity growth by about five per cent.

These findings are largely verified by the data averaged over 3-years. The negative relationship between within-diversification and productivity growth apparently requires further investigation to understand why within diversification in fact reduces the productivity growth. Higher within-diversification seems to be not a source of successful discoveries and lower income countries may be involved in causing such an outcome. In what follows, we study the impact at sectoral level and for different income groups to get a better grasp of this impact.

Finally, Table 4.10 reports the findings for seven different sectoral classifications. Even in that case, system GMM estimation technique provides no significant results, except for sector 7. In sector 7, within-diversification appears to be negatively correlated with productivity growth. One per cent increase in WDI reduces the productivity growth more than 3%. It appears that the negative impact of within diversification on productivity growth in manufacturing industries comes to a large extent from sector 7. Under total factor productivity measure TFP3, SGMM estimation indicates that lower specialization in sector 7 might boost productivity growth. Fixed effect estimation yields additional significant outcomes and it indicates that overall specialization improves productivity in sector 4. It additionally provides negative impact of within-diversification in sector 5.

Table 4.10: Impacts of Diversification on Productivity – Sectoral Disaggregation (5-Years Averages)

Productivity - Est.:	TFP1 - SGMM			TFP3 - SGMM			TFP1 - FEAR		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Sector 1	Food and Live Animals Chiefly for Food + Animal and Vegetable Oils, Fats and Waxes								
Diversification	-1.189	-2.861	0.094	-0.416	1.161	-1.049	0.966	-2.506	-3.244
	(-0.490)	(-0.287)	(0.038)	(-0.139)	(0.116)	(-0.440)	(0.524)	(-0.307)	(-1.401)
Sector 2	Beverages And Tobacco								
Diversification	-0.561	-1.354	2.630	-0.103	-1.404	2.683	-0.737	0.203	2.989
	(-0.697)	(-0.301)	(0.895)	(-0.127)	(-0.281)	(0.847)	(-1.034)	(0.063)	(1.551)
Sector 3	Crude Materials, Inedible + Mineral Fuels, Lubricants and Related Materials								
Diversification	-0.964	4.464	3.028	-1.143	4.050	2.957	-0.448	-0.247	2.070
	(-0.581)	(1.389)	(1.569)	(-0.649)	(1.027)	(1.612)	(-0.279)	(-0.071)	(1.221)
Sector 4	Chemicals and Related Products								
Diversification	-1.295	5.004	0.359	-1.426	10.044	1.174	-1.827	5.622	3.07**
	(-0.576)	(0.539)	(0.174)	(-0.673)	(1.102)	(0.496)	(-1.650)	(1.183)	(1.999)
Sector 5	Manufactured Goods Classified Chiefly by Material								
Diversification	-2.092	-5.156	1.740	-1.564	1.799	1.844	-1.945	2.557	1.272
	(-0.848)	(-0.578)	(0.879)	(-0.509)	(0.181)	(0.799)	(-1.371)	(0.349)	(0.796)
Sector 6	Machinery and Transport Equipment								
Diversification	-1.690	2.465	0.109	-1.062	3.112	-1.027	-1.368	5.653	0.258
	(-1.327)	(0.384)	(0.072)	(-0.749)	(0.465)	(-0.758)	(-1.379)	(1.273)	(0.225)
Sector 7	Miscellaneous Manufactured Articles (incl. scientific and optical goods, furniture etc.)								
Diversification	-3.11**	2.756	-3.361	-3.032*	2.527	-4.74**	-1.99**	10.88**	0.172
	(-1.998)	(0.470)	(-1.597)	(-1.827)	(0.416)	(-2.144)	(-2.136)	(2.239)	(0.118)

Notes: System GMM (SGMM) and Fixed effect with AR(1) (FEAR) estimation results obtained from 5-years averages. All equations include period dummies. T-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. The Arellano-Bond second order autocorrelation tests are not rejected in system GMM estimations, so not reported.

4.7.2 Stages of Development

Though on average diversification has no impact on productivity growth, the impact for groups of countries at different stages of development may be well different. In this section, we first reexamine the relationship with aggregated data, then for different industrial categories. We found in the previous section that in manufacturing industries, higher within-diversification may reduce overall productivity growth and that is likely to be the case especially for sector 7.

In investigating the relationship between diversification and productivity for countries at different income levels, we first provide the findings for all industries, then for broadly categorized agricultural and manufacturing industries and finally for seven different sectoral classifications. Due to space restriction, estimations obtained only from 5-years averages are presented. Table 4.11 presents the findings for all industries with data over 5-years averages.

Findings from system GMM estimation for all industries reveal no significant impact for any income group and that is true for alternative definitions of productivity (there are significant results under alternative estimation methods, but we ignore them as they are not verifies by at least another estimator). Irrespective of the degree of the development, aggregated data indicates that countries do not benefit in terms of productivity returns from overall diversification or specialization. Each sector naturally enjoys its own dynamics in generating productivity impact. This emphasizes the fact that different industries should be considered separately so that to understand the dynamics within each industry. Therefore, we now investigate the linkages for different industries and industry groups.

Table 4.11: Impacts of Diversification on Productivity for Different Income Levels – All Industries

Productivity:	TFP1			TFP2			TFP3		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Low Income	1.109	0.801	-0.469	0.522	2.665	-1.095	0.667	3.305	-1.308
	(0.394)	(0.111)	(-0.187)	(0.210)	(0.409)	(-0.439)	(0.251)	(0.473)	(-0.516)
Lower Middle Income	-3.646	-8.237	-1.775	-4.448	-6.084	-2.076	-3.839	-5.667	-2.062
	(-0.907)	(-0.730)	(-0.802)	(-1.317)	(-0.601)	(-0.944)	(-1.076)	(-0.541)	(-0.892)
Upper Middle Income	2.723	2.046	-0.726	-0.399	4.297	-1.390	0.431	4.214	-1.372
	(0.314)	(0.227)	(-0.455)	(-0.052)	(0.369)	(-0.660)	(0.054)	(0.353)	(-0.639)
High Income	-0.441	-3.485	-1.458	-5.271	-3.166	-2.559	-4.177	-3.015	-2.413
	(-0.069)	(-0.592)	(-1.133)	(-0.802)	(-0.413)	(-1.488)	(-0.623)	(-0.389)	(-1.438)
AR2(p)	0.2123	0.2219	0.2757	0.4928	0.4317	0.4997	0.496	0.4344	0.506
Productivity:	Difference GMM			FE with AR(1)			FGLS with AR(1)		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Low Income	1.700	3.243	-0.776	-1.833	-0.400	0.168	0.719	-3.125	-1.254
	(0.731)	(0.508)	(-0.331)	(-0.950)	(-0.060)	(0.092)	(0.598)	(-0.613)	(-1.401)
Lower Middle Income	-3.944	-3.427	-1.911	-6.35**	6.004	0.106	-0.280	5.085	-0.202
	(-0.937)	(-0.271)	(-0.947)	(-2.208)	(0.773)	(0.068)	(-0.196)	(1.042)	(-0.248)
Upper Middle Income	1.208	5.329	-1.139	-5.159	5.670	0.021	-0.623	6.980*	0.100
	(0.142)	(0.615)	(-0.655)	(-1.430)	(0.756)	(0.014)	(-0.323)	(1.723)	(0.129)
High Income	-2.027	-1.833	-1.882	-6.475	2.757	-0.392	-4.050	6.504*	0.209
	(-0.302)	(-0.294)	(-1.236)	(-1.132)	(0.376)	(-0.249)	(-1.051)	(1.784)	(0.240)
AR2(p)	0.1593	0.1599	0.2131						

Notes: Table presents the estimation results obtained from 5-years averages for all industries. Definitions of alternative productivity measures are provided in Table 4.2. All equations include period dummies. T-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. AR2(p) shows the p values for the Arellano-Bond second order autocorrelation test and it is required not to reject the test.

4.7.2.1 Agricultural Industries

By broadly categorizing the industries under agricultural and manufacturing industries, we seek to identify the productivity impacts of export structure for countries with different income groups. Yet again, in agricultural and mining industries countries at different development stages seem to gain no

productivity benefits from sophisticated or simplified trade structure (Table 4.12). None of the estimation techniques provide statistically significant results on the impact of export diversification on productivity growth. This result tempts us to argue that in agricultural industries, there is no productivity effect of export diversification but we will study the impact under further categorization of industries before making any conclusion.

Table 4.12: Impacts of Diversification on Productivity for Different Income Levels – Agricultural Industries

Productivity:	TFP1			TFP2			TFP3		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Low Income	1.027	1.694	-0.168	1.088	3.385	-1.628	1.180	3.612	-1.399
	(0.561)	(0.310)	(-0.057)	(0.605)	(0.704)	(-0.579)	(0.603)	(0.704)	(-0.496)
Lower Middle Income	-1.036	-3.149	-1.647	-1.837	-2.821	-2.200	-1.258	-1.876	-1.718
	(-0.419)	(-0.444)	(-0.763)	(-0.774)	(-0.407)	(-0.918)	(-0.511)	(-0.261)	(-0.703)
Upper Middle Income	6.606	9.453	-0.625	5.877	9.012	-1.162	6.009	9.680	-1.010
	(1.428)	(0.883)	(-0.369)	(1.183)	(0.635)	(-0.518)	(1.176)	(0.671)	(-0.457)
High Income	1.070	-2.227	-1.545	-0.234	-3.535	-2.508	0.060	-3.149	-2.273
	(0.357)	(-0.531)	(-1.059)	(-0.073)	(-0.550)	(-1.259)	(0.017)	(-0.517)	(-1.193)
AR2(p)	0.1988	0.1914	0.2978	0.4051	0.3952	0.4967	0.404	0.3893	0.5127
Productivity:	Difference GMM			FE with AR(1)			FGLS with AR(1)		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Low Income	1.633	3.276	-1.579	-0.668	-2.608	0.041	0.154	-3.073	-0.607
	(1.039)	(0.678)	(-0.536)	(-0.351)	(-0.467)	(0.018)	(0.148)	(-0.814)	(-0.558)
Lower Middle Income	-0.358	-0.107	-2.484	-3.332	-3.272	0.170	0.275	1.158	0.362
	(-0.138)	(-0.014)	(-1.114)	(-1.234)	(-0.484)	(0.082)	(0.234)	(0.296)	(0.367)
Upper Middle Income	6.710	10.162	-1.282	-1.429	0.470	0.304	1.090	4.575	0.574
	(1.429)	(0.984)	(-0.690)	(-0.427)	(0.060)	(0.160)	(0.607)	(1.099)	(0.620)
High Income	1.131	-2.836	-2.216	-2.972	-2.967	-0.097	-0.042	3.079	0.843
	(0.419)	(-0.590)	(-1.294)	(-0.760)	(-0.370)	(-0.053)	(-0.015)	(0.684)	(0.794)
AR2(p)	0.1443	0.1378	0.2236						

Notes: Table presents the estimation results obtained from 5-years averages for agricultural industries. All equations include period dummies. T-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. AR2(p) shows p values for the Arellano-Bond second order autocorrelation test.

Table 4.13: Impacts of Diversification on Productivity for Different Income Levels – Sectoral Disaggregation of Agricultural Industries

Productivity:	TFP1 - SGMM			TFP3 - SGMM			TFP1 - FEAR		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Sector 1	Food and Live Animals Chiefly for Food + Animal and Vegetable Oils, Fats and Waxes								
Low Income	0.813	0.564	-0.614	0.990	2.426	-0.894	0.489	-2.865	-2.122
	(0.722)	(0.098)	(-0.333)	(0.793)	(0.438)	(-0.450)	(0.371)	(-0.492)	(-0.921)
Lower Middle Income	-3.294	-8.675	0.583	-3.067	-6.492	-0.026	-3.396	-3.835	-1.316
	(-1.482)	(-0.792)	(0.228)	(-1.318)	(-0.612)	(-0.010)	(-1.580)	(-0.499)	(-0.579)
Upper Middle Income	2.768	2.042	0.959	3.401	5.585	0.175	-1.861	0.931	-1.020
	(0.556)	(0.141)	(0.373)	(0.575)	(0.361)	(0.062)	(-0.617)	(0.108)	(-0.453)
High Income	-3.812	-0.150	-0.897	-1.252	0.061	-1.834	-2.664	0.725	-1.442
	(-0.742)	(-0.019)	(-0.464)	(-0.204)	(0.007)	(-0.835)	(-0.736)	(0.088)	(-0.634)
Sector 2	Beverages and Tobacco								
Low Income	-0.486	1.336	2.583	-0.446	2.187	3.454	-0.247	3.640	4.006
	(-1.232)	(0.362)	(1.097)	(-1.150)	(0.495)	(1.262)	(-0.551)	(1.102)	(1.399)
Lower Middle Income	-1.871*	-7.546	1.405	-1.807*	-5.711	0.955	-1.116	-1.323	3.851
	(-1.916)	(-1.045)	(0.377)	(-1.727)	(-0.824)	(0.236)	(-1.574)	(-0.339)	(1.586)
Upper Middle Income	-0.089	6.555	7.955	-0.907	6.946	9.140	0.047	-0.028	6.164*
	(-0.066)	(0.514)	(1.616)	(-0.598)	(0.516)	(1.297)	(0.043)	(-0.006)	(1.900)
High Income	-1.277	4.293	1.311	-3.259*	5.877	1.354	0.045	-0.268	-0.365
	(-0.913)	(0.591)	(0.386)	(-1.871)	(0.780)	(0.378)	(0.029)	(-0.049)	(-0.109)
Sector 3	Crude Materials, Inedible + Mineral Fuels, Lubricants and Related Materials								
Low Income	0.820	2.999	2.232	0.928	4.446	1.750	0.406	-0.170	1.018
	(0.543)	(0.724)	(0.754)	(0.672)	(1.123)	(0.720)	(0.286)	(-0.040)	(0.437)
Lower Middle Income	-3.549*	2.493	3.554*	-2.525	3.043	3.223*	-1.865	1.058	2.936
	(-1.752)	(0.464)	(1.760)	(-1.442)	(0.528)	(1.697)	(-1.040)	(0.218)	(1.536)
Upper Middle Income	0.656	8.145	2.861	1.308	10.142	2.775	-1.738	0.829	2.045
	(0.209)	(1.241)	(1.287)	(0.278)	(0.967)	(1.326)	(-0.755)	(0.160)	(1.055)
High Income	-1.286	-3.993	0.711	-1.779	-4.656	0.329	-3.547	-5.308	1.033
	(-0.549)	(-1.374)	(0.430)	(-0.507)	(-1.137)	(0.194)	(-1.333)	(-0.833)	(0.523)

Notes: System GMM (SGMM) and Fixed effect with AR(1) (FEAR) estimation results obtained from 5-years averages. All equations include period dummies. T-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. The Arellano-Bond second order autocorrelation tests

As provided in Table 4.7, we defined three sectors under agricultural and mining industries. The estimation results for each of these sectors reveal finally significant outcomes (Table 4.13). System GMM estimation for two different TFP measures yields that lower-middle income countries suffer from higher within-diversification in sector 2 (beverages and tobacco). While 1% increase in WDI index reduces the productivity growth in lower-middle income countries by about 2%, high income countries suffer productivity losses up to 3,3% with higher within-diversification. Fixed effect estimation additionally provides significant productivity gains for upper-middle income countries if they raise the level of specialization in sector 2. Regarding the sector 3, the impacts are all about lower-income countries. They tend to suffer from higher within diversification and benefit from higher specialization with around 3% increase in productivity in that sector.

4.7.2.2 Manufacturing Industries

Manufacturing industries naturally preserve a better prospective in affecting the productivity growth. Much of the learning-by-doing, learning-by-exporting, or technological spillovers take place in manufacturing industries, as they hold much capability to improve productivity through successful discoveries. The findings do not directly confirm this proposition (Table 4.14). Much of the impact takes place yet again with respect to the within-diversification of exports. The main result is that the low and lower-middle income countries suffer productivity impairments if they seek to within-diversify their exports. 1% increase in the WDI index is associated with about 2.8% productivity losses in overall manufacturing industries of low income countries and more than 5% in that of lower-middle income countries. While not confirmed by other estimators, FGLS approach indicates that upper-middle income and high income countries may obtain productivity gains if they export more specialized goods. At the next step, we attempt to identify the sectors that may contribute to productivity changes in total manufacturing industries and investigate the same impact for four different sectoral classifications of manufacturing industries.

Table 4.14: Impacts of Diversification on Productivity for Different Income Levels – Manufacturing Industries

Productivity:	TFP1			TFP2			TFP3		
Diversificatn:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Low Income	-2.88**	2.022	-0.881	-2.77**	2.387	-0.862	-2.86**	3.096	-1.031
	(-2.01)	(0.304)	(-0.619)	(-1.983)	(0.385)	(-0.576)	(-1.993)	(0.477)	(-0.649)
Lower Middle I.	-5.98***	-8.959	-2.637	-5.35**	-9.139	-2.797	-5.09**	-9.450	-2.791
	(-2.99)	(-0.757)	(-1.328)	(-2.526)	(-0.827)	(-1.433)	(-2.300)	(-0.829)	(-1.346)
Upper Middle I.	-1.075	1.272	-1.827	-1.930	1.224	-2.249	-1.525	1.356	-2.166
	(-0.19)	(0.127)	(-0.955)	(-0.347)	(0.107)	(-0.998)	(-0.265)	(0.114)	(-0.942)
High Income	-1.993	-2.877	-2.286	-5.337	-4.982	-2.911	-4.517	-4.627	-2.640
	(-0.49)	(-0.373)	(-1.349)	(-1.090)	(-0.596)	(-1.430)	(-0.920)	(-0.540)	(-1.310)
AR2(p)	0.2633	0.2222	0.2776	0.4914	0.4566	0.5468	0.521	0.4597	0.5335
Productivity:	Difference GMM			FE with AR(1)			FGLS with AR(1)		
Diversificatn:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Low Income	-3.46*	3.335	-0.706	-1.987	2.452	-0.232	-0.888	-1.569	-1.251
	(-1.82)	(0.563)	(-0.515)	(-1.501)	(0.407)	(-0.158)	(-1.007)	(-0.373)	(-1.485)
Lower Middle I.	-6.53***	-6.831	-2.981	-4.75***	5.671	-1.160	-1.99**	4.863	-0.371
	(-2.98)	(-0.550)	(-1.595)	(-2.859)	(0.872)	(-0.871)	(-2.017)	(1.249)	(-0.529)
Upper Middle I.	-2.459	2.787	-2.603	-3.752	5.721	-1.405	-1.813	6.192*	-0.041
	(-0.42)	(0.294)	(-1.306)	(-1.336)	(0.918)	(-0.979)	(-1.219)	(1.931)	(-0.052)
High Income	-3.622	-2.031	-3.149	-4.357	3.899	-1.689	-4.711	5.888**	0.035
	(-0.77)	(-0.270)	(-1.573)	(-0.997)	(0.625)	(-1.048)	(-1.576)	(2.090)	(0.039)
AR2(p)	0.2276	0.1669	0.236						

Notes: Table presents the estimation results obtained from 5-years averages for manufacturing industries. Definitions of alternative productivity measures are provided in Table 4.2. All equations include period dummies. T-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. AR2(p) shows p values for the Arellano-Bond second order autocorrelation test and it is required not to reject the test.

Table 4.15 provides the findings for four sectoral classifications under manufacturing industries. The findings in general confirm the previous findings in Table 4.14 and explain which sectors account for lower productivity growth with higher within-diversification. Regarding the sectors 4 and 5, we find one major significant result. Compared to other countries, lower-middle income countries tend to suffer from within diversification by about 4.5% in sector 4

Table 4.15: Impacts of Diversification on Productivity for Different Income Levels – Sectoral Disaggregation of Manufacturing Industries

Productivity:	TFP1 - SGMM			TFP3 - SGMM			TFP1 - FEAR		
Diversification:	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Sector 4	Chemicals and Related Products								
Low Income	-0.522	4.310	1.742	-0.696	6.378	2.632	-1.258	2.741	3.628**
	(-0.45)	(0.629)	(0.777)	(-0.636)	(1.066)	(1.199)	(-1.428)	(0.618)	(1.972)
Lower Middle Income	-4.51**	-4.277	0.053	-4.65***	-1.872	0.802	-2.431*	3.358	2.747*
	(-2.40)	(-0.527)	(0.023)	(-2.699)	(-0.243)	(0.332)	(-1.870)	(0.724)	(1.656)
Upper Middle Income	3.769	0.461	0.938	3.956	1.934	1.519	0.902	1.874	2.033
	(0.91)	(0.054)	(0.524)	(0.794)	(0.198)	(0.569)	(0.348)	(0.391)	(1.152)
High Income	0.721	-1.800	-0.431	-1.090	-1.341	0.008	-2.165	1.675	0.453
	(0.21)	(-0.318)	(-0.352)	(-0.267)	(-0.209)	(0.005)	(-0.600)	(0.380)	(0.251)
Sector 5	Manufactured Goods Classified Chiefly by Material								
Low Income	-0.597	-0.589	2.533	-0.111	1.444	1.798	-0.480	-1.625	1.428
	(-0.37)	(-0.111)	(1.445)	(-0.075)	(0.270)	(0.919)	(-0.401)	(-0.287)	(0.766)
Lower Middle Income	-3.52**	-8.835	0.981	-2.970*	-6.285	0.891	-3.98***	5.672	1.281
	(-2.27)	(-0.897)	(0.498)	(-1.658)	(-0.595)	(0.398)	(-2.902)	(0.903)	(0.856)
Upper Middle Income	1.083	-1.071	1.768	1.407	1.752	1.929	-2.309	5.352	1.168
	(0.41)	(-0.112)	(1.044)	(0.506)	(0.129)	(0.758)	(-0.907)	(0.824)	(0.721)
High Income	-1.461	-5.257	0.198	-2.807	-4.075	0.144	-3.289	2.873	0.337
	(-0.75)	(-0.692)	(0.157)	(-0.904)	(-0.392)	(0.077)	(-0.917)	(0.483)	(0.205)
Sector 6	Machinery and Transport Equipment								
Low Income	-1.27**	6.543	1.166	-0.896	3.246	0.018	-1.376	5.703	0.877
	(-2.12)	(0.977)	(0.680)	(-1.370)	(0.583)	(0.014)	(-1.385)	(1.209)	(0.687)
Lower Middle Income	-2.916	-7.937	-0.600	-1.608	-8.712	-1.426	-1.254	1.197	-0.325
	(-1.47)	(-1.048)	(-0.346)	(-0.704)	(-1.257)	(-0.819)	(-0.963)	(0.233)	(-0.236)
Upper Middle Income	2.875	2.844	0.395	4.827	1.159	-0.394	0.935	3.719	-0.145
	(0.60)	(0.377)	(0.176)	(0.916)	(0.127)	(-0.171)	(0.391)	(0.764)	(-0.096)
High Income	-0.653	-2.154	-1.574	-3.154	-3.453	-1.796	-1.468	1.286	-1.322
	(-0.17)	(-0.354)	(-0.719)	(-0.666)	(-0.491)	(-0.900)	(-0.325)	(0.245)	(-0.718)

Sector 7	Miscellaneous Manufactured Articles (incl. scientific and optical goods, furniture etc.)								
Low Income	-3.36**	2.055	-2.842	-2.540*	2.967	-3.174	-3.3***	4.411	-0.162
	(-2.36)	(0.473)	(-1.640)	(-1.769)	(0.695)	(-1.397)	(-2.699)	(0.994)	(-0.098)
Lower Middle Income	-2.760	-6.684	-5.18***	-2.819	-7.155	-5.72***	-0.987	4.655	-0.385
	(-1.41)	(-0.937)	(-2.729)	(-1.455)	(-1.037)	(-2.898)	(-0.925)	(0.955)	(-0.234)
Upper Middle Income	-1.225	5.459	-2.176	-4.698	4.593	-3.193	-0.527	9.252*	0.985
	(-0.49)	(0.634)	(-0.948)	(-1.220)	(0.479)	(-1.108)	(-0.236)	(1.796)	(0.572)
High Income	-3.906	2.095	-1.941	-7.952	-1.257	-3.094	-5.203	7.601	0.881
	(-1.18)	(0.307)	(-0.972)	(-1.473)	(-0.181)	(-1.133)	(-1.258)	(1.419)	(0.474)

Notes: System GMM (SGMM) and Fixed effect with AR(1) (FEAR) estimation results obtained from 5-years averages. All equations include period dummies. T-statistics are in parenthesis. The significance of coefficients are denoted by stars: *: p<.10, **: p<.05, ***: p<.01. The Arellano-Bond second order autocorrelation tests.

and around 3.5% in sector 5. Fixed effect estimation additionally provides evidence that lower income countries can benefit from higher specialization in sector 4.

In sectors 6 and 7, the main impacts concentrate again on lower income (low income and lower-middle income) countries. Low income countries experience productivity losses with higher within-diversification in sector 6 and 7, while the impact is stronger in sector 7. Lower-middle income countries, on the other hand, benefit from lower specialization in sector 7. 1% reduction in specialization is associated with more than 5% increase in productivity growth. As estimated by FGLS with aggregated manufacturing data (Table 4.14), fixed effect estimation using sectoral data reveals that upper-middle income countries benefit from higher specialization in sector 7.

4.8 CONCLUDING REMARKS

The relationship between trade and growth is extensively analyzed in the literature and it is usually found to be positive. The role of productivity as a channel through which trade may affect a country's economic performance is by and large acknowledged as well. In this context, a pertinent question is

whether the trade structure matters for productivity. This paper analyzes the relationship between these two economic dynamics, productivity and export structure by arguing that a diversified export structure may potentially improve productivity in the presence of sufficient absorptive capacity. Moreover, recent studies emphasize the importance of within diversification in international trade. There exists, however, no adequate measure of within diversification in empirical studies. In this paper, we additionally introduce an index of diversification, called within-diversification index (WDI), in order to take into account the diversification within industries. Standard diversification indexes measure only the diversification among the industries and are not able to consider the diversification within industries (or products). The differences of WDI from alternative diversification indexes are highlighted in comparison with several figures.

More specifically, we speculated that export diversification and specialization may alternatively improve productivity in various ways under certain circumstances and aimed to distinguish the role of diversification from that of specialization with respect to their impact on productivity growth. In this perspective, we intended to identify whether export diversification provides a basis for potential discovery of productive capacities or further specialization on already active industries is the better option in promoting total factor productivity. By using four alternative measures of productivity and three measures of diversification, we estimated the impact of export diversification (and specialization) on productivity growth. We first estimated the impact without taking into account the degree of development and heterogeneity of industries. Then in separate exercises, we estimated for countries with different income levels and for different industrial classifications. Finally we combined the both aspects of heterogeneity and provided conclusive evidence on the productivity impact of export structure.

In the first step of estimation, we found no significant relationship between export structure and productivity growth. These results are robust to alternative measures of productivity, diversification, aggregation of the data, and estimation

methods. We then examined the association for different sectors and country groups. Main findings from sectoral disaggregation indicate that agricultural industries in general produce no significant effect. Regarding the manufacturing industries, it is found that within-diversification is negatively linked to productivity growth, but further investigation reveals that this impact is in fact driven by low-income and lower-middle income countries.

The second extension is done to account for countries with different income levels. System GMM estimation using aggregated data still provides no significant evidence on the impact of export sophistication on productivity growth. However, alternative estimators hint at potential positive impact of higher specialization for higher income (upper-middle income and high income) countries. At the final stage, we combined the two dimensions of the extensions and investigated the impact for different income groups under different sectoral classifications. With broad categorization of sectors under agricultural and manufacturing industries, we obtained significant results only for manufacturing industries. The main result is that the lower income countries suffer productivity impairments if they seek to within-diversify their exports in manufacturing industries. 1% increase in the WDI index is associated with about 2.8% productivity losses in overall manufacturing industries of low income countries and more than 5% in that of lower-middle income countries.

Further disaggregation of the data provides significant results for both agricultural and manufacturing industries. System GMM estimation for two different TFP measures yields that lower-middle income countries suffer from higher within-diversification in sector 2 (beverages and tobacco). While 1% increase in WDI index reduces the productivity growth in lower-middle income countries by about 2%, high income countries suffer productivity losses up to 3,3% with higher within-diversification. Fixed effect estimation additionally provides significant productivity gains for upper-middle income countries if they raise the level of specialization in sector 2. Regarding the sector 3, the impacts are all about lower-income countries. They tend to suffer from higher within diversification and benefit from higher specialization with around 3%

increase in productivity in that sector. Lower-middle income countries tend to suffer from within diversification by about 4.5% in sector 4 and around 3.5% in sector 5. Low income countries experience productivity losses with higher within-diversification in sector 6 and 7, while the impact is stronger in sector 7. Lower-middle income countries, on the other hand, benefit from lower specialization in sector 7. 1% reduction in specialization is associated with more than 5% increase in productivity growth. Finally, as estimated by FGLS with aggregated manufacturing data, fixed effect estimation using sectoral data reveals that upper-middle income countries benefit from higher specialization in sector 7.

Table 4.16: Summary of the Findings

	Low income countries			Lower-middle income countries			Upper-middle income countries			High income countries		
	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF	WDI	TDI	HRF
Sector 2	.	.	.	N	.	.	.	.	P!	N	.	.
Sector 3	.	.	.	N	.	P	.	.	.	.	.	.
Sector 4	.	.	P!	N	.	P!	.	.	.	.	.	.
Sector 5	.	.	.	N	.	.	.	.	.	.	.	.
Sector 6	N	.	.	.	.	.	.	N!	.	.	.	.
Sector 7	N	.	.	.	.	P	.	.	.	.	.	.

Notes: N and P respectively indicate negative and positive impacts of within-diversification (WDI), overall trade diversification (TDI) and overall specialization (HRF) on productivity growth. Dot (.) indicates the insignificant outcome. Exclamation sign (!) indicates that the result is obtained from alternative estimation techniques and not verified by system GMM estimation. Sector 1 is dropped due to insignificant results.

The summary of the main findings is given in Table 4.16. In general, it is fair to say that the productivity impact of export structure is only limited. Evidently much of the productivity impacts are associated with within-diversification, while overall specialization and diversification plays barely limited role in boosting productivity growth. Furthermore, much of the impact takes place in lower income countries. This is equivalent to say that within-specialization is an important factor in productivity improvements in lower income countries.

Within-diversification is found to play no major role in productivity growth in higher income countries. Specialization, on the other hand, is found to be important for lower-middle income countries in certain industries. This finding is also in line with the findings of Weinhold and Rauch (1999), where authors identified a positive relationship between specialization and productivity for less developed countries. But we do not find any supportive evidence for the findings of Imbs and Wacziarg (2003), where authors find a U-shaped relationship between specialization and per capita income.[34] Finally, it appears that the positive impact of diversification on economic growth found in the literature is not due to its impact on productivity and we need to search for alternative channels. Apparently, export diversification is not a suitable way of successful discoveries. And we mostly confirm the theoretical findings on the role of specialization in economic development.

This paper provides the first empirical evidence on the relationship between export structure and productivity for different country and industry classifications. Analysis with more disaggregated data or on specific countries would certainly provide better insights. In future studies, a rather interesting approach in this context would be to make use of finance literature. Is there an optimal portfolio in trade as in finance, a portfolio providing the maximum return for the lowest unit of risk? One can even try to apply an optimal portfolio analysis for export products since each product can be associated with certain risks and returns in international markets. Although some economic variables like demand elasticity would provide required tools to make such an analysis, it might be rather difficult to obtain these data for every product and country.

[34] Since the approach used in Imbs and Wacziarg (2003) depends on equal diversification across sectors, they do not take into account the relative world demands. However, it is hard to argue that the equal distribution of sectors in export rather than distribution according to relative world export shares is optimal for productivity.

APPENDIX

Table 4A.1: Correlation Matrix for selected variables

	TFP1	WDI	TDI	Herf.	Inv.	Schl.	Infl.	Infr.	Pop.
WDI	0.1346								
TDI	-0.026	-0.636							
Herf.	-0.156	-0.506	0.296						
Inv.	0.2147	0.7924	-0.511	-0.599					
Sch.	0.0288	0.551	-0.338	-0.377	0.5172				
Infl.	-0.207	-0.049	0.012	0.0179	-0.064	-0.070			
Infrastr.	0.052	0.6349	-0.515	-0.387	0.5924	0.703	-0.081		
Pop.	0.216	0.3623	-0.258	-0.293	0.6904	0.045	-0.025	0.071	
Open.	-0.040	-0.055	-0.080	0.029	-0.245	0.1586	-0.069	0.12	-0.497

Table 4A.2: Descriptive statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
TFP1	558	.6007257	12.15965	-56.15302	37.1792
TFP2	558	1.500647	12.69819	-54.76476	39.47508
TFP3	558	.4460595	12.53219	-60.32834	36.42894
LP	554	.092916	.1343079	-.3214281	.6690152
WDI	642	.3072743	.1872058	.0099326	.8860568
TDI	642	.6181546	.1140102	.2648969	.8666716
Herfindahl	642	.1215539	.1392685	.0053667	.8497908
Investment	510	22.63041	2.087981	18.46478	28.15421
Schooling	604	9.641225	9.439324	0	47.5
Inflation	619	37.56391	254.5458	-4.905194	4828.708
Infrastructure	623	14.08852	21.42395	.0521729	116.507
Population	655	20.3742	1.436422	17.33545	25.14256
Openness	611	55.30493	29.43884	5.314175	202.9804
OECD	655	.2580153	.4378768	0	1

Table 4A.3: List of Countries

1	Argentina	22	Finland	43	Malaysia	64	Singapore
2	Australia	23	France	44	Mali	65	Slovakia
3	Austria	24	Germany	45	Mauritius	66	South Africa
4	Bangladesh	25	Ghana	46	Mexico	67	Spain
5	Belgium	26	Greece	47	Morocco	68	Sri Lanka
6	Benin	27	Guatemala	48	Mozambique	69	Sweden
7	Bolivia	28	Haiti	49	Nepal	70	Switzerland
8	Brazil	29	Honduras	50	Netherlands	71	Syria
9	Bulgaria	30	Hungary	51	New Zealand	72	Tanzania
10	Cameroon	31	India	52	Nicaragua	73	Thailand
11	Canada	32	Indonesia	53	Niger	74	Togo
12	Chile	33	Ireland	54	Norway	75	Trinidad Tobago
13	China	34	Israel	55	Pakistan	76	Tunisia
14	Colombia	35	Italy	56	Panama	77	Turkey
15	Costa Rica	36	Jamaica	57	P. N. Guinea	78	Uganda
16	Cyprus	37	Japan	58	Paraguay	79	United Kingdom
17	Denmark	38	Jordan	59	Peru	80	United States
18	Ecuador	39	Kenya	60	Philippines	81	Uruguay
19	Egypt	40	Korea Rep.	61	Portugal	82	Zambia
20	El Salvador	41	Madagascar	62	Romania	83	Zimbabwe
21	Ethiopia	42	Malawi	63	Senegal		

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