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List of abbreviations and acronyms

BE	between effects
BI	Balassa Index
Comtrade	Commodity Trade Statistics Database
DI	Diversification Index
EU	European Union
FE	fixed effects
GDP	gross domestic product
HO	Heckscher-Ohlin
ILO	International Labour Organization
ISIC	International Standard Industrial Classification of All Economic Activities
LAD	Least Absolute Deviations
MVA	Manufacturing value added
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PPP	purchasing power parity
PSH	Prebisch-Singer hypothesis
SITC	Standard International Trade Classification
HS	Harmonized Commodity Description and Coding System
UN	United Nations
UNIDO	United Nations Industrial Development Organization
USA	United States of America

1. Introduction

For centuries economists have argued about the role of economic specialization and diversification in economic development. On the one hand, starting with the theory of comparative advantage in the early 19^{th} century, the case has been made for the benefits of specializing on "what one does best". On the other hand, it has been argued that diversification of production and exports can make a country less prone to negative economic shocks. Policy makers – and this is particularly relevant for low-income countries – are thus faced with contradicting theories concerning the best way for sustainable economic growth.

However, this long-lasting discussion on specialization, diversification and economic development has gained new impetus due to recent empirical findings (Imbs and Wacziarg, 2003). These authors show that the economy of low-income countries is typically specialized in a narrow range of products. As GDP per capita rises, the structure of production of goods diversifies through the launch of new products and through diversification within those goods that are already produced or exported. At higher levels of GDP per capita, this trend for diversification slows down and – for high-income countries – eventually turns around towards re-specialization. The pattern of specialization and GDP per capita therefore seems to be characterized by a "U-curve".

This empirical evidence indicates that different theories are appropriate during different stages of the economic growth process. In particular for low-income countries, this suggests that they can succeed in overcoming their economic marginalization through the acquisition of skills and knowledge necessary to diversify their economic portfolio rather than focusing on what one does best, while only high-income countries seem to benefit from specialization. Several international development institutions have now incorporated this idea into their policy advice scheme (cf. UNIDO, 2009; World Bank, 2009).

However, research findings in this area are still preliminary. Some studies confirm the existence of this U-curve for the structure of production (Kalemli-Ozcan, Sorensen and Yosha, 2003; Koren and Tenreyro, 2004), while other studies find a U-curve also in data on exports (Carrere, Strauss-Kahn and Cadot, 2006; Klinger and Ledermann 2004, 2006). However, some authors reject these findings (De Benedictis, Gallegati and Tamberi, 2007). In particular, the definition and measurement of “specialization” itself remains an open issue. In addition to this, it is crucial to understand whether the U-curve represents a typical “path of development” of a country, or if the level of specialization is determined by other factors. This is particularly relevant for development policy: The process of diversification and specialization could be driven either by specific policy instruments, market forces, or other non-observable factors.

The purpose of this study is to analyse and contribute new empirical findings to the recent discussion on the stages of economic diversification and specialization. The dispute over the existence and relevance of a specific trend of diversification, specialization or both is reviewed in the light of the empirical finding of a U-curve by Imbs and Wacziarg (2003). The conclusions from this debate are then considered through an empirical analysis of the main issues. The central question is: Do countries initially diversify and then re-specialize their economic structure as income grows? In other words, Is the proposed U-curve relationship between specialization and economic income indeed a valid stylized fact of the real world, or is it merely a statistical effect that depends on the employed data sets, methods and definitions? In particular, what does “specialization” mean in this context, and what conclusions on the structure and dynamics of sectoral economic concentration can be drawn from the literature as well as from available data? Besides this, are there robust conclusions concerning economic “development” to be drawn from this discussion and the empirical findings? These questions shall be answered by reviewing the recent literature in this field and by conducting an econometric analysis that combines and extends the methods and datasets used therein.

Section 2 begins with an overview of the historical discussion concerning specialization versus diversification, and continues with a more detailed review about the recent publications that introduce and discuss the combination of specialization and diversification. Emphasis is placed on the various versions and critiques of the U-curve relationship, as well as some relevant extensions. The relevance of this discussion for actual policy advice is also outlined. Section 3 presents the statistical methods and datasets used in the subsequent econometric analysis. Section 4 employs several datasets, specialization/diversification measures, concepts about specialization and econometric methods to find evidence for or against the proposed U-curve, including controlling for other potential determinants. Section 5 concludes this study.

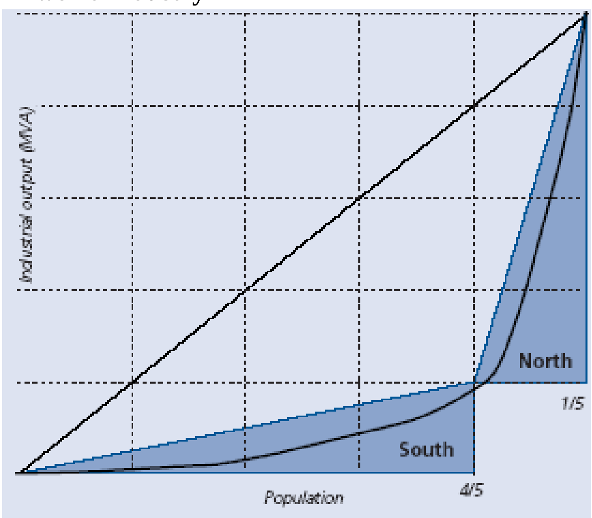
2. Literature review: Specialization versus diversification

2.1. Historical overview

2.1.1. The relevance of structural analysis

Despite promising growth rates of per capita gross domestic product (GDP)[1] in many developing countries[2], poverty remains widespread, and the Millennium Development Goals are unlikely to be met in several regions. Countries that are home to the so-called "Bottom Billion"[3] struggle to find ways out of poverty, and the economic North-South Divide – not only in terms of income distribution, but also in terms of productive capacities and participation in global markets – remains significant. For example, 80 percent of global manufacturing value added (MVA) is produced by just 20 percent of the global population. This relationship is graphically represented as a stylized Lorenz curve in Figure 2.1., where population is displayed on the horizontal axis, ranked by MVA of the respective country.

Figure 2.1. The North-South divide in world industry



Source: UNIDO (2005:133).

[1] GDP per capita is used as an indicator of total economic activity, as is common in the development economics literature. Although GDP per capita correlates with some dimensions of well-being, it should be noted that GDP per capita falls short of capturing all aspects of socio-ecological wealth (see the discussion in Easterly, 1999:239-241) For a critical discussion of the usage of GDP per capita, which would go beyond the scope of this study, cf. NEF (2009).

[2] Throughout this study, the term "developing country" is used for statistical convenience and reflects the economic level of a country, while "development", in this context refers to an economic dimension only.

[3] The "Bottom Billion" is a phrase coined by Paul Collier (2007), denoting the one billion people living in low-income countries.

A key issue in development economics is therefore to understand the drivers and effects of economic growth. The relevance of structural change for sustainable economic growth has been put forward by the founders of the modern theory of economic development (cf. Lewis, 1954, Chenery, 1979). Structural change can be defined as a shift of capital and labour from low productivity to high productivity sectors. Nevertheless, empiric growth literature of the past decade – for example Barro (1991) and Mankiw, Romer and Weil (1992) – usually focuses on economy-wide recipes for faster growth, e.g. institutions, governance and trade, and often fail to capture structural dynamics within a national economy. Policy advice for whole economies derived from these studies is undoubtedly relevant for economic success, but fails to address the structural component of economic growth. If structural change follows economic growth, then the lack of a structural perspective in policy advice should not matter, but if structural change is a driver of economic growth, then a more detailed analysis on the nature of structural change is required to understand economic growth and to determine reasonable policy advice. This idea is reflected in the recently emerging literature that takes up the old idea of policy directions for structural change and therefore might be called "new structuralism" (UNIDO 2009:6).

The question of whether economic growth is accompanied by an increasing or by a decreasing intensity of economic specialization has been at the core of economic thought for centuries. Theories and evidence exist supporting both possibilities, whereby policy makers are confronted with a serious dilemma. The main arguments of both strands of the discussion are outlined in the subsequent two chapters.

2.1.2. Classic arguments for specialization

Traditional trade models suggest that countries should open to trade and specialize their production in goods in which they have a comparative advantage. By becoming more specialized, the allocation of resources will become more efficient, allowing for mutual welfare increases (Krugman and Obstfeld, 2006). This idea goes back to David Ricardo, who pointed out – in his famous example of Portuguese wine and British cloth[4] – that although

[4] Ricardian theory can also be applied to a higher number of countries and/or goods (Dornbusch, Fischer and Samuelson, 1977; Bhagwati and Srinivasan, 1983:35-51; Becker, 1952).

Portugal requires less labour to produce a unit[5] of either good compared to the United Kingdom, opening up for trade would still benefit both countries by specializing on that good with the lower opportunity cost[6] (Ricardo, 1971:153-154). This implies that poor countries can trade with rich countries and can still gain (Ruffin 2002:741f). However, the core insight of Ricardian theory is to provide an explanation of the *current* pattern of trade, not how it *should* be: "A country exports that commodity in which it has comparative labour-productivity advantage." (Bhagwati and Srinivasan, 1983:29)

Despite the simplicity of Ricardo's theory, it has been interpreted in several different ways, and still has a huge impact on the way in which specialization and economic development is (mis)understood, as Deardorff (2005:3) describes: "Comparative advantage is certainly one of the most basic ideas in economics, underlying much of our understanding of why countries trade the way they do and why they benefit from doing so. But it is also a difficult concept for many people to understand, and seemingly even more difficult for them to believe once they do understand it (and especially if they don't)."

"Indeed, Paul Samuelson – the Nobel laureate economist who did much to develop the models of international trade", Krugman and Obstfeld (2006:24) write in their book, "has described comparative advantage as the best example he knows of an economic principle that is undeniably true yet not obvious to intelligent people." Ricardian theory of comparative advantage states that specialization in accordance with comparative advantage is an important factor to produce more goods compared to a situation where every country is economically autarkic. However, this does not automatically imply that all countries individually gain from comparative-advantage driven trade, or that free trade will make countries specialize in that way, because this would require perfect competition, in particular free and frictionless trade. And even then, world prices could equal autarky prices for some countries, allowing for zero gains from trade for them. It is rather the gains from trade that imply the pattern of trade, not the other way around. While trade according to comparative advantage is necessary to realize gains from trade, it is not a sufficient condition. Overall, the simple nature of Ricardian theory of static comparative advantage results in extreme predictions about trade patterns, but if one

[5] Maneschi (2002) points out that Ricardo did not mean unit labour coefficients, but labour needed to produce the amounts of wine and cloth actually traded. However, this discussion is not essential to the present analysis.

[6] Opportunity cost in this context denotes how much production of another good has to be dispensed to produce a good.

allows for a small amount of more realistic – thus more complex – assumptions, the predictions and political implications become less clear (Deardorff, 2005:5-13).

The principle of comparative advantage should therefore be treated more as a textbook-style model with the purpose to explain the general dynamics of trade. Drawing conclusions for economic policy from the Ricardian model, in particular policy advice based on the potential advantages of specialization, should be treated with caution. ”The obstinate conservatism with which the classical comparative cost thinking”, Ohlin (1967:308-309) points out, “has been retained in theory as something more than a pedagogical introduction – or a model for the treatment of a few special problems – is evidence that, even today, there is in many quarters an insufficient understanding of this fundamental fact.”

The necessity of specialization according to comparative advantage for economic development is still being used for policy advice, as Rodrik (2007:103) affirms: “Those who associate under-development with inadequate exposure to international markets generally imply – although this is often left unstated – that specialization according to comparative advantage is an essential ingredient of development.” The World Trade Organization announces the general applicability of this idea on its website: “Simply put, the principle of ‘comparative advantage’ says that countries prosper first by taking advantage of their assets in order to concentrate on what they can produce best, and then by trading these products for products that other countries produce best.” (WTO, 2009)

When focusing on the industrial sector, Hausmann and Rodrik (2003:23) state that “for all economies except possibly the most sophisticated, industrial success entails concentration in a relatively narrow range of high-productivity activities.” However, some years later, Rodrik (2007:99-152) uses the findings of Imbs and Wacziarg (2003) as an empirical evidence for the relationship between industrial *diversification* and economic growth to justify industrial policy that promotes diversification of the production portfolio.

2.1.3. Classic arguments for diversification

The relevance of economic diversification has been argued by famous economists, such as Nobel laureate Simon Kuznets, who states in his Nobel Prize lecture that “[a] country’s economic growth may be defined as a long-term rise in capacity to supply increasingly diverse economic goods to its population […].” (Kuznets, 1971). Grossman and Helpman (1992:334) make an even stronger statement by asserting that “[g]rowing economies produce an ever-increasing quantity, quality and variety of goods and services.”

The simplest argument is that diversified economies are less vulnerable to economic shocks than specialized economies: “[…] [A]lthough there are good theoretical arguments for specialization according to comparative advantage”, Osakwe (2007:1) argues, “in practice policymakers in developing countries are interested in diversifying their production and export structure to reduce vulnerability to external shocks.” More diversified economies are less volatile in outputs, and lower output volatility is associated with higher economic growth (Ramey and Ramey, 1995).

An early concept of highlighting the problem of specializing in agriculture is the so-called “Graham paradox”, which incorporates the non-constant unit costs, hence productivity, among different sectors into Ricardian theory (cf. Graham, 1923). Productivity in the manufacturing sector rises with production as unit costs fall with rising output due to the benefits of mass production, while unit costs of agricultural products increase with production. For a country with a comparative advantage in agriculture, specialization according to comparative advantage decreases productivity in both the agricultural and the manufacturing sectors, hence the country’s total output declines. Even global production can decline if the increase in production of countries specializing in manufacturing is not large enough (Raffer, 2004b:112-117).

Prebisch (1950) and Singer (1950) have further elaborated on arguments for the importance of diversification for economic growth. Probably their most influential idea was the formulation of the so-called Prebisch-Singer hypothesis (PSH), asserting that economic growth cannot be based on resource-based products, because world prices for primary exports relative to manufactured exports decline over time. Consequently, the ratio of export prices to import prices – the terms of trade – for developing countries, which are mostly heavily dependent on exports of commodity products, is declining as well. Among the proposed potential explanations are: (1) Strong labour unions in industrialized countries cause wages in the manufacturing sector in each business cycle to rise to a much higher extent than wages in developing countries;[7] (2) Monopoly power in manufactures prevents technological increase resulting in lower prices; (3) Demand for primary commodities shows a relatively lower income elasticity, which means that income growth tends to lower the relative demand for, and hence price of, primary commodities; and (4) Raw-material-saving technical progress in manufacturing causes a relatively slow-growing demand for primary products (Cuddington, Ludema and Jayasuriya, 2002:5). Eventually, the PSH was used as a theoretical justification for economic diversification through Import Substitution Industrialization,[8] which is labelled a "great historical mistake" by Sachs and Warner (1995:4), because it was based on prolonged trade barriers rather than on export promotion.

The PSH has been widely discussed in the literature, with conclusions being drawn both for and against its validity. Lutz (1999) builds on this mixed evidence and confirms the validity of the PSH, as do Ocampo and Parra (2004), while Raffer (2004:119) concludes that the PSH has been widely accepted since the 1990s. Cuddington, Ludema and Jayasuriya (2002), however, demonstrate that the terms of trade of primary products have experienced a few abrupt shifts – or structural breaks – downwards, but do not follow any particular trend.

Overall, the Graham paradox and the PSH do not provide arguments in favour of diversification per se, but explain the disadvantage of being specialized in the "wrong" sector, namely, agriculture, as opposed to being specialized in manufacturing. In principle, these arguments can therefore serve as a rationale for changing the respective sector in which a country specializes or as justification of overall economic diversification.

The literature on endogenous growth theory also highlights the importance of the nature of the sector in which a country is specializing, as the returns to scale depend on the sector itself. Once increasing returns to scale are assumed in the manufacturing sector, and constant returns to scale are assumed in the agricultural sector, it obviously follows that when a country "initially has a comparative advantage in manufacturing (agriculture), its manufacturing productivity will grow faster (slower) than the rest of the world and accelerate (slow down) over time." (Matsuyama 1991:11).

[7] During economic booms, strong labour unions can negotiate for wage increases, while during recessions unions can prevent wages from falling. In the absence of labour unions, the wage increase during booms is lower, while recessions might cause decreasing wages.

[8] Import Substitution Industrialization is a strategy to replace imports by domestic products through diversifying the domestic production structure. This strategy was used for the first time by Latin American countries during the Great Depression (Nuscheler, 2004: 627).

Collier (2002) lists three additional severe problems of developing countries stemming from heavy dependence on exports of primary commodities: *First*, as commodity prices are highly volatile, countries have to cope with large external shocks. *Second*, rents generated by primary commodities are usually associated with poor governance. *Third*, being dependent on a narrow range of natural commodities increases the risk of civil war as natural resources might generate income for rebel groups. Generally, the negative impact of natural resource abundance and economic growth has been coined the "curse of natural resources" (cf. Sachs and Warner 1995, 1999) or – in the context of a single booming sector that negatively influences the industrial sector – the "Dutch Disease" (cf. Corden and Neary, 1982).

The benefits of a diversified export structure have been well-established in the literature, but there exists no unified framework to describe the drivers of export diversification. Structural models of economic development show that countries should develop their export structure from primary exports into manufactured exports in order to achieve sustained economic growth. The portfolio effect of the finance literature might apply to the export structure as well: a specialized export structure, especially when a country depends on commodity products with volatile market prices, discourages necessary investments by risk-averse firms. Diversification of exports therefore helps to stabilize export earnings in the long run (Hesse, 2008).

Bebczuk and Berretoni (2006:8) warn against explaining export diversification from an aggregate viewpoint only, since the decision to diversify the export portfolio is taken by individual firms (assuming that the government has no direct influence on the export structure). Extending the insights on incentives to diversify financial assets to export diversification might be misleading, as flexible financial markets differ from the inflexible production decisions of firms, which are more irreversible and depend on a much broader set of conditions.

Once the issue of uncertainty is incorporated into the Ricardian model, the predicted specialization patterns can oppose those under certainty, as a risk-averse country will shift its production towards another good if price uncertainty in the initial good is too large. The expected gains from trade for country with absolute risk aversion can become negative, causing it to cease trading altogether (Propositions 7 and 9 in Turnovsky, 1974:211-215). Acemoglu and Zilibotti (1997) develop a theoretical model with uncertainty on the return to investments, where economic development goes hand in hand with better opportunities for diversification and a more productive use of financial funds. At early stages of economic development, the presence of indivisible projects limits the degree of diversification, hence risk spreading, that the economy can achieve. This inability to diversify risks introduces a large amount of uncertainty in the growth process, and the desire to avoid highly risky investments slows down capital accumulation. The chance of conducting profitable projects determines how long countries remain in the stage of initial capital accumulation before they reach a takeoff stage where full diversification of risks can be achieved.

The stimulating effect of export diversification on the creation of new industries can also take place through forward and backward linkages (Hirschman, 1958:98-119). Export diversification does not always mean climbing the ladder of value added however. For example, the case of Chile’s export diversification since the 1970s has seen neither the emergence of heavy industry through industrial policy, nor the imitation of high-technology products, but instead the emergence of new agricultural products (De Pineres and Ferrantino, 1997:389).

Thus, convincing arguments for the existence and relevance of both trends – specialization and diversification of the economy – have been widely described in the literature, but these phenomena have been treated as being mutually exclusive. This restriction has been overcome by recent empirical findings, which are presented in detail in the following section.

2.2. Combining specialization and diversification

2.2.1. The U-curve of specialization in production and GDP per capita

The discussion concerning the relevance and trend of economic specialization or diversification outlined in the previous chapter consisted of theories, political arguments or evidence exclusively either for or against economic specialization. A non-linear relationship, a relationship that consists of specialization trends in both directions, was not considered until recently.

In their seminal econometric analysis of the stages of diversification, Imbs and Wacziarg (2003) consider and detect a non-linear – namely, a U-curved – relationship between diversification of production and GDP per capita. Their findings consist of the following empirical stylized facts: (i) Low-income countries have a very specialized production structure; (ii) As countries levels of GDP per capita increase, the sectoral distribution of economic activity diversifies. This diversifying trend decreases with rising GDP per capita, and after a turning point – which takes place at a very high level of income – the sectoral distribution exhibits re-specialization. Although simple in nature, this discovery proved to be a novelty and initiated a new debate on the structure of growth, as Imbs and Wacziarg (2003:63) predicted: "This new finding has potentially important implications for theories of trade and growth. Most existing theories predict a monotonic relationship between income and sectoral concentration." In his weblog, Rodrik (2007b) even labelled this finding "[o]ne of my favourite stylized facts about development […]".

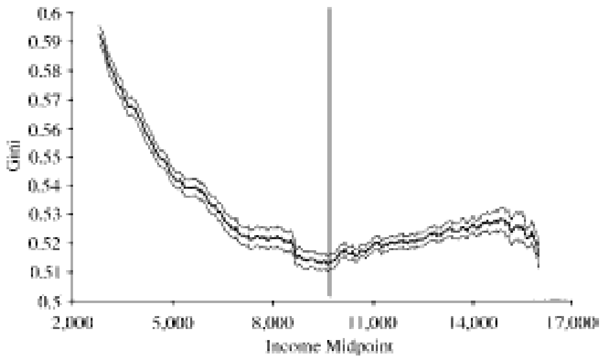
Imbs and Wacziarg (2003) use several datasets to show the robustness of their results. The first dataset covers employment data from the ILO on nine economic sectors, for the period 1969 to 1997 for a large set of countries ranging from low to high income. The second dataset uses OECD data on value added and employment for the period 1960-1993, covering 14 economic sectors. The third dataset, from UNIDO, consists of employment and value added covering 28 manufacturing sectors. The datasets are edited in a way that the number of sectors available through time for each country was constant, which involves dropping several insufficient observations. To estimate within-country variation, countries for which 27 or more sectors were available from UNIDO data, and 6 or more from ILO data are retained. For between-country variation, the sample was restricted to observations where all sectors were reported. To show the robustness of their results, Imbs and Wacziarg (2003) employ several measures of sectoral concentration, among them the Gini coefficient and the Herfindahl Index.[9]

To investigate the structure of the data without imposing any specific functional form, Imbs and Wacziarg (1993:67-72) first employ a non-parametric methodology based on the locally robust weighted scatter plot smoothing (Lowess). The results indicate a U-curved relationship

[9] A higher value of the Gini coefficient or Herfindahl Index indicate a higher degree of specialization, while a value of zero means that the distribution of economic activity is equal across sectors.

between specialization and GDP per capita,[10] where countries diversify over a large range of GDP per capita. The upward-bending part, at highest levels of GDP per capita, is distinct but does not reach the level of sectoral concentration on the left part of the curve (Figure 2.2.). Although less pronounced than the initial specialization, this upward-sloping part of the curve appears to be statistically significant for all datasets. The turning point where the diversification trend switches to re-concentration appears to be at quite a high level of income per capita, with re-concentration within the manufacturing sector occurring earlier than across a broader range of sectors.[11]

Figure 2.2. Specialization of MVA, non-parametric curve

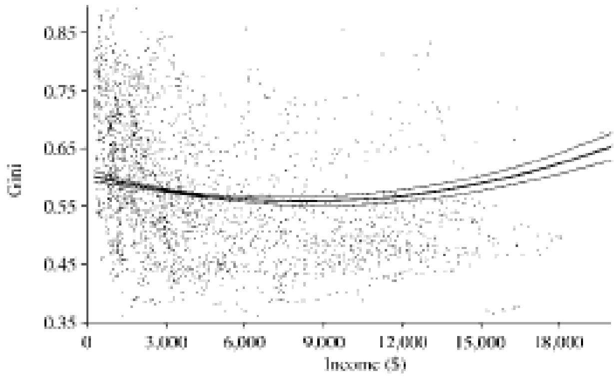


Source: Imbs and Wacziarg (2003:69).

As a next step, Imbs and Wacziarg (2003:72-75) run parametric estimations, i.e., panel data regression methods that regress specialization on GDP per capita and squared GDP per capita. Including both a linear and a squared term of income per capita allows for verifying the assumption of U-curve that was indicated by the non-parametric method, as a negative coefficient on the linear term and a positive one on the squared term add up to a U-shaped function. By using between- and within-country regressions, the existence and robustness of a U-shape as a phenomenon of differences between countries as well as structural change within countries can be confirmed (see Figure 2.3. for within-country results). Furthermore, Imbs and Wacziarg (2003:75-82) use several additional methods to prove the robustness of their results, like focusing on individual countries and accounting for country size, periodic-specific effects and region-specific effects.[12]

[10] Here measured in constant international dollars at purchasing power parity (PPP).
[11] The turning point lies around US$16,500 at constant 2000 international dollars at PPP (UNIDO 2009:12)
[12] Additional results and robustness checks are presented in Imbs and Wacziarg (2002), which is a supplement to Imbs and Wacziarg (2003).

Figure 2.3. Within-country regression between specialization of MVA and GDP per capita



Source: Imbs and Wacziarg (2003:69).

The curve in Figure 2.2 describes the structure of the pooled panel by treating both dimensions – countries and years – identical, hence representing the sum of within- and between-country effects, while Figure 2.3 presents the regression output of the within-country regression, i.e., an estimation of the deviations from the actual observations from the country means, over a backdrop of the pooled panel scatter plot. It can be seen that the estimated within-variation is smaller than the overall variation, thus indicating the influence of fixed effects, e.g., country-specific characteristics that do not – or only slowly – change over time. In addition, it should be noted that Imbs and Wacziarg (2003) do not analyse any intra-distribution dynamics – the same value of the Gini Index can result from different Lorenz curves –, neither the "quality" of the distribution, or if the different locations within the specialization-GDP-space correspond to an optimal combination of goods in terms of impact on welfare, growth, employment, and so on.

The novelty lies in the fact that existing thoughts – as summarized in chapter 2.1 – which are either for or against specialization and therefore seem to contradict each other, might *all* be correct, as "[…] each set of theories seems to be at play at different points in the development process." (Imbs and Wacziarg, 2003:64). In particular, these results are surprising if one thinks within an oversimplified Ricardian model of specialization. "What is significant about this finding from our standpoint", Rodrik (2007:103) argues, "is that it goes against the standard intuition from the principle of comparative advantage. The logic of comparative advantage is one of specialization. It is specialization that raises overall productivity in an economy that is open to trade. […] Imbs and Wacziarg's findings suggest otherwise."

Although it is tempting to replace the old oversimplified "rule" of economic growth via specialization with a new "rule" of economic growth via diversification and late re-specialization, it might still make sense to focus on the importance of diversification for developing countries, as Subramanian (2007:2) concludes from the U-curve: "[S]uccessful growth is accompanied by the private sector undertaking new, varied, and sophisticated activities […]. All economies start off agricultural, and the successful ones diversify away from agriculture toward manufacturing and, within manufacturing, from simple to more sophisticated activities. Diversification is thus intrinsic to development."

Several studies respond to Imbs and Wacziarg (2003) by either criticising or expanding the methodology. Table 2.1 presents an overview of these studies, discussed in more detail later.

Table 2.1. Studies considering a non-linear relationship between specialization and income per capita

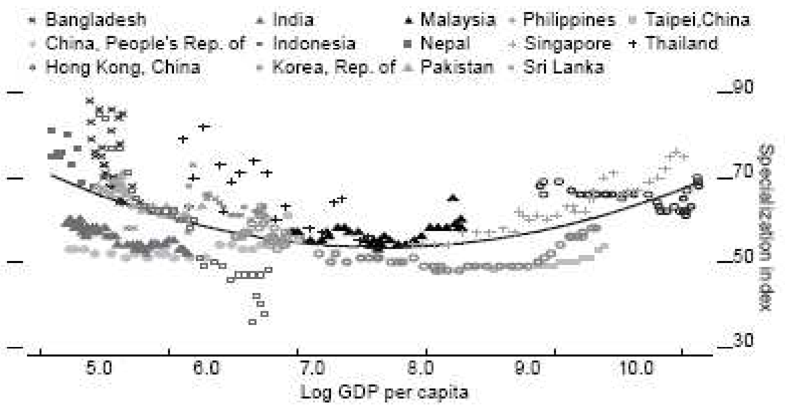
Authors	Regression method	Data	Evidence for U-curve
Batista and Potin (2007)			Theory
Bebczuk and Berrettoni (2006)	Parametric (plus controlling for other determinants)	Exports	Yes
Carrère, Strauss-Kahn and Cadot (2007)	Parametric (plus analysis of extensive and intensive margin)	Exports	Yes
De Benedictis (2004)	Non-parametric	Export	No
De Benedictis, Gallegati and Tamberi (2003)	Non-parametric	Exports	Yes
De Benedictis, Gallegati and Tamberi (2007)	Non-parametric (relative specialization)	Exports	No
De Benedictis, Gallegati and Tamberi (2008)	Non-parametric	Exports	No
Harrigan (2007)	Parametric	MVA (only Asia)	Yes
Imbs and Wacziarg (2003)	Parametric, non-parametric	Employment, VA, MVA	Yes
Imbs and Wacziarg (2000)	Parametric, non-parametric	Employment, VA, MVA	Yes, Theory
Kalemli-Ozcan, Sorensen and Yosha (2003)	Parametric (plus analysis of risk-intensity)	Manuf. output, MVA and manuf. employment	Yes
Klinger and Lederman (2004)	Parametric (plus analysis of discoveries)	Exports	Yes
Klinger and Lederman (2006)	Parametric (plus analysis of innovation)	Exports	Yes
Koren and Tenreyro (2004)	Non-parametric and parametric (plus analysis of risk-intensity)	Manuf. output, MVA and manuf. employment	Yes

2.2.2. *Confirmations and extensions of the U-curve*

The existence of a U-curve in the production pattern is confirmed by a number of studies, while the U-curve has also been found using export data. Several authors not only provide evidence for or against the existence of a U-curve, but also attempt to add more dimensions to the discussion, such as the intensive and extensive margins of diversification, the risk content of sectors, the level of product sophistication, and the relationship between specialization and economic growth.

Harrigan (2007) confirms the existence of a U-curve between specialization and GDP per capita for MVA data when analysing a panel of 14 Asian economies for the period 1970-2005 (Figure 2.4).[13] By running a pooled panel regression, he ignores country fixed effects however, i.e., he does not account for whether the U-curve is driven by static differences between countries or by a movement of every country along a U-curve. Harrigan also argues that the observed U-curve might be driven by country size.

Figure 2.4. Specialization of MVA in Asia



Source: Harrigan (2007:4)

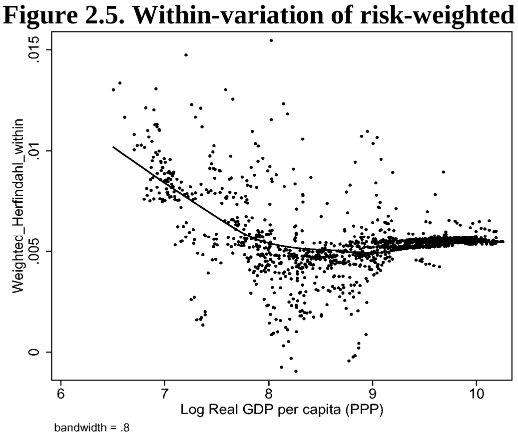
As the proposed U-curve itself describes general specialization patterns but does not discriminate between different types of products, a follow-up question concerns the *nature* of the sectors or products a country is specializing in. Kalemli-Ozcan, Sorensen and Yosha (2003) use the level of risk, measured by the insurance against shocks to specialization, to classify those sectors that countries specialize in at the low-income and high-income section

[13] Harrigan (2007) does not explain the measure of specialization used in his analysis. It should also be noted that there seems to be a misprint in his regression output, as the presumed squared term actually lacks the power.

of the U-curve. They quantify income insurance indirectly by measuring the deviation of the movement of GDP from the average movement within a wider geographical group of regions. Hence, if a region is insured via capital markets, its GDP fluctuation should not deviate from the fluctuation of the risk-sharing group. They use data on sectoral manufacturing output, value added and employment for several OECD countries and regions within countries to calculate a country's specialization as the sum of all sectoral deviations from the group mean. By regressing specialization on income insurance, linear and squared GDP per capita[14] and several other potential determinants[15] of specialization, they find a U-shaped relationship between GDP per capita and specialization, and a positive correlation between risk-sharing and specialization.

Koren and Tenreyro (2004) further investigate the idea of risk by modeling the economy as a portfolio of sectors with different risk intensities referring to volatility, inter-sectoral correlation and broadness of sectors.[16] They calculate several measures of sectoral risk which are then used as weights in the sectoral specialization measures in order to extend the results of Imbs and Wacziarg (2003). They find that at low income per capita, countries are relatively concentrated in high-risk sectors. As income increases countries extend their production towards low-risk sectors, thus experiencing a decrease in specialization. Finally, while the trend to diversify becomes weaker and eventually switches towards re-specialization with rising GDP per capita, sectoral risk continues to decline (Figure 2.5).

Figure 2.5. Within-variation of risk-weighted specialization



Source: Koren and Tenreyro (2004:54).

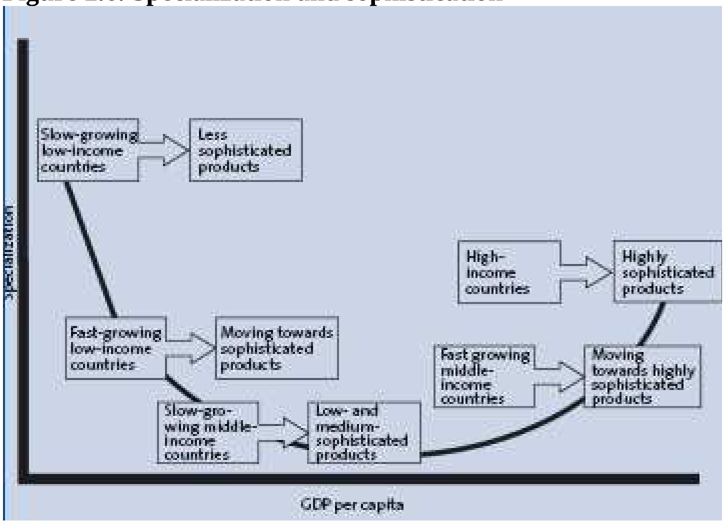
[14] Measured in constant US dollars.
[15] They include trade volume, factor endowments, distance, shipping cost, customs union, education and population as additional control variables.
[16] High-technology sectors are more disaggregated than low-technology sectors and agriculture.

Besides accounting for the risk content of products, another attempt to analyse the quality of the products a country is specializing in or adding to its production structure is presented in the recent Industrial Development Report (UNIDO, 2009), which links the U-curve of specialization with the concept of sophistication.

"Sophistication" in this context is a new measure of the complexity of products, which was traditionally measured by the level of technology. Lall (2000) emphasises the relevance of the technological composition[17] of a country's export basket for industrial development. Having an export structure with a higher technological intensity offers better prospects for future growth, because the growth of trade in high-technology products tends to be greater due to higher income elasticity, creation of new demand, faster substitution of older products, greater potential for further learning, and larger spillover effects. Although this concept of "technology" serves well for many purposes, it is a static concept, is ad-hoc, and is limited to aggregated product groups. To overcome these shortcomings, the concept of "sophistication" was developed by Lall, Weiss and Zhang (2006) and Hausmann, Hwang and Rodrik (2007): A certain good is classified as more sophisticated, the higher the average income of its exporter. The rationale for this index is that products that are exported by high-income countries have characteristics that allow high-wage producers to compete in world markets. These characteristics include, inter alia, technology, transport costs, natural resource availability, marketing and infrastructure quality. The sophistication index therefore represents an indirect measure of an amalgam of a various set of influences. This concept of measuring sophistication is combined with the U-shaped curve between specialization and GDP per capita in UNIDO (2009). Countries diversify by moving towards sophisticated products, and reach the highest level of diversification by producing low- and medium-sophisticated products. High-income countries specialize by producing highly sophisticated products (Figure 2.6).

[17] Lall (2000:34-35) divides all products in the SITC revision 2 (3-digit level) into primary products (PP), resource-based manufactures (RB) consisting of agro-based (RB1) and other products (RB2), low-technology manufactures (LT) consisting of textiles, garment and footwear (LT1) and other products (LT2), medium-technology manufactures (MT), consisting of automotive (MT1), process (MT2) and engineering (MT3), and high-technology manufactures (HT), consisting of electronic and electrical (HT1) and other (HT2).

Figure 2.6. Specialization and sophistication



Source: UNIDO (2009:18).

2.2.3. The U-shaped structure of exports

For analysing the production structure of a country, data on MVA are the most accurate, but are only available at a relatively aggregated level. The studies discussed below instead use export data, which are available at higher levels of disaggregation.

When excluding the top quartile of the countries according to GDP per capita, Bebczuk and Berrettoni (2006) confirm a U-shaped relationship between export specialization and GDP per capita. Klinger and Lederman (2004) confirm this U-curve for all countries and report a turning point towards re-specialization at a higher level than that for production data found by Imbs and Wacziarg (2003).[18] This leads them to conclude that "[…] the pattern of economic diversification observed by Imbs and Wacziarg is probably driven by patterns of international trade flows" (Klinger and Lederman, 2004:21), which they denote as "trade-driven economic diversification". However, this conclusion is questionable, because it might also be reasonable to conclude that export patterns *follow* production patterns, implying that countries first develop their production portfolio nationally and then enter the global market. Sunset industries, on the other hand, might still export despite declining production. A similar conclusion is also drawn in UNIDO (2009:12).

[18] Klinger and Ledermann (2004) use export data from UN Comtrade (2008) at the SITC 3-digit level (around 175 commodity groups), HS 4-digit level (around 1,200 commodity groups) and HS 6-digit level (around 5,000 commodity groups) of aggregation.

Klinger and Lederman (2004) extend their analysis to consider whether diversification takes place within existing products or sectors or through introducing new sectors that have not been exported before and are therefore "discovered"[19] to be profitable. They find that economic discoveries in the 1990s did not only take place in "modern" sectors, but also in sectors that are considered "traditional", such as foodstuffs and agriculture, with the highest level of discoveries in chemicals. The relationship between discovery events and GDP per capita[20] appears to be an inverted U-curve, but highly skewed to the left, indicating that the initial stage of diversification is driven by discoveries, whereas the subsequent stage of diversification is driven by dispersing production[21] among goods that are already produced. Surprisingly, sectoral discovery activity and income per capita are not significantly different across industries. This indicates that economic discovery activity is *not* driven by the process of structural transformation, as this would only be the case if discoveries in "traditional" labour-intensive sectors peak at low levels of development, whereas discoveries in "modern" capital-intensive sectors peak at high levels of development. Klinger and Lederman (2004:29) conclude that "[…] developing countries are not limited to discoveries in certain sectors based on their level of development."

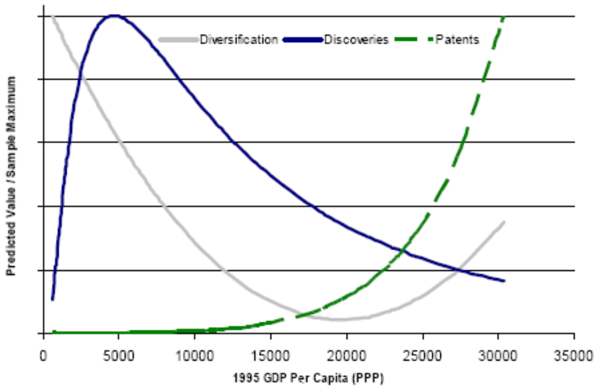
In a subsequent paper, Klinger and Lederman (2006) further investigate the idea of diversification by splitting diversification into inside-the-frontier-innovation, i.e., discovering the profitability of an existing product, and on-the-frontier-innovation, i.e., invention of new products measured by new patents. Figure 2.7 presents their empirical results of the evolution of discoveries (dark solid line), patents (dashed line) and overall specialization (grey line) in relationship with GDP per capita: Low-income countries introduce new products mainly rough discoveries, but as GDP per capita grows, the amount of discoveries decreases while the amount of new patents rises. Parallelly, the overall specialization follows a U-curve.

[19] The term "discovery" in this context was established by Hausmann and Rodrik (2003) to denote the production of a new good that does not necessarily stem from innovation but from entrepreneurial copying from abroad. This is particularly relevant in the context of developing countries. Klinger and Lederman (2004) define a "discovery" when the export level of a product was below US$10,000 in 1992 and above US$1,000,000 during the period 2000-2002.

[20] Measured in constant US dollars.

[21] Klinger and Lederman (2004:23) indeed use the term "production" and not "exports", although their analysis is based entirely on trade data.

Figure 2.7. Diversification and innovation

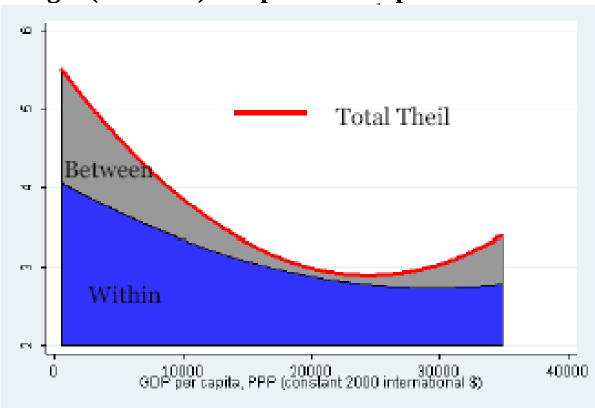


Source: Klinger and Lederman (2006:15).

A similar approach is to directly separate exports into differences at the extensive margin, i.e., differences in the number of product lines, and the "intensive margin", i.e., differences in the amount exported among the same number of products lines. Hummels and Klenow (2005) find that the extensive margin accounts for 62 percent of the greater exports[22] of larger economies. Carrère, Strauss-Kahn and Cadot (2007) further investigate this idea by splitting not just the export *value* but also export *diversification* into diversification at the extensive and intensive margins, i.e., diversification due to the addition of new product lines and diversification due to a more equal distribution within a constant number of product lines.[23] They confirm a U-shaped relationship between national income and export specialization for pooled and between regressions, but not for within-country regression, with the turning point found to vary among specialization measures.[24] As a separate exercise, Carrère, Strauss-Kahn and Cadot (2007) show that the U-curve is dominated by changes in the extensive margin, e.g., the opening and closing of new product lines (Figure 2.8). Unsurprisingly, countries with a higher share of raw material exports are more specialized, providing some support for the Dutch Disease hypothesis. However, controlling for raw material exports does not affect the turning point, which shows that the non-linear shape is indeed a feature of the overall economic development process rather than a reflection of the existence of primary-product exports.

[22] Measured at the HS 6-digit level for 126 exporters and 59 importers.
[23] Carrère, Strauss-Kahn and Cadot (2007) use export data from UN Comtrade (2008) on the HS 6-digit level and calculate the Gini, Theil and Herfindahl indices. Excluding countries with a population below 1,000,000 increases the level of the turning point. Including time effects (year dummies) to control for global shocks like high commodity prices does not alter their results.
[24] Carrère, Strauss-Kahn and Cadot (2007) suggest that the non-existence of a turning point when accounting for country fixed effects may result from the short time span covered.

Figure 2.8. Extensive margin ("between") and intensive margin ("within") components of specialization



Source: Carrère, Strauss-Kahn and Cadot (2007:39).

The relationship between production or export diversification and economic *growth* is of additional interest as it adds a time-dynamic perspective to the otherwise static diversification-income-analysis. Al-Marhubi (2000) shows that when controlling for other determinants, countries with a relatively higher export diversification[25] experienced faster growth. Lederman and Maloney (2003:15) provide further evidence for a positive effect of export diversification on the growth of GDP per capita that is robust to including other explanatory variables. Hesse (2008) finds a negative and linear relationship between export concentration and GDP per capita growth. Agosin (2007) develops and empirically tests a model of export diversification and economic growth, and finds that the introduction of new exports accounts for the main share of sources of economic growth in countries that are below the global technological frontier.

2.2.4. Criticisms on the U-curve

In his comment on Imbs and Wacziarg (2003), De Benedictis (2004) raises a number of criticisms on their approach and methodology. He points out that there are two different phenomena at work – diversification and structural change – which should be treated separately. *Structural change* means – in general terms – diversifying away from specialization in the agricultural sector by entering industrial activities and eventually specializing in services. This movement emerges as a U-curve, because it includes a stage of diversification characterised by more or less equal shares of the three sectors. *Diversification*,

[25] He calculates a simple form of relative diversification using export data on SITC 3-digit level, excluding countries which account for less than 0.3 percent of the country's total exports.

De Benedictis (2004) claims, is a short- to medium-term process of variations within sectors considered at a high level of disaggregation. To capture any diversification not resulting from structural change, one needs panel data with a high level of disaggregation and where the number of sectors exceeds the number of observed years, which is quite different from the dataset used by Imbs and Wacziarg (2003), who use a large number of years and a small number of sectors. Therefore de Benedictis, (2004:8) concludes that "[…] they [Imbs and Wacziarg, FK] in fact melt together structural change and diversification, short and long run, industrialization and efficiency from specialization. We believe that instead of strengthening their results, their robustness analysis confounds the possible causes of their result." (De Benedictis, 2004:8) This critique is underpinned by the observation that the upward-bending part of the U-curve for manufacturing is less distinct than the one for economy-wide data, presumably due to the exclusion of structural change in the first case.

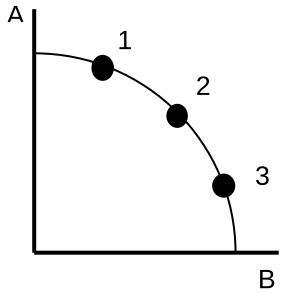
De Benedictis (2004) furthermore suggests the usage of export data instead of production data, as the theoretical arguments for national economic concentration refer to efficiency advantages due to international specialization. He uses different settings for the non-parametric approach to show that the relation between diversification and GDP per capita is highly nonlinear, with alternating phases of diversification and concentration along the path of rising GDP per capita. When using country fixed effects, diversification always increases along the path of rising GDP per capita, but this relationship is influenced by other explanatory variables, such as the size of the country (GDP or population), the level of openness, and the quality of institutions.

De Benedictis, Gallegati and Tamberi (2003) comment on Imbs & Wacziarg (2000)[26] by pointing out several potential problems, among them the understanding of "specialization" itself. Although a country will specialize in line with comparative advantage according to Ricardian theory, this does not automatically imply that its *overall* degree of specialization will increase. This idea is illustrated in Figure 2.9, where a country can produce two different goods, A and B. Assume that under autarky the country produces more of good A than of good B, which is marked by point 1. When the country opens up for trade, it receives production incentives from abroad via price signals that motivate it to shift production to a higher proportion of good B, indicated by point 2. This country has thus increased its

[26] Imbs and Wacziarg (2000) is an earlier version of Imbs and Wacziarg (2003).

specialization in good B, but its overall specialization has *decreased*. Assuming that the international price signal shifts the country to point 3 then an overall specialization index will first show a decrease in specialization, followed by re-specialization, thus creating a U-shaped path. Therefore, specialization in exports does not necessarily equal specialization in production.

Figure 2.9. Specialization in a two-good world



Source: Adapted from De Benedictis, Gallegati and Tamberi (2003:28).

An additional problem mentioned by De Benedictis, Gallegati and Tamberi (2003) is the use of employment shares to calculate specialization, since this implies the assumption of identical production functions across countries – i.e., same employment shares correspond to the same production pattern – which is questionable. They therefore employ export data[27] only and confirm a U-shape relationship between export specialization and GDP per capita for an average country, albeit with a weak re-specialization part.[28] In particular, they find that the level of GDP per capita affects the level of specialization for low-income countries, while the average intercept term, and therefore the country-specific effects, is more important when explaining the level of specialization in medium- and high-income countries.

In a subsequent paper, but using the same dataset, De Benedictis, Gallegati and Tamberi (2008) employ a fixed effects generalized additive model[29] and find no evidence for a re-specialization trend. They conclude that the re-concentration observed by Imbs and Wacziarg (2003) therefore may not be linked to trade-induced specialization.

[27] SITC 4-digit level, 786 total sectors but restricted to 539 manufacturing sectors, 1985-1998, 39 countries, GDP per capita in constant PPP dollars.
[28] Fixed effects rolling regressions to account for country-specific fixed effects. This method produces more robust results, but is not described here further, as it is not used in this analysis.
[29] This method allows for combining fixed country-effects with a non-parametric smoothing function.

An important criticism of the standard measures of specialization is that they implicitly measure the deviation from a rectangular distribution, where each sector or product has the same share in total production, exports or employment. This shortcoming can be resolved by using the concept of “relative diversification” (Amiti, 1999). The following example illustrates the difference between absolute and relative diversification as well as the conceptual shortcoming of absolute diversification. Consider a simplified world with three different goods and a small country that exports these goods with a certain distribution to the rest of the world at time *t*. Assume a specific distribution of exports, as described in Table 2.2 for two periods of time, together with a constant global distribution of exports, which should equal the global distribution of imports.

Table 2.2. Example for absolute specialization and relative diversification

	Country X at time t=1 (percentage)	**Country X at time t=2** (percentage)	**World average at time t=1,2** (percentage)
Good 1	20	10	10
Good 2	30	40	30
Good 3	50	50	60

This country increases its export specialization over time, which would be reflected in a higher value of the Gini coefficient. When thinking along classical terms of specialization and volatility, it could be concluded that due to the increased focus on a narrower set of products, the country becomes more vulnerable to global demand shocks. However, the country’s export structure convergs towards the world’s import structure, hence the country meets foreign demand better than before, which might be beneficial despite being more specialized in an “absolute” sense. Given the current interdependence of national economies, the idea of relative diversification might be more meaningful than absolute diversification, because it is sensitive to global changes, reflecting the fact that the economic situation of a country changes when the global situation changes, e.g., due to changes in preferences or in technology. Amiti (1999) adds that relative specialization is a better option because trade theories predict that trade liberalization will lead each country to become more different from its trading partners in terms of production and exports.

De Benedictis, Gallegati and Tamberi (2007:11-12) use the idea of revealed comparative advantage[30] to quantify the idea of measuring the *relative* diversification of manufacturing exports.[31] They run separate regressions[32] for the linear and quadratic effects of GDP per capita and find that countries diversify with rising GDP per capita, with a more rapid change found at lower levels of GDP per capita, but *without* an upward-bending part. Since they explicitly criticise the U-curve discovered by Imbs and Wacziarg (2003), it should be noted that they include only 39 countries, while Imbs and Wacziarg (2003) include 99 countries.

Using US import data, Schott (2004) shows that specialization across products is not taking place, as the same products are imported from high-, middle- and low-income countries, however he finds evidence for specialization within products, meaning that high-wage countries export high-price products to the United States of America (USA), i.e., Italy exports sportswear that is capital or skill intensive, while China exports sportswear that is labour intensive.

For the countries of the European Union (EU)[33], no strong and general trend towards specialization is observed. Specialization in production is increasing, but this is mainly driven by large industries in big economies, stressing the importance of regional clusters. There is no clear trend in production specialization in small economies. Specialization in exports is decreasing, and, in particular, large trade balances are declining (Aiginger et al., 1999). The increasing specialization in production is also exposed in Aiginger and Davies (2004), who additionally reveal the surprising trend of decreasing concentration of industries among EU member States in the 1990s. However, evidence in favour of increasing relative specialization in the EU is observed when a specific period of trade liberalization is analysed (Amiti, 1999).

Although there seems to be disagreement on the existence of a re-specialization trend for high-income countries, the majority of studies present empirical evidence indicating a trend to diversify the production or export structure in low-income countries. However, UNCTAD (2008:22-28) finds that only 19 out of 50 African countries experienced a decrease in their

[30] See section 3 for methodological details of their analysis.
[31] SITC 2-digit (around 50 manufacturing products) and 4-digit level (around 500 manufacturing products). They restrict the dataset to manufacturing to avoid biases linked to geographical and geophysical characteristics.
[32] Using a General Additive Model that allows one to combine non-parametric and parametric components.
[33] The European Union comprised only 15 member States at the time of the cited survey.

export specialization between 1995 and 2006,[34] hence dependency on a small number of export products has increased since the liberalization of the trade regimes in the late 1980s and 1990s.

2.2.5. Theoretical explanations of the U-curve

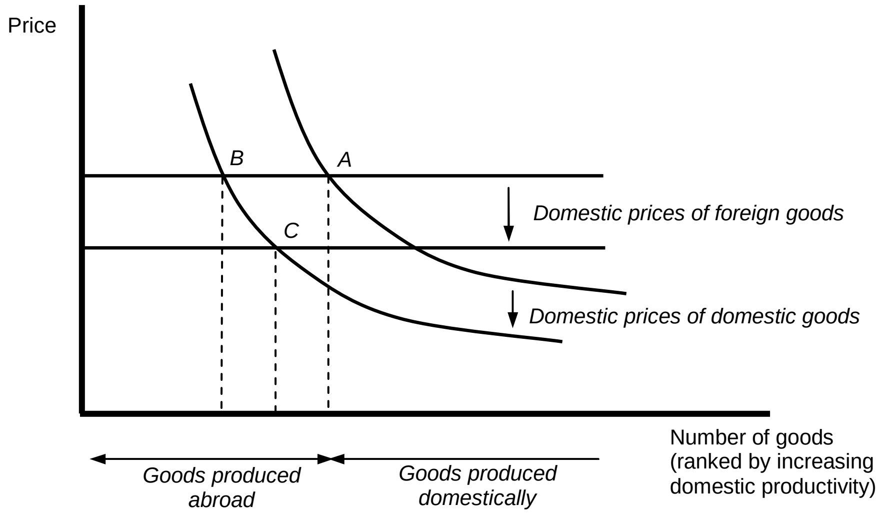
The *causality* between export diversification and growth can potentially run in two directions: On the one hand, the acquisition of new comparative advantages can lead countries to enter new markets and increase their income while, on the other, countries with a low GDP income per capita tend to have a comparative advantage in a limited range of goods, as they lack the skills or inputs to apply knowledge that already exists elsewhere. As GDP per capita rises, a country becomes increasingly able to produce a wider range of goods and compete in international markets (Agosin, 2007:4).

In a working version of their paper concerning the U-curve, Imbs and Wacziarg (2000)[35] propose a theoretical model which endogenizes the stages of diversification via trade forces (Figure 2.10). Each country produces only the subset of all potentially producible goods in which it is most productive, i.e., which can be produced cheaper than imported products. As a country catches up with the global technological frontier, its aggregate productivity rises, and so does the number of goods that can be produced domestically at competitive prices, thus the country diversifies (represented by a shift from A to B in Figure 2.10). But as infrastructure improves, transport costs fall, which leads to a decrease in the prices of imported goods. As a result, the number of domestically produced goods decreases, so concentration rises again (indicated by the movement from B to C in Figure 2.10). In other words, "[…] the presence of transport costs forces diversification beyond comparative advantage." (Imbs and Wacziarg, 2000:11).

[34] Based on a Herfindahl-Index applied to SITC 3-digit data, including only products whose national export value is higher than US$100,000 or represent more than 0.3 percent of total national exports (UNCTAD, 2008b).

[35] Imbs and Wacziarg (2000) is an earlier working version of Imbs and Wacziarg (2003). The theoretical model presented in the earlier version is not included in the later published version.

Figure 2.10. Specialization and transport costs



Source: Adapted from Imbs and Wacziarg (2000).

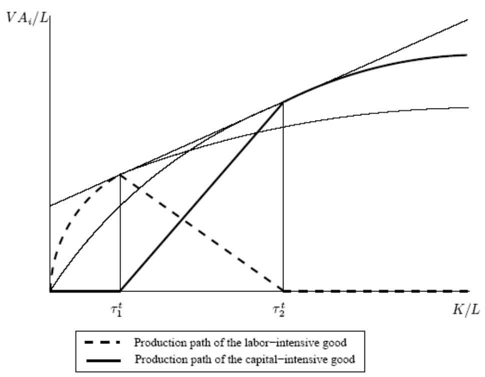
Linking the financial sector with the real sector constitutes a different theoretical explanation: When a country does not have access to global financial markets that could alleviate potential negative sectoral shocks, the only way left to absorb the potential effects of a sectoral shock is to diversify production across sectors. Once a country has gained access to the global financial market, sectoral diversification is no longer required to spread the risk. At this stage, the country can experience the advantage of specialization due to economies of scale via international division of labour (Saint-Paul, 1992).[36]

Batista and Potin (2007) employ a Heckscher-Ohlin model to explain the potential causes of the U-curve: Countries with a low capital-labour ratio – mainly low-income countries – specialize in the production of labour-intensive goods, countries with a high capital-labour ratio – high-income countries – specialize in the production of capital-intensive goods, and countries with an intermediate capital-labour ratio produce both types of goods. Figure 2.11 displays these different production paths: For countries with a minimum amount of capital, the value added per worker in the labour-intensive good (the dotted line in Figure 2.11) first rises steeply with rising capital intensity, while value added in the capital-intensive good (the solid line in Figure 2.11) remains at zero level. After reaching a point of maximum value added per worker in the labour-intensive sector, the value added per worker in this sector

[36] Saint-Paul (1992) finds the equilibrium with higher financial integration and specialization of technology more "appealing" than the equilibrium with lower financial integration and a diversified production technology, because "[…] we tend to think that financial markets are the most appropriate instrument for such a diversification." Saint-Paul (1992:764) However, this opinion can be questioned, especially in view of the 2008/2009 global financial crisis.

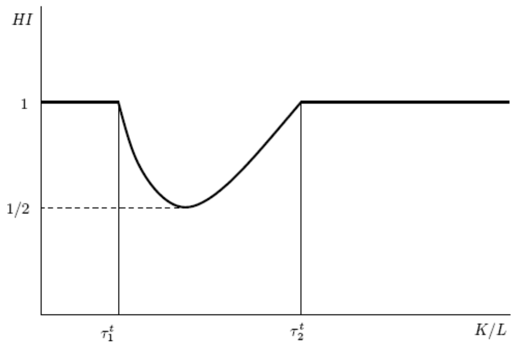
declines with rising capital-labour ratio, while the value added per worker in the capital-intensive sector rises until the country is fully specialized in capital-intensive goods. Figure 2.12 shows the resulting U-curved relationship between specialization on the vertical axis and capital-labour ratio on the horizontal axis.[37] Batista and Potin (2007) find that neoclassical factors – capital accumulation through the Rybczinski[38] effect, changes in relative prices, biased technological change – account for at least one third of the evolution of economic specialization, leaving the rest for other explanations like economies of scale and risk diversification. The textbook-HO-model model they employ is based on several assumptions such as constant returns to scale, access to the same technology by all countries,[39] small size of countries, free trade between countries, and a production where only two factors (capital and labour) are used to produce the two types of goods.

Figure 2.11. Production patterns in the 2x2 HO model



Source: Batista and Potin (2007:6-7).

Figure 2.12. Herfindahl index in the 2x2 HO model



Source: Batista and Potin (2007:6-7).

2.2.6. Other determinants of diversification

The discussion on the U-curve has also stimulated new research on the *determinants* of export specialization and diversification, as the level of specialization is most probably not only determined by economic income, and the U-curve might not be robust when controlling for other potential determinants.

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[37] The classification of goods into capital-intensive or labour-intensive is taken from Schott (2003), whereas data on manufacturing investment, labour and value added were taken from UNIDO at the 3-digit level of ISIC Revision 2. The 28 sectors were aggregated into 19 sectors like in Koren and Tenreyro (2004). They calculate Herfindahl indices decomposed into change within sectors and change between sectors (i.e., due to shift from labour-intensive to capital-intensive).

[38] The Rybczinski effect shows that an increase in the endowment of one production factor causes a more than proportional increase in the output of the good that uses this factor intensively (Krugman and Obstfeld, 2006:60).

[39] Schott (2003:11) notes that assuming same technologies for all countries might be problematic, as within-industry capital intensity varies substantially across countries.

Bebczuk and Berrettoni (2006) find that richer, more efficient, more stable and more open countries tend to specialize rather than diversify their exports.[40] Surprisingly, variables typically associated with good macroeconomic performance (GDP per capita, exports to GDP ratio, investment rate, credit and infrastructure) are correlated with *specialization*, which goes against the idea that export structures diversify during the process of economic development. They interpret these results as evidence for supporting an individualistic view in which entrepreneurs wish to take advantage of specialization-based economies of scale when macroeconomic risks are low. Unsurprisingly, exporters of manufacturing products are more diversified than fuel exporters. Regional dummies for South America and Africa account for a big share of specialization, which are not explained by measurable macroeconomic factors.[41] As countries, on average, move towards increased diversification over time, despite different macroeconomic stability situations, Bebczuk and Berrettoni (2006:15) conclude that it is not volatility per se that drives diversification, but the "[…] desire to unburden themselves from the primary product dependence."

Osakwe (2007:20) tests whether aid inflows, geography and resource endowments help explain Africa's lack of economic diversification,[42] while controlling for infrastructure, the level of development, macroeconomic policy, education and the quality of institutions.[43] His results[44] show that there is path dependence in the diversification process. Infrastructure and institutions have a positive impact, whereas aid has a negative coefficient. Surprisingly, the ratio of arable land to total land has a positive impact on diversification, and geography has no influence at all. However, Osakwe (2007) does not consider a non-linear influence of any determinant on specialization.

In their analysis of product discovery, Klinger and Lederman (2004:34-35) find that export growth has a significant and positive impact on product discovery, indicating that export-promoting strategies are also discovery-promoting. Nevertheless, absorptive capacity is negatively correlated and barriers to entry are positively correlated with discovery, which is

[40] Using 2-digit SITC export data (69 sectors).
[41] Although not admitted by Bebcuk and Berrettoni (2006), the coefficients of the regional dummies could also result from macroeconomic factors that are not included in their regression.
[42] Although Osakwe (2007:17) uses only the share of manufactures in total exports as a measure of diversification, the potential explanatory factors might also apply to a broader definition of diversification.
[43] Instrumental variables for institutions are the number of telephone lines per 1,000 persons, per capita income, inflation rate, literacy rate and durability of political regime.
[44] Using the System Generalized Methods of Moments regression method.

surprising, and lends support to the market failure hypothesis described in Hausmann and Rodrik (2003).

2.2.7. Implications for development policy

The implications for development policy, resulting from the discussion outlined in the previous chapters concerning the stages of diversification, are immense. The common notion of specializing in what one does best as a way to economic prosperity and hence poverty reduction seems to be substantially wrong. “Whatever it is that serves as the driving force of economic development”, Rodrik (2007:103) concludes from Imbs and Wacziarg (2003), “it cannot be the forces of comparative advantage as conventionally understood. The trick seems to be to acquire mastery over a broader range of activities, instead of concentrating on what one does best.”[45] The misconception of comparative advantage in this context is the idea of interpreting it as a static concept rather than a dynamic process. These insights might not be a big surprise, but according to Rodrik (2005), go against what was taught over the past four decades in North American Universities in Economics doctorate programmes, namely, that a country must specialize according to its comparative advantages in order to get rich and free itself from poverty.

The seminal study of Imbs and Wacziarg (2003) therefore not only had a huge impact on the academic discussion, but is also influencing international development policy. In the recent Industrial Development Report (UNIDO, 2009), the U-curve serves as a justification for the “new structuralist” view that what a country manufactures matters for growth. The crucial question is why and how diversification in low-income countries is taking place. Is it a result of market forces that might stimulate diversification through competition or trade, or can diversification only be achieved through public economic policy? In the latter case, market forces might better serve as an explanation of the declining trend and eventual turn of diversification. After diversifying an economy through industrial policy and thereby reaching a certain level of GDP per capita, the influence of market forces increases and inefficient branches of the economy shrink.

[45] See also Rodrik (2007c:9-10) for a similar conclusion.

The current paradigm of liberalising an economy and investing in human capital to exploit existing comparative advantages in simple activities may generate economic growth in the short run, but once the initial “easy” stage of exporting is completed, significant technological upgrading and deepening are required to continue the growth trend (Lall 2000:30). The resulting question is therefore, why some countries manage to develop a broader range of products than others. The answer to this question will shed light on the matter of the “right” industrial policy.[46] Rodrik (2007:100, italics in original) proposes that “[t]he nature of industrial policies is that they complement – opponents would say ‘distort’ – market forces: they reinforce or counteract the allocative effects that the existing markets would otherwise produce. […] [The] analysis of industrial policy needs to focus not on the policy *outcomes* – which are inherently unknowable ex ante – but on getting the policy *process* right.”

On its website, the World Bank is utilizing the findings of Imbs and Wacziarg (2003) and Rodrik[47] as a motivation for its New Industrial and Innovation Policy, which aims at facilitating “[…] learning and self-discovery of private sector actors […] [to] acquire mastery over broader range of activities, not just concentrate on what one does best […].” (World Bank, 2009)

But why would this process of learning and self-discovery need any support through industrial policy? One answer may lie in market failures through externalities. Hausmann and Rodrik (2003) apply the idea of information externalities to problems faced by developing countries. Their challenge is not to develop *new* products or processes, but to discover that a certain product or process, which is already well established in world markets, can be produced locally at low cost. Most knowledge is tacit, meaning that it cannot be formalized and transferred to other countries. The innovators of new goods and processes can be protected through an intellectual property right regime, but an investor who discovers the profitability of an existing good does not receive such a protection, so the private returns to investment in discoveries lies below the social returns – a laissez-faire policy would therefore create too little investment initially. Entrepreneurial effort – and therefore investment – is also required to adapt a product that is already produced domestically to the “taste” of potential foreign markets. An example is wine production in Chile. Wine has been produced in Chile since the

[46] Rodrik (2007:100) generally defines “industrial policy” as “policies for economic restructuring”.
[47] World Bank (2009) does not mention specific publications of Dani Rodrik, but puts a link to his collected publications.

16th century, but has only been exported since 1985 after entrepreneurs introduced modern techniques and uncovered foreign demand patterns (Agosin and Bravo-Ortega, 2007:11-25).

Rodrik (2007:107-109) describes coordination failures as another type of externality relevant to the discussion of economic diversification. Starting a new economic activity depends to a large extent on the surrounding infrastructure and other supporting institutions, which have a high level of fixed costs. An individual producer might not know in advance if their investment will be profitable and will therefore be reluctant to invest in upstream and downstream activities. A similar way to interpret coordination failures in the context of development theory is connected to economies of scale: The so-called big push models of economic development assume that low-income countries are in a trap of low productivity created by an absence of economies of scale. A third way to combine coordination failures with the thinking of economic diversification is the cluster approach, which describes the instruments to be used by governments to foster the development of some specific sectors of the economy. Again, a process of clustering of new emerging economic activities can theoretically be achieved within the private sector alone, but this is probably not the case for low-income countries. One way to overcome these coordination failures is for the governments to promise subsidies for the case that theinvestments are not profitable. If this expectation of a bailout in case of failure is credible, then investments will take place and the likelihood of an unprofitable investment will be small ex-post, which will make the ex-ante promised subsidies obsolete.[48] Obviously, this method of promoting economic diversification is open to moral hazard and abuse, and such policy instruments were blamed for the Asian financial crisis of 1997. Noteworthy, the same policies that were attributed as the root cause of the Asian crisis, Raffer and Singer (2004:148) point out, were previously praised as the reason for the preceding enormous growth rates.

Above all, successful policies for economic diversification cannot be a top-down process with a static set of rules for the private sector. As only the private sector is fully informed of the problems to be solved, economic policy needs to create some form of strategic collaboration and coordination between the public and private sectors (Rodrik, 2005:20-21).

[48] This solution also applies to overcome information externalities, where the key lies in encouraging investments in the modern sector ex ante, but to rationalize production ex post (Hausmann and Rodrik, 2003:7).

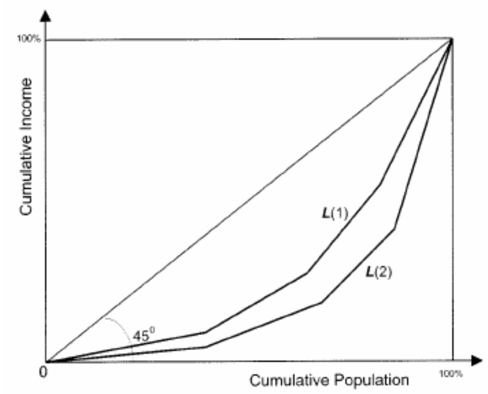
Having outlined the intensive discussion concerning the existence and interpretation of a general pattern in diversification or specialization of economic activity, the subsequent quantitative sections focus on the core of this discussion, namely, whether countries follow a specific trend of diversification and/or specialization.

3. Data and methodology

3.1. Measuring absolute product specialization

Several specialization (or diversification) measures are calculated for each country and year for each export and MVA dataset. The Gini coefficient is a commonly used measure of diversification. A Gini value of zero equals perfect equality, whereas a value of one indicates a maximum unequal distribution, i.e., one sector or product line accounts for the total value of production or exports, whereas all other sectors (or product lines) have zero values. Geometrically, the Gini coefficient can be interpreted as the ratio of the area between the line of perfect equality and the Lorenz curve to the area of the triangle between the line of perfect equality and the diagram axes. Figure 3.1 shows two stylized Lorenz curves for the income of population groups – for which the concept of the Lorenz curve was initially developed (cf. Lorenz, 1905) –, where *L(1)* displays a more equal distribution of income than *L(2)*. In the subsequent analysis, sectors or products are used instead of population groups, and MVA or export values instead of income.

Figure 3.1. Stylized Lorenz curve



Source: Ray (1998:180).

The Gini, Theil and Herfindahl indices are calculated according to Carrère, Strauss-Kahn and Cadot (2007:6-7). For each country and year, the products are sorted in increasing order of their value added (or export value) *e* such that that $e_k < e_{k+1}$ for all product lines *e*, with *K* denoting the total number of product lines. Omitting country and time subscripts, the formula for the Gini coefficient is given by

$$G = \left| 1 - \sum_{k=1}^{K} (E_k - E_{k-1})(2k-1)/N \right|. \quad (1)$$

where E_k, the cumulative value added (or export) shares, can be written as

$$E_k = \frac{\sum_{i=1}^{k} e_i}{\sum_{i=1}^{K} e_i}. \tag{2}$$

The second measure, the Herfindahl Index, can be computed according to

$$H = \frac{\sum_{k=1}^{K} (s_k)^2 - \frac{1}{K}}{1 - \frac{1}{K}} \tag{3}$$

where

$$s_k = \frac{e_k}{\sum_{i=1}^{K} e_i} \tag{4}$$

is the share of product or export line k in total value added or exports. This Herfindahl Index is normalized to range between zero and one.

As third measure, the Theil entropy index takes the form

$$T = \frac{1}{K} \sum_{k=1}^{K} \frac{e_k}{\mu} \ln\left(\frac{e_k}{\mu}\right) \tag{5}$$

with

$$\mu = \frac{\sum_{k=1}^{K} e_k}{n}. \tag{6}$$

Similar to the Herfindahl Index is the Hirschman Index, which is given by

$$HI = \sqrt{\sum_{k=1}^{n} (s_k)^2}. \tag{7}$$

Additionally, the number of active product lines, i.e., observations with a value greater than zero, is also used to capture the extensive margin of diversification.

3.2. Measuring relative product specialization

Using standard distribution measures that describe deviations from uniform distributions might not be sufficient to describe the evolution of the economic structure of a country, as described in section 2. To capture *relative* specialization, De Benedictis and Tamberi (2004) use the Balassa Index (BI) of revealed comparative advantage:

$$BI = \frac{e_{c,k}}{e_c} \Big/ \frac{e_{w,k}}{e_w} \qquad (8)$$

where e denotes exports, c denotes a specific country, w the whole world, and k a specific product. The BI therefore measures – for each sector – the ratio of a sector's share within a country relative to the global share of that sector within total exports.

The BI can also be written as

$$BI = \frac{e_{c,s}}{e_{w,s}} \Big/ \frac{e_c}{e_w} \qquad (9)$$

which can be interpreted as the ratio of a country's share of sectoral export to the country's share in world exports. When a sector has a BI above one, it reveals a comparative advantage in that sector. To calculate an overall BI of a country, the respective medians of the sectoral BIs are more suitable than the means due to the skewness of a country's BIs. A high median BI implies that a country has revealed comparative advantage in a large share of sectors.

Two additional measures of overall relative specialization are calculated following De Benedictis, Gallegati and Tamberi (2007). First, after sorting the observations of each country by the BI in ascending order, the relative Gini coefficient[49] is given by

$$relGini = \frac{\sum_{i=1}^{n-1}\left(p_i - q_i\right)}{\sum_{i=1}^{n-1} p_i} \qquad (10)$$

where q_i and p_i are cumulated shares of the numerator and denominator of BI (equation 8), thus the cumulated national and world sectoral shares. Second, the Theil Index can be also be modified to account for relative specialization:

[49] Also called "country Gini" in some studies.

$$relTheil = \sum_{k=1}^{K} \left[\frac{e_k}{e} \ln\left(\frac{e_k / E}{f_k / F} \right) \right] \tag{11}$$

where e_k denotes country exports in sector k, f_k is world exports in sector k, E is total exports in the country, and F is total world exports. The relative Theil Index is therefore a weighted sum of the logarithms of sectoral Balassa Indices, with weights represented by country sectoral shares.

Al-Marhubi (2000), UNCTAD (2008b) and Albaladejo (2007) use the sum of the differences of the national and world sectoral shares as a measure of relative specialization:

$$DI_c = \frac{\sum_k \left| h_{k,c} - h_k \right|}{2} \tag{12}$$

where $h_{k,c}$ is the share of commodity k in total exports of country c, and h_k is the share of commodity k in world exports.[50]

3.3. Econometric methods

Panel data sets, which are a combination of cross-country and time-series datasets, are used throughout this study. One major advantage of panel data over either cross-country or time-series data is that if the explanatory variables in a cross-country regression are correlated with other unobservable variables, then the least squares coefficient estimators are biased. This is most likely the case in the data used in this study, as a large number of factors are expected to determine the specialization level of countries, including factors that are static over time, such as country size and geography. Using the panel structure, the effects of unobservable correlates may be eliminated by looking at first differences or deviations from the country means.

Following Greene (2003:283-303), the basic panel data model with constant coefficients can be written as

$$y_{ct} = x'_{ct}\beta + z'_c\alpha + \varepsilon_{ct} \tag{13}$$

[50] Note, the formula in Al-Marhubi (2000:560) has the absolute value bars on different positions, but in my opinion it is only correct as reported here.

where z_c contains a constant term and a set of country-specific variables, and c and t denote the country and time dimension, respectively. If z_c contains only a constant term, then the panel structure can be neglected and Ordinary Least Squares (OLS) provides consistent and efficient estimates of the constant α and slope β. This method is called pooled regression.

If z_c is unobserved but correlated with x_{ct}, then the model takes the form

$$y_{ct} = x_{ct}'\beta + \alpha_c + \varepsilon_{ct} \tag{14}$$

where $\alpha_c = z_c'\alpha$ specifies an estimable country-specific constant term. This so-called fixed effects regression can be estimated by either including country dummies in the pooled regression or by estimating the model using deviations from the group means:

$$y_{ct} - \bar{y}_{c.} = \left(x_{ct} - \bar{x}_{c.}\right)'\beta + \varepsilon_{ct} - \bar{\varepsilon}_{c.} \tag{15}$$

Fixed effects regression can be interpreted as an estimation of the variation of an "average" country. The results on the fixed effects regression are highly relevant in the context of this study, as they indicate whether the specialization paths of countries follow individual U-shaped curves, which might not be observable in a pooled panel, because the difference between the average levels of countries might outweigh the variation within each country.

To capture the variation of the time-invariant means of country's specialization patterns, the so-called between effects regression takes the form

$$\bar{y}_{c.} = \bar{x}_{c.}'\beta + \alpha + \bar{\varepsilon}_{c.} \tag{16}$$

If the unobserved individual heterogeneity can be assumed to be uncorrelated with the included variables, then the so-called "random effects" approach can be used:

$$y_{ct} = x_{ct}'\beta + \alpha + u_c + \varepsilon_{ct} \tag{17}$$

where $u_c + \varepsilon_{ct}$ can be treated as a composite error term, as u_c cannot be estimated separately. Contrary to the pooled regression above, this composite error term violates some assumptions of OLS, with Generalized Least Squares being the best linear unbiased estimator.

The general parametric specification to verify the existence of a U-curve is to regress specialization on GDP per capita and squared GDP per capita:

$$Specialization_{ct} = \beta_0 + \beta_1 \cdot GDPperCapita_{ct} + \beta_2 \cdot GDPperCapita_{ct}^2 + \varepsilon_{ct} \qquad (18)$$

where β_1 is expected to be negative and β_2 to be positive, as the sum of a negative linear function and a positive squared function equals a U-curve, though only when the turning point lies within the range of GDP per capita. The turning point is calculated by setting the first derivative of (18) with respect to GDP per capita to zero and rearranging:

$$GDPperCapita^{turn} = -\frac{\beta_1}{2\beta_2} \qquad (19)$$

Non-parametric curves were calculated using the Lowess procedure (cf. Imbs and Wacziarg, 2003). The general idea of non-parametric smoothing procedures is a local linear least squares problem,

$$\min_{\alpha,\beta} \sum_{i=1}^{I} \left\{ \left[y_i - \alpha - \beta(x_i - x) \right]^2 w(x_i - x; h) \right\} \qquad (20)$$

where the right part is the positive symmetric kernel function with a maximum at zero and decreasing with distance from *x*, therefore giving less weight to observations further away from *x*. The fixed smoothing parameter *h* selects the bandwidth of the smoothing function. An advantage of this method is that it allows one to draw conclusions about the shape of the relationship between two variables without imposing a structure on the functional form. An obvious disadvantage is the higher computational intensity. It should also be noted that the selected bandwidth has a large impact on the results obtained, and one should be aware of the potential to "over-smooth" or "under-smooth" the data.

3.4. Overview of the data

This study brings together four different datasets, with one dataset for industrial production and three datasets for exports. Data on MVA are taken from UNIDO (2006) using the ISIC revision 2 nomenclature[51] at the 3-digit level, corresponding to 28 different manufacturing

[51] The International Standard Industrial Classification (ISIC) is a system for classifying economic production, while the Standard International Trade Classification (SITC) as well as the Harmonized Commodity Description and Coding System (HS) are used to classify trade flows. As the total variety of products increase over time through innovation, these systems undergo revisions every few years. In every nomenclature, all

sectors, where data are available from 1963 to 2003.[52] Export data are obtained from the UN Comtrade (2008) database at the 5-digit level (935 non-zero product lines) of the SITC Revision 1 classification, and the 6-digit level (5,018 non-zero product lines) of the HS 1989/92 system, as well as the dataset of Feenstra et al. (2005), who created a database at SITC Revision 2 (4-digit level, 1,069 non-zero product lines) that has been corrected for errors by comparing export and import data and by including national databases. Each of these datasets has particular advantages and disadvantages: The HS dataset has the highest level of disaggregation, but covers the shortest period (1989-2005), the Feenstra dataset has been corrected for errors and covers a longer period (1962-2000), but is much more aggregated. The SITC dataset covers the longest time span (1962-2006), with an aggregation level similar to the Feenstra dataset (Table 3.1).

Table 3.1. Datasets on exports and MVA used in this study

Variable	Source	Number of Countries	Period
Exports SITC Revision 1, 5-digit	UN Comtrade (2008)	212	1962-2007
Exports HS 1989/92	UN Comtrade (2008)	185	1988-2007
Exports SITC Revision 2, 4-digit	Feenstra et al. (2005)	201	1962-2000
MVA ISIC Revision 2, 3-digit	UNIDO (2006)	158	1965-2003

For MVA data, the dataset is modified so that the number of sectors available through time for each country is constant, which requires excluding observations on some sectors when observations for a given country were not available for all years (cf. Imbs and Wacziarg, 2003:3). This approach is necessary since missing values do not necessarily indicate zero values, but may represent non-reported entries, because UNIDO data are based on data obtained from national surveys which do not always cover all economic activities. However, some countries report an aggregation of specific sectors – for example, food products and beverages – into one larger sector. These various aggregation combinations differ between countries, and there are several ways to deal with this issue. First, all aggregated sectors were deleted, leaving only countries that do not aggregate sectors at all and hence report on all 28

products are classified into product groups at different levels of aggregation, where the number of digits within the name of the category represent the level of aggregation. For example, in ISIC revision 3, category 1552 (Wines) is a sub-sector of 155 (beverages), which is part of division 15 (Manufactures of food products and beverages) in category D (manufacturing).

[52] In this dataset, data from countries that already report their data in Revision 3 have been converted to Revision 2 data (Yamada, 2005).

sectors.[53] Second, as some specific combinations of sectors appear in a substantial number of countries, one can aggregate these sectors in *all* countries. Following the combinations suggested by Koren and Tenreyro (2004:15-16), the dataset we are left with has 19 sectors. This latter method results in more observations than when using 28 sectors, but it also means that data of countries reporting more than 19 sectors are contracted, hence some information is lost.

For export data, handling missing values is different, because most missing values in fact represent zero exports.[54] Contrary to employment and MVA data, missing values therefore have to be replaced by zero values to obtain a rectangular dataset (cf. Carrère, Strauss-Kahn and Cadot, 2007:7).

Data on GDP per capita are from World Bank (2008), using both constant 2000 US dollars to exclude effects stemming from inflation and constant 2005 international dollars at Purchasing Power Parity (PPP) for better comparability across countries.[55] Other variables that are used in the subsequent analysis are listed in Table 3.2.

Table 3.2. Explanatory variables used in this study

Variable	Source
Capital-labour ratio	Isaksson (2007)
GDP per capita (constant 2005 US dollars)	World Bank (2008)
GDP per capita (constant international PPP dollars)	
Capital stock	Calculated using the perpetual inventory method using World Bank (2008) data on Gross Capital Formation
Sophistication (constant 2005 US dollars)	Calculated from UN Comtrade (2008) according to Hausmann, Hwang and Rodrik (2006)
Share of oil exports in total exports (percent)	Calculated from UN Comtrade (2008)
Share of exports in GDP (percent)	World Bank (2008)
Share of agricultural value added in GDP (percent)	World Bank (2008)
Share of MVA in GDP (percent)	World Bank (2008)
Labour force	World Bank (2008)
Land Area	CEPII (2006)
Years of schooling	Barro and Lee (2000)

[53] Imbs and Wacziarg (2003) include countries with 27 reported sectors in their fixed effects regressions.
[54] Gleditsch (2002) conducts an in-depth analysis on the issue of missing values in trade datasets: Some missing export values are actually non-reported positive values, which can be obtained from the corresponding import values, as being done in the Feenstra dataset. A minority of missing values can be replaced by positive values through time-series methods such as interpolating and estimating lags and leads.
[55] The availability of GDP data in constant PPP dollars is smaller than in constant US dollars however, so this study concentrates on using constant 2000 US dollars, (while further results are presented in Appendix B.2).

Population	World Bank (2008)
Share of urban population in total population (percent)	World Bank (2008)
Share of agricultural raw material exports in total exports (percent)	World Bank (2008)
Domestic credit to private sector (percent of GDP)	World Bank (2008)
FDI inflows (percent of GDP)	World Bank (2008)
Inflation, GDP deflator (annual percent)	World Bank (2008)
Life expectancy (years)	World Bank (2008)
Share of manufactured exports in total exports (percent)	World Bank (2008)
Mobile phone subscribers (per 100 people)	World Bank (2008)
Telephone mainlines (per 100 people)	World Bank (2008)
Political instability	Polity IV (2007)
Absolute latitude of country centroid	CEPII (2006)
OPEC dummy	Rose (2006)
Landlocked dummy	CEPII (2006)
Island dummy	Rose (2006)
Regional Dummy (6 regions excluding Western Europe)	World Bank (2008)

4. Econometric analysis

This section presents the results from the empirical analysis on the pattern of economic diversification, based on the literature presented in Section 2. Since the papers discussed above employ different definitions of "specialization", different econometric methodologies and different datasets, the conclusions from these studies often differ or even contradict each other. To be able to draw general conclusions therefore, it is imperative to conduct a thorough econometric analysis, which combines and directly compares the various methods and datasets used.[56]

4.1. Production of goods

4.1.1. Descriptive statistics

Although Imbs and Wacziarg (2003) have initiated the recent discussion on the pattern of diversification, their analysis leaves many questions open. Production statistics, especially concerning MVA, are based on national surveys and estimates that might not reveal the true economic activity of an economy, in contrast to export data, which are directly measured. Even if surveys would cover all formal activity in a specific country, one has to be aware that any conclusions of the results ignore informal economic activity.

It is also questionable whether using UNIDO data as in Imbs and Wacziarg (2003), which only cover manufacturing, allows one to obtain information about the robustness of the results, or whether this is something separate that cannot be compared to studies of the entire economic activity of a country as De Benedictis (2004) stresses (see Section 2). However, their approach is used as a starting point for the econometric analysis that follows in this study.

For MVA data, the absolute Gini, Theil, Herfindahl and Hirschman indices are computed as described in section 3. Table 4.1 shows the ten most diversified and ten least diversified

[56] All statistical results in this section, including tables and figures, are based on the author's own calculations if not otherwise indicated.

countries according to their Gini value in 1994.[57] Portugal, Austria and Argentina are the most diversified countries, while Kuwait, Senegal and Gabon are the most specialized countries. This is somehow consistent with the U-curve hypothesis, as the list is not entirely headed by highest-income countries, although high-income countries, like Austria and the United Kingdom, still rank relatively high. However, as expected, the most specialized countries are low-income countries.

Table 4.1. Ten most and ten least specialized countries, MVA, 1994

Rank	Country	Gini	Theil	Herfindahl	Hirschman
1	Portugal	0.44	0.33	0.03	0.25
2	Austria	0.46	0.35	0.03	0.25
3	Argentina	0.48	0.39	0.03	0.26
4	Korea, Rep. of	0.49	0.40	0.04	0.27
5	United Kingdom	0.49	0.40	0.03	0.26
6	Canada	0.49	0.42	0.03	0.26
7	Turkey	0.50	0.41	0.03	0.26
8	United States	0.50	0.42	0.03	0.26
9	Macedonia, FYR	0.51	0.43	0.03	0.26
10	Chile	0.51	0.47	0.05	0.28
32	Ethiopia	0.67	0.84	0.08	0.34
33	Honduras	0.69	0.93	0.11	0.38
34	Oman	0.70	0.91	0.09	0.35
35	Panama	0.72	1.09	0.15	0.43
36	St. Lucia	0.73	1.05	0.11	0.37
37	Ecuador	0.76	1.26	0.18	0.46
38	Iceland	0.76	1.34	0.25	0.52
39	Gabon	0.77	1.19	0.11	0.38
40	Senegal	0.79	1.33	0.19	0.47
41	Kuwait	0.80	1.66	0.38	0.64

Table 4.2 presents summary statistics of the diversification measures and the economic development measures. The variance of the Gini coefficient is quite high, ranging from 0.36 to 0.94, which indicates that the sample includes economies that are very specialized in their production as well as economies with a highly diversified production structure. The population size of countries ranges from 140,000 to over a billion. In terms of annual constant GDP per capita, the sample ranges from very low figures (US$92) to very high figures (US$45,000).

[57] After this year, the number of countries that report all 28 sectors declines rapidly per year.

Table 4.2. Summary statistics, MVA

Variable	Observations	Mean	Std. Dev.	Min	Max
Gini	1869	0.58	0.11	0.36	0.94
Theil	1869	0.65	0.35	0.21	2.77
Herfindahl	1869	0.08	0.08	0.02	0.75
Hirschman	1869	0.32	0.09	0.23	0.87
Population	1866	4.17E+07	1.13E+08	139908	1.05E+09
GDP per capita	1757	7012	7887	92	45391
GDP per capita (PPP)	866	11768	9341	388	59893

The pair-wise correlation coefficients between the specialization measures in Table 4.3 indicate that all four measures are highly correlated among each other, indicating that they quantify the same phenomenon. However, the graphical correlation matrix (Figure 4.1) reveals that the specialization measures are not correlated in a linear manner. For example, the Theil Index discriminates more finely between countries with lower specialization, while the Theil and especially the Herfindahl Index discriminate more between countries with higher specialization, therefore computing the correlation of ranks is more appropriate. Table 4.4 therefore presents ranks correlations[58] instead of correlations between values, and indeed indicates a very high correlation between the specialization measures.

Table 4.3. Correlation table, MVA

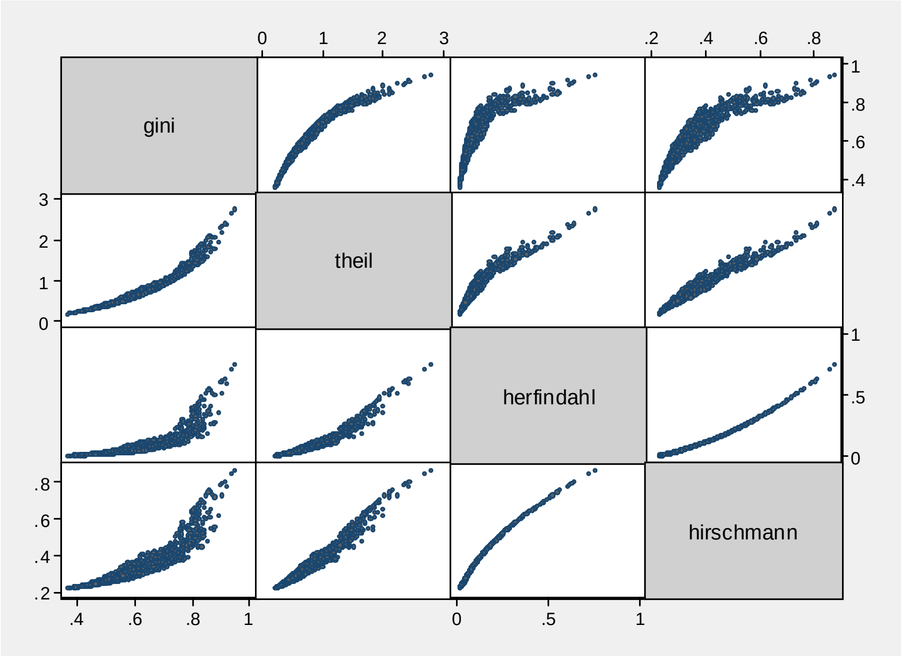
	Gini	Theil	Herfindahl	Hirschman
Gini	1.00			
Theil	0.96	1.00		
Herfindahl	0.83	0.95	1.00	
Hirschman	0.90	0.98	0.98	1.00

Table 4.4. Rank correlation table, MVA

	Gini	Theil	Herfindahl	Hirschman
Gini	1.00			
Theil	1.00	1.00		
Herfindahl	0.97	0.98	1.00	
Hirschman	0.97	0.98	1.00	1.00

[58] The Spearman rank correlation was used throughout this study.

Figure 4.1. Correlation matrix, MVA



4.1.2. Non-parametric results

The following figures show the scatter plots of export diversification measured by the Gini coefficient and a country's income per capita level measured using both constant US dollars and constant PPP dollars. Observations from all available years are included, but countries with a population with less than a million people are excluded to avoid specialization effects that are purely a result of small country size.

Figure 4.2 shows a pooled panel scatter plot, i.e., all years and countries in one plot, for all countries that report 28 sectors together with a locally weighted scatterplot smoothing (Lowess) curve. The same relationship is presented in Figure 4.3 for the sample of countries that report data for 19 industrial sectors. Countries with the lowest GDP per capita are relatively specialized, and this specialization decreases rapidly with economic growth. The decrease in specialization then becomes flatter and turns towards increased specialization at high levels of GDP per capita. This supports the assumption of a U-shaped relationship between concentration in production and economic development, although the shape of the curve resembles an "L" rather than a "U" shape. However, any preliminary conclusions have to be treated with caution, because the Lowess curve smoothes over the pooled panel of countries and years, thus mixing between- and within-country effects.

Figure 4.2. Specialization of MVA, 28 sectors

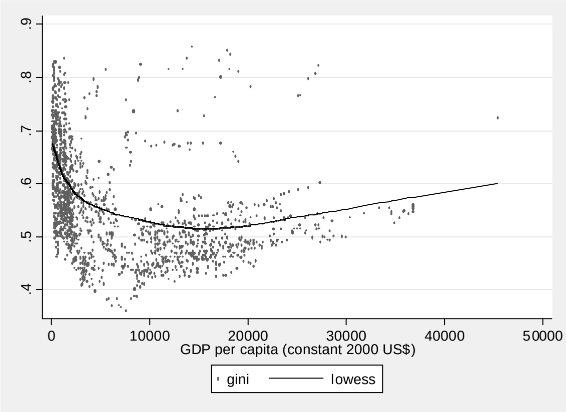
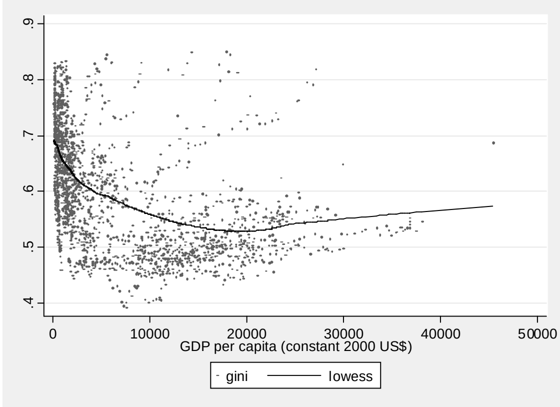


Figure 4.3. Specialization of MVA, 19 sectors



Figures 4.4 (for 28 sectors) and 4.5 (for 19 sectors) show the relationship between specialization and GDP per capita measured in constant PPP dollars,[59] a measure commonly used in the existing literature (in particular, Imbs and Wacziarg, 2003). Although the resulting Lowess curve has a much more distinctive U-shape when compared with the results using constant US dollars, the upward-sloping part seems to be driven by a small number of highly specialized high-income countries. Note that the coverage of PPP dollars is lower than for constant US dollars.

Figure 4.4. Specialization of MVA, 28 sectors, PPP dollars

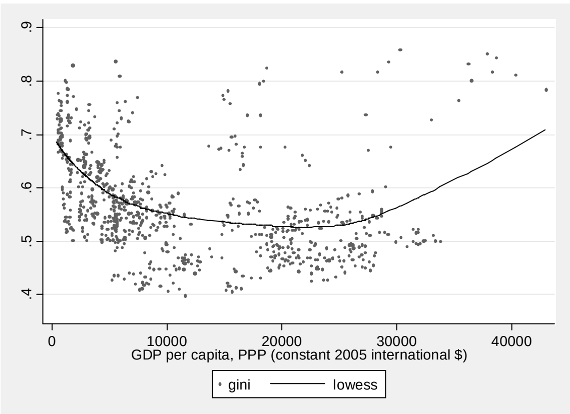
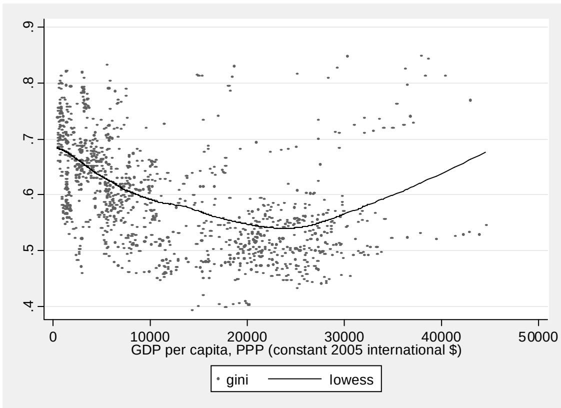


Figure 4.5. Specialization of MVA, 19 sectors, PPP dollars



[59] United Arab Emirates is excluded when using constant PPP dollars as it is an extreme outlier.

When countries are classified according to their income group,[60] an interesting picture emerges (Figure 4.6). The observations of low-income countries are scattered across a wide range of specialization values, ranging from below 0.5 to above 0.8. Lower middle-income countries are similarly spread, but with fewer observations at higher levels of diversification. Upper-middle income countries seem to be much more diversified on average than lower middle-income countries, and high-income OECD countries are also more highly diversified, with a slight upward trend. Only high-income non-OECD countries do not fit into this picture. These observations are scattered across the whole spectrum, including many observations in the high-income and high specialization region, which follows from the fact that many high-income non-OECD countries are oil exporters and thereby achieve high income levels without economic diversification.

Figure 4.6. Specialization of MVA, 28 sectors, highlighted country groups

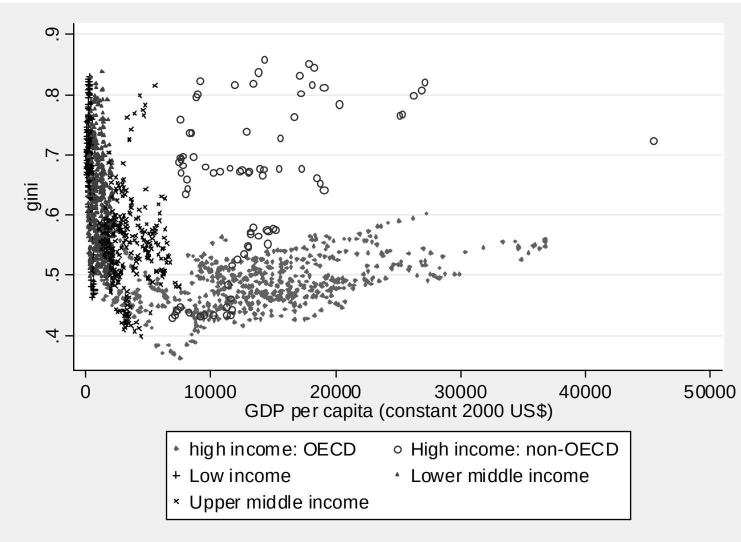


Figure 4.7 presents the levels of specialization for six countries – Germany, Chile, the Republic of Korea, Mexico, Ghana and the USA[61] – over time. Nigeria is the most specialized country within this group, although it was almost as diversified as Chile around 1970. The Republic of Korea was relatively specialized in the first half of the 1960s, then diversified until the 1980s, and showed a strong trend towards re-specialization in the 1990s, thus

[60] Income groups are classified according to World Bank (2008).

[61] These particular countries were selected mainly for illustrative purpose: The USA as the world's largest economy, Mexico as a developing Latin-American country neighbouring the USA, Chile as another Latin American country with a different economic structure than Mexico, the Republic of Korea as a former low-income country that has transformed into a high-income country, and Germany and Ghana to eventually include one country from each continent. A more substantive analysis beyond these ad-hoc comparisons follows in subsequent chapters.

following the U-curve relationship, given that the Republic of Korea's GDP per capita increased during this period. Germany experienced a movement in the opposite direction, as it was more diversified than the Republic of Korea in the 1960s, but became more specialized in the 1970s, which might represent the upward-sloping part of a U-curve. The USA also shows a slight trend towards specialization. Ghana's economy also followed a distinct U-curve relationship, but not in the sense of Imbs and Wacziarg (2003), as its GDP per capita actually *declined* from US$270 to US$198 between the 1960s and 1985 while its level of specialization fell in the 1960s and then rose again until the 1980s, thus indicating what might be called a "backward U-curve". Figures 4.8 and 4.9 investigate further by presenting specialization on the left vertical axis (solid line) and GDP per capita on the right vertical axis (dotted line) for the Republic of Korea and Ghana. In a panel data regression, both countries would strengthen the significance of a U-curve relationship, although the underlying dynamics are much different – economic growth in the Republic of Korea and economic decline in Ghana.

Figure 4.7. Specialization of MVA over time

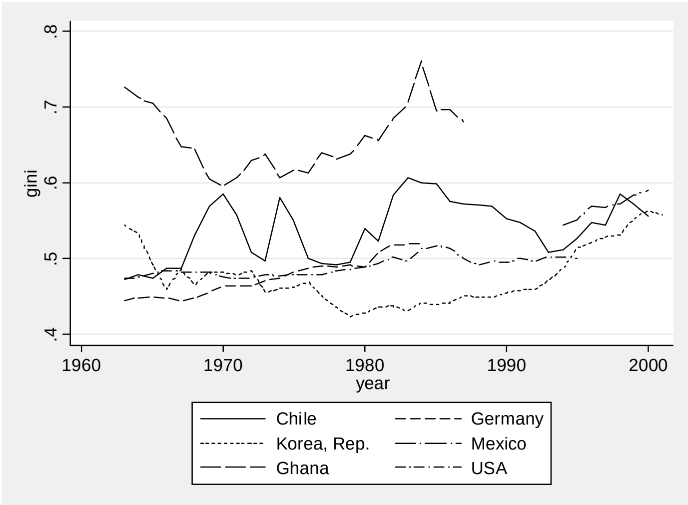
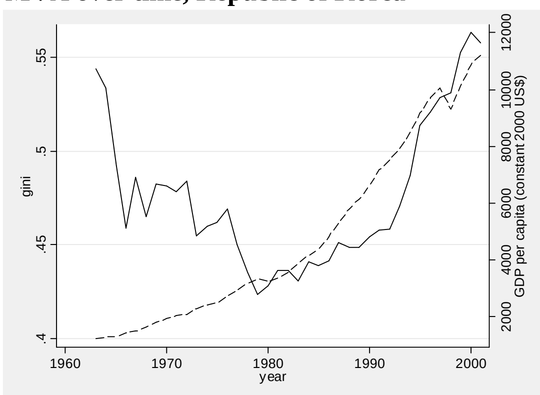


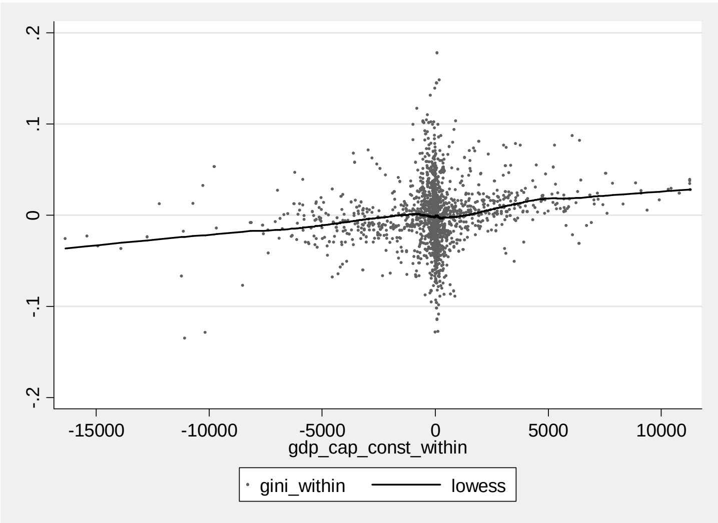
Figure 4.8. GDP per capita and specialization of MVA over time, Ghana

Figure 4.9. GDP per capita and specialization of MVA over time, Republic of Korea



Following De Benedictis (2004:15-16), the most natural attempt to analyse the specialization-income-relationship is to attribute its nonlinearity to the influence of country specificities on specialization. Through a within-transformation (i.e., demeaning the values of specialization and GDP per capita), it is possible to capture how the level of specialization of an average country evolves over time, thus indicating the general "development path" of countries. Figure 4.10 plots the demeaned values of the Gini coefficient against the demeaned values of GDP per capita, together with a non-parametric lowess. There is no evidence for a within-country U-curve between specialization and GDP per capita, as the level of specialization increases within each country with rising GDP, although the magnitude of the lowess is marginal. Even though, this finding depends on the specific smoothing function, it represents evidence against findings of Imbs and Wacziarg (2003).

Figure 4.10. Within-country relationship between specialization of MVA and GDP per capita, 28 sectors



Summarizing, only vague conclusions can be drawn on the existence of a distinct U-shaped relationship between specialization and economic development, but it can be confirmed that – when analysing a pooled panel – for most countries rising GDP per capita goes hand in hand with a *diversification* of the productive activities, not with *specialization*. At the highest income levels a slight trend towards specialization can be observed, though this is potentially driven by outliers. The within-country variation shows a marginal trend of countries towards higher levels of specialization.

To further investigate the patterns of specialization and diversification, and to verify the assumption of a U-curve beyond the tentative conclusions based on non-parametric pooled panel analysis, parametric panel data regression methods are applied in the following chapter.

4.1.3. Regression results

The analysis in the previous chapter is based on a non-parametric analysis of pooled panel plots, which do not distinguish if two different observations are indeed two different countries or one single country in two different periods. The presented preliminary findings indicate a non-linear relationship between specialization and GDP per capita. By using parametric panel data regression methods, the two different dimensions – countries and years – of the datasets are taken into account.

The following regression analysis looks to verify the U-curve hypothesis using parametric panel data regression methods, which include a linear and a squared term of GDP per capita[62] to account for the U-curve. A U-curve can said to be present if a negative coefficient on the linear term and a positive one on the squared term is obtained.

The parametric regression specification that corresponds to the non-parametric regression presented above is a simple pooled regression, which means that the panel-structure of the dataset is ignored, where the correlation between specialization and economic level is estimated using the standard OLS estimator. The U-curved relationship is – as expected from the non-parametric analysis – significant at the 1-percent level for all four measures of specialization, both levels of aggregation (28 and 19 sectors), and both measures of GDP per capita (Table 4.5, column 1 for the Gini coefficient and column 2 for the Herfindahl index.)[63] When the Hirschman and Theil coefficients are used as measures of specialization, the same results are obtained (Appendix Table 27). The U-curve is also significant when only a single year is included, and in this case simple OLS is in fact an appropriate measure. When constant PPP dollars are used, the results remain the same (Appendix Table 28). The turning point of

[62] Measured in constant US dollars and constant PPP dollars to exclude effects stemming from inflation. As constant PPP dollars are available for a lower number of country-years, this analysis focuses on constant US dollars.

[63] Note that the estimated coefficients appear to be small, because GDP per capita is measured by the level of GDP per capita in dollars (see Table 3.2).

the U-curve, when significant, lies at a GDP per capita level between US$17,000 and US$22,000, so re-specialization indeed takes place at only at very high economic levels.

Table 4.5. Regression results for specialization of MVA, 28 and 19 sectors

ISIC 28 sectors	(1) Gini Pooled	(2) Herfindahl Pooled	(3) Gini FE	(4) Herfindahl FE	(5) Gini BE	(6) Herfindahl BE
GDP per capita	-1.597e-05***	-5.156e-06***	8.960e-07	8.845e-07*	-1.501e-05***	-4.795e-06***
	(8.179e-07)	(5.004e-07)	(1.029e-06)	(5.101e-07)	(3.020e-06)	(1.786e-06)
GDP per capita squared	4.726e-10***	1.430e-10***	4.494e-11*	-1.329e-11	3.820e-10***	1.224e-10**
	(3.455e-11)	(1.776e-11)	(2.348e-11)	(1.117e-11)	(9.060e-11)	(5.359e-11)
Constant	6.232e-01***	8.819e-02***	5.522e-01***	6.310e-02***	6.440e-01***	9.582e-02***
	(3.402e-03)	(2.073e-03)	(4.747e-03)	(2.770e-03)	(1.500e-02)	(8.871e-03)
Observations	1637	1637	1637	1637	1637	1637
Number of countries	82	82	82	82	82	82
R-squared	0.259	0.082	0.0796	0.0672	0.248	0.0816
Turning point	16,896	18,028			19,647	19,587
ISIC 19 sectors						
GDP per capita	-1.700e-05***	-1.185e-05***	3.012e-06***	9.282e-07*	-1.768e-05***	-1.245e-05***
	(6.597e-07)	(6.079e-07)	(8.893e-07)	(5.213e-07)	(3.122e-06)	(3.175e-06)
GDP per capita squared	4.508e-10***	2.942e-10***	6.074e-12	6.000e-12	4.526e-10***	2.830e-10**
	(2.745e-11)	(2.295e-11)	(2.013e-11)	(1.161e-11)	(1.124e-10)	(1.143e-10)
Constant	6.644e-01***	1.738e-01***	5.731e-01***	1.159e-01***	6.781e-01***	1.902e-01***
	(2.769e-03)	(3.113e-03)	(4.228e-03)	(2.705e-03)	(1.297e-02)	(1.320e-02)
Observations	2155	2155	2155	2155	2155	2155
Number of countries	98	98	98	98	98	98
R-squared	0.341	0.214	0.225	0.150	0.341	0.212
Turning point	18,855	20,139			19,532	21,996

Robust standard errors in parentheses (non-robust standard errors for BE)
*** p<0.01, ** p<0.05, * p<0.1

A pooled OLS regression is methodologically questionable as it ignores the panel structure of the data. As the existence of country-specific unobserved characteristics in cross-country observations is likely, it is appropriate to also look at a fixed effects panel data regression. These results are probably most relevant as they describe how the production structure of an "average" country evolves alongside the economic development process. The results show a less distinct picture than for the pooled regression (columns 3 and 4 in Table 4.5, see Appendix Table 23 for Theil and Hirschman indices). When using 28 sectors, no U-curve relationship can be observed. The upward-sloping part is only significant for the Gini-coefficient (column 3), and only at the 10-percent level. The coefficient on the linear term even has an unexpected positive sign of GDP per capita for the Herfindahl (column 4) and Hirschman Index, though only at the 10-percent significance level. When using 19 sectors, thereby increasing the countries with applicable MVA data from 74 to 91 (lower part of Table 4.5), the unexpected positive sign on the linear term becomes significant at the 1-percent significance level for the Gini (column 3) and Theil Index and at the 10-percent significance level for the Herfindahl (column 4) and Hirschman Index. When constant PPP dollars are used, the within-country U-curve does not become more significant (Appendix Table 24).

Since the results above indicate that the U-curve in the pooled panel is not mainly driven by within-country effects, it is of interest to investigate the between-country effects, i.e., the correlation between country's means of the specialization measures and GDP per capita. A between-country U-curve would mean that the U-curve is a time-invariant global structure, and not a "development path" of countries. The between-effects estimates (columns 5 and 6) show a highly significant (i.e., at the 1-percent level in most cases) U-curve for all measures of diversification and for both levels of aggregation (28 and 19 sectors). This holds also for other measures of diversification and when using constant international Dollar (Appendix Tables 25 and 26).

The natural way of "combining" fixed and between effects would be the random effects estimator rather than the pooled regression presented above, but the Hausman test – as expected – rejects the null hypothesis of no country fixed effects, thus suggesting the fixed effects model to be the most appropriate specification. For completeness, however, the random effects results are shown in Appendix Tables 21 and 22. When using constant US dollars, the U-curve is not statistically significant, regardless of the level of aggregation and the diversification measure used. In the 19-sector setting, the linear term has an unexpected positive sign for the Gini and Theil coefficients and, in some cases, the coefficient is significant. When constant PPP dollars are used as the measure of GDP per capita, then the U-curve becomes significant in most settings.

The scatter plots in the previous chapter indicate large variation of the values of specialization at all levels of GDP per capita. This is especially the case at higher levels of GDP per capita, where outliers might be driving the results from both the non-parametric and parametric estimation. An alternative to trying to identify and exclude outliers is to use a method that is less sensitive than OLS to outliers. The Least Absolute Deviations (LAD), or median regression model, is such a method, and the associated quantile regression model is used in this study. The LAD estimator minimizes the sum of absolute errors rather than the sum of squared errors. This property of the LAD estimator makes it less sensitive, and therefore more robust to outliers.[64] To account for country fixed effects in the following estimations, the

[64] For a thorough review of these methods and the associated quantile regression model see Koenker (2005). The development of methods for panel quantile regression models are still in their infancy (see, for example, Koenker, 2004).

variables have been demeaned.[65] The results for the fixed effects quantile regression method (Appendix Tables 29 and 30), do not show a U-curved relationship at all, and even indicate a significant inverted U-curve in some cases.

Given this clear evidence against a robust U-curve in the data used in this study, the question arises as to why there is such a difference to the results in Imbs and Wacziarg (2003). One methodological difference is the choice as to which observations to include. In order to obtain robust results, countries that do not report on all 28 sectors and countries that have more than one million inhabitants are excluded from the analysis. Imbs and Wacziarg (2003) include small countries, and in the fixed effects regression they also include countries that report on only 27 sectors.[66] Their dataset ends in the year 1996, while the dataset used in this study includes data up to 2003. In addition, they do not adjust the standard errors for heteroskedasticity.

To account for these methodological differences, Table 4.6 (columns 1 and 2) shows the fixed effects results when including small countries and countries with 27 or 28 reported sectors, when using only GDP per capita in constant US dollars and without adjusting for heteroskedasticity. Interestingly, the U-shape is now significant at the 1-percent level for the Theil and Herfindahl Index,[67] but the significance disappears again when constant PPP dollars are used (columns 3 and 4). When dropping all years after 1996, the U-curve becomes significant at the 5-percent level for the Gini coefficient and at the 1-percent level for the Theil, Herfindahl and Hirschman indices (Table 4.7, columns 1 and 2). When using GDP per capita in PPP dollars, the significance levels decrease, but the U-curve remains significant at the 10-percent level (columns 3 and 4).

[65] Demeaning implies that for each country, the means of the specialization indices and the GDP measures are calculated and subtracted from the actual values. The obtained within-country variation is then used in the regression, which is equivalent to accounting for fixed effects.

[66] See footnote 6 in Imbs and Wacziarg (2003:65)

[67] Imbs and Wacziarg (2003) use *thousands of dollars* as the unit on the x-axis, so to compare the coefficients, the presented coefficients have to be multiplied by 10^3 and 10^6, respectively.

Table 4.6. Fixed effects regression results for specialization of MVA, 27-28 sectors, including small countries, constant and PPP dollars

ISIC Rev. 2 27-28 sectors	(1) Gini FE, const US$	(2) Herfindahl FE, const US$	(3) Gini FE, PPP$	(4) Herfindahl FE, PPP$
GDP per capita	-4.260e-07	-2.802e-06***	6.862e-08	-1.784e-06
	(8.685e-07)	(8.536e-07)	(1.552e-06)	(1.590e-06)
GDP per capita squared	7.187e-11***	1.155e-10***	5.183e-11	1.084e-10***
	(1.991e-11)	(1.957e-11)	(3.453e-11)	(3.539e-11)
Constant	5.729e-01***	8.450e-02***	5.682e-01***	7.350e-02***
	(4.113e-03)	(4.042e-03)	(1.128e-02)	(1.156e-02)
Observations	1905	1905	966	966
R-squared	0.00103	0.104	0.0342	0.0286
Number of countries	92	92	85	85
Turning point		12,130		

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Table 4.7. Fixed effects regression results for specialization of MVA, 27-28 sectors, including small countries, constant and PPP dollars, 1962-1996

ISIC Rev. 2 27-28 sectors	(1) Gini FE, const US$	(2) Herfindahl FE, const US$	(3) Gini FE, PPP$	(4) Herfindahl FE, PPP$
GDP per capita	-1.980e-06**	-5.143e-06***	-2.994e-06*	-2.653e-06
	(9.278e-07)	(8.827e-07)	(1.753e-06)	(1.683e-06)
GDP per capita squared	1.060e-10***	1.800e-10***	9.539e-11**	1.025e-10***
	(2.131e-11)	(2.028e-11)	(3.778e-11)	(3.628e-11)
Constant	5.787e-01***	9.257e-02***	5.920e-01***	8.286e-02***
	(4.343e-03)	(4.132e-03)	(1.288e-02)	(1.237e-02)
Observations	1764	1764	825	825
Number of countries	90	90	81	0.0846
R-squared	0.0584	0.165	0.193	0.0846
Turning point	9,340	14,286	15,693	

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Overall, the U-curve can be observed under some circumstances, but when additional years after 1996 are used or when heteroskedasticity in the residuals is corrected for, the U-curve becomes insignificant. This finding is surprising, because if countries would indeed follow a U-shaped path between development and specialization, then this should hold for all periods and also when using robust standard errors, which is not supported by the results of this study. In particular, the results of the panel data regressions reveal that even if countries are aligned along a U-shaped or L-shaped function of specialization and economic level, then this shape does *not* represent the “development path” of an “average country”, although this impression can be created by dropping some part of the data. Instead countries are “aligned” along a U- or L-curve, but do not show a strong tendency to individually describe a U-curve.

Thus far, this study has concentrated on relatively aggregated data with a maximum of 28 different sectors. The level of aggregation is likely to have a large influence on the observed shape of specialization. Given the level of aggregation, specialization may occur within rather than between sectors, but only the latter form of specialization is observabled in the data. As a result, the data observed thus far may not provide a true reflection of the actual levels of specialization. Value added data are not available at more disaggregated levels for low- and middle income countries, but trade data are available at various aggregation levels for a large set of countries. The following chapter therefore employs export data to further investigate the patterns of diversification.

4.2. Export of products – absolute specialization

4.2.1. Descriptive statistics

As discussed in the literature review (Section 2), looking at export patterns might reveal more about the specialization/diversification-path of countries, as trade data are available at a much higher level of disaggregation and for a larger number of countries than production data. In addition, trade data are available for agricultural as well as manufactured products, allowing for a broader analysis. For an analysis of manufactured exports only, see Appendix B.1.

The country with the most diversified export structure in the year 2005, measured at the highest disaggregation level (HS 6-digit) is Italy, followed by the USA and Germany, with the remaining seven countries being OECD members plus China. Out of the ten least diversified countries, African countries occupy the bottom seven positions, with Mauritania, Gabon and Sudan at the lower end of the scale (Table 4.8). This is consistent with the idea that high-income countries are more diversified than low-income countries, though a trend towards re-specialization cannot be ruled out as the most diversified countries do not fully correspond to countries with the highest levels of GDP per capita.

Table 4.9 presents the most important summary statistics for the HS 6-digit and the SITC 5-digit data. The HS 6-digit dataset covers the widest span of export lines, with up to 4,976 recorded export lines, but the data only go back to 1988. The SITC 5-digit dataset reports a maximum of 921 different export lines, but with data going back to 1962. In general, the observed range for the export specialization measures are much higher than for the production specialization measures, which is largely due to the higher level of disaggregation of the data. For the purposes of the current study, however, it is the *evolution* and not the actual *level* of the specialization measure that is of primary interest.

Table 4.8. Ten most and ten least specialized countries, HS 6-digit exports, 2005

Rank	Country	Gini	Theil	Herfindahl	Hirschman	Number of export lines
1	Italy	0.83	1.71	0.00	0.06	4746
2	Germany	0.84	1.96	0.01	0.08	4666
3	United States	0.85	2.01	0.01	0.08	4831
4	France	0.86	2.09	0.01	0.09	4683
5	Spain	0.86	2.20	0.01	0.09	4765
6	China	0.87	2.18	0.01	0.09	4743
7	Belgium	0.88	2.43	0.01	0.12	4750
8	Netherlands	0.88	2.38	0.01	0.11	4741
9	United Kingdom	0.88	2.47	0.01	0.11	4756
10	Austria	0.89	2.16	0.01	0.07	4520
107	Oman	1.00	7.21	0.51	0.72	985
108	Azerbaijan	1.00	6.67	0.33	0.57	1122
109	Yemen	1.00	7.60	0.72	0.85	1111
110	Central African Republic	1.00	6.52	0.19	0.43	115
111	Mali	1.00	7.26	0.48	0.69	488
112	Burundi	1.00	7.17	0.40	0.63	292
113	Algeria	1.00	7.03	0.34	0.58	935
114	Sudan	1.00	7.62	0.70	0.84	212
115	Gabon	1.00	7.66	0.69	0.83	730
116	Mauritania	1.00	7.88	0.60	0.78	15

Table 4.9. Summary statistics of specialization in exports, HS 6-digit and SITC 5-digit

HS6-digit	Observations	Mean	Std. Dev.	Min	Max
Number of export lines	2363	1620	9	4976	2363
Gini	0.96	0.04	0.79	1.00	0.96
Theil	4.56	1.69	1.59	8.47	4.56
Herfindahl	0.14	0.19	0.0025	0.9873	0.14
Hirschman	0.31	0.22	0.0521	0.9936	0.31
Population	4.27E+07	1.47E+08	40740	1.31E+09	4.27E+07
GDP per capita	7505	9772	100	54178	7505
GDP per capita (PPP)	11811	11878	319	73277	11811
SITC 5-digit					
Number of export lines	388	279	1	921	388
Gini	0.9576	0.0488	0.7698	0.9989	0.9576
Theil	4.00	1.50	1.26	6.85	4.00
Herfindahl	0.24	0.29	0.0060	1	0.24
Hirschman	0.42	0.26	0.0842	1	0.42
Population	3.12E+07	1.10E+08	40740	1.31E+09	3.12E+07
GDP per capita	6332	8305	92	54178	6332
GDP per capita (PPP)	10956	11361	319	79032	10956

Table 4.10 presents the pairwise correlation between the specialization/diversification measures for the SITC dataset. Some pairs are relatively weakly correlated, e.g., the correlation between the Gini and the Herfindahl Index is only 0.57, compared with 0.85 the between the Gini and the Theil Index. As with the production data, however, the correlations

(Figure 4.11) show a high degree of non-linearity between some indices. At the higher level of disaggregation, the export shares of many sectors are close to zero, meaning that the squared shares are even closer to zero, and consequently the entire sum of shares is forced towards zero. For this reason, it is appropriate to look at the pairwise rank correlations (Table 4.11), which are indeed much higher than the standard pairwise correlations, thus revealing the similarity of the measures. In Table 4.11, the number of export lines is negatively correlated with the other measures, as expected, since more export lines correspond to less specialization, and therefore lower values of the Gini, Theil, Herfindahl and Hirschman indices.

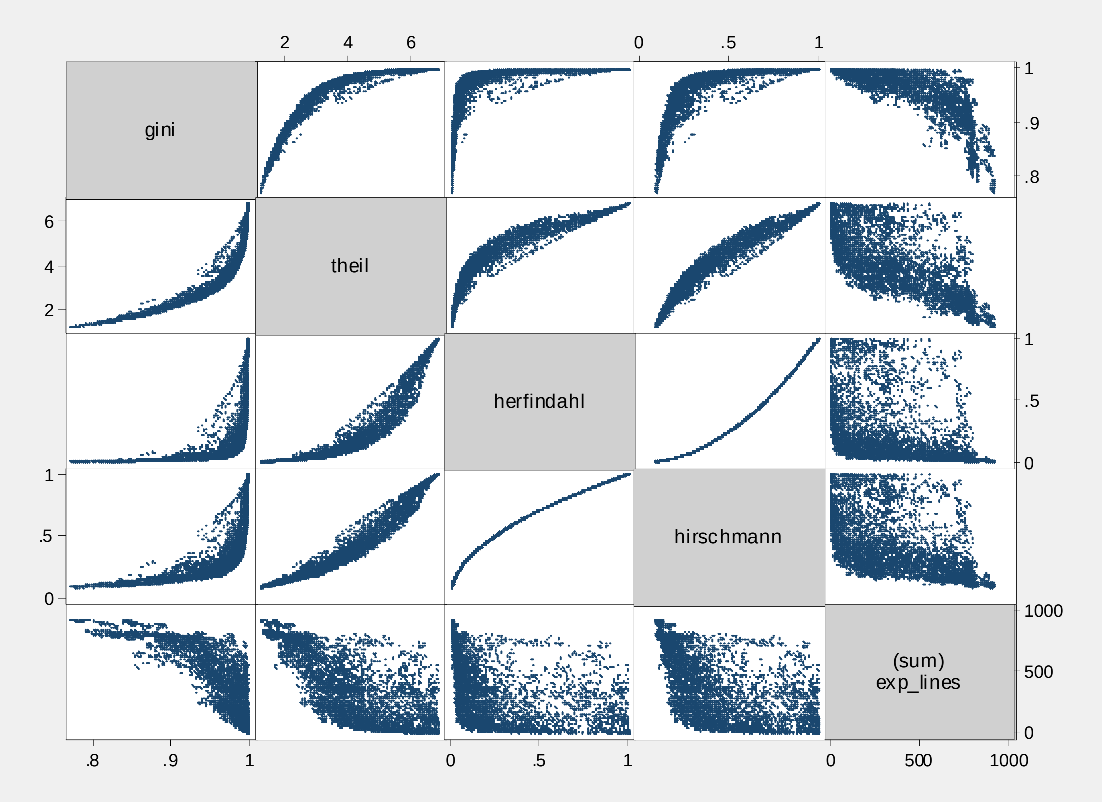
Table 4.10. Correlation between export specialization measures, SITC 5-digit

	Gini	Theil	Herfindahl	Hirschman	Number of export lines
Gini	1.00				
Theil	0.85	1.00			
Herfindahl	0.57	0.89	1.00		
Hirschman	0.70	0.96	0.97	1.00	
Number of export lines	-0.82	-0.76	-0.51	-0.61	1.00

Table 4.11. Rank correlation between export specialization measures, SITC 5-digit

	Gini	Theil	Herfindahl	Hirschman	Number of export lines
Gini	1.00				
Theil	0.99	1.00			
Herfindahl	0.95	0.98	1.00		
Hirschman	0.95	0.98	1.00	1.00	
Number of export lines	-0.85	-0.78	-0.71	-0.71	1.00

Figure 4.11. Correlation matrix between export specialization measures, SITC 5-digit



4.2.2. Non-parametric results

Figures 4.12-4.15 plot the Gini coefficient of the pooled panel against GDP per capita, along with a non-parametric Lowess. The Lowess curve clearly shows a U-curve for the 5-digit data (Figure 4.12), which is robust to lower bandwidths of the Lowess procedure. However, the observations are quite scattered, with a large number of observations some distance from the Lowess curve. The implication of this result is that the U-curved behavior is indeed a feature of the data, but does not entirely describe the variation of the Gini coefficient. For the Feenstra dataset (Figure 4.13), the upward-sloping part is even less distinct, and for HS 6-digit data (Figure 4.14), which covers the smallest time range, the upward-sloping part seems to be non-existent.

A large number of observations are concentrated in the upper-left part, i.e., countries with low GDP per capita and a high degree of specialization. On the right side of the figure, the density is very low, and it seems reasonable to assume that the observed upward-sloping part might be driven by outliers. When applied to the SITC 5-digit dataset, the outlier detection procedure developed by Hadi (1992, 1994) suggests 31 observations to be outliers. Figure 4.15 highlights those observations if they belong to countries with a population above on million inhabitants, along with a new Lowess curve, which excludes these observations, and which now shows no increase in specialization at higher levels of GDP per capita.

Figure 4.12. Export specialization, SITC 5-digit

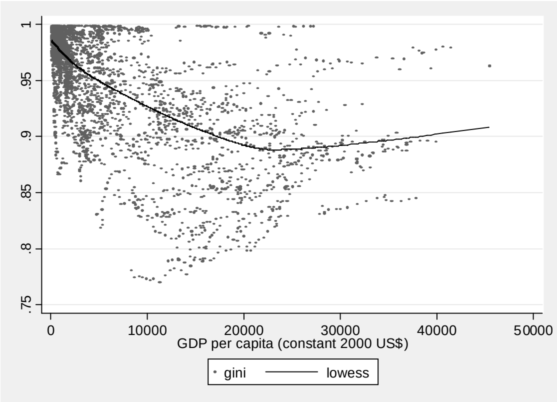


Figure 4.13. Export specialization, HS 6-digit

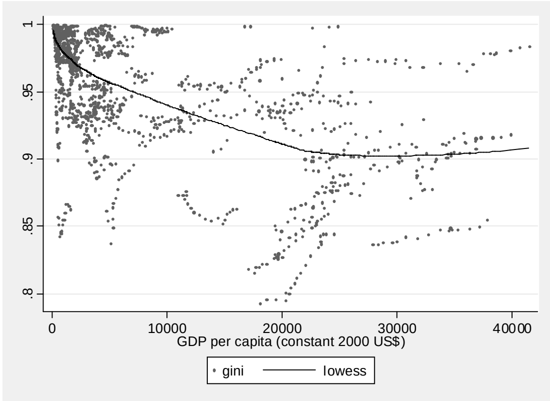


Figure 4.14. Export specialization, Feenstra 4-digit

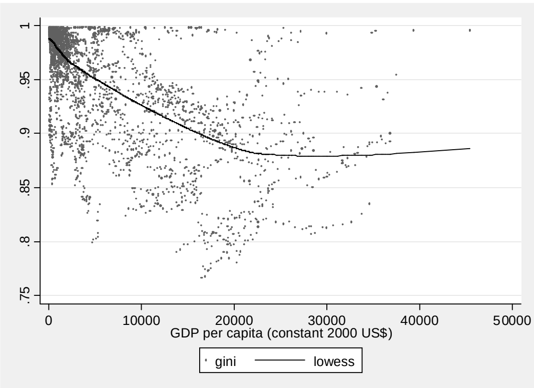
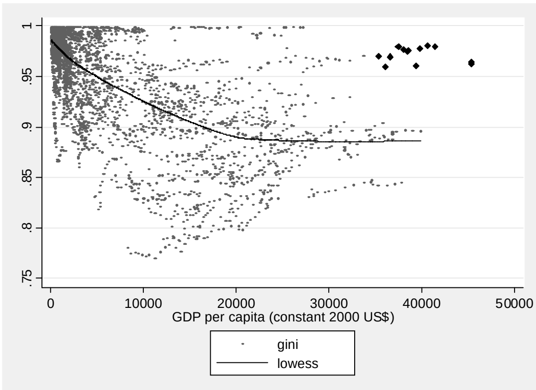


Figure 4.15. Export specialization, SITC 5-digit, excl. outliers



The downward-sloping part of the supposed U-shaped behavior can also be seen when using constant PPP dollars (Figure 4.16), but again the upward-bending part seems to be driven by very few observations.

As the observations on the upper-left part of the scatter plot are very dense, Figure 4.17 shows the same relationship as Figure 4.12, but uses a logarithmic scale on the horizontal axis to allow for a better visual observation of low-income countries. It can be seen that with rising GDP per capita, some countries remain specialized, while others experience a decrease in specialization.

Figure 4.16. Export specialization, SITC 5-digit, PPP dollars

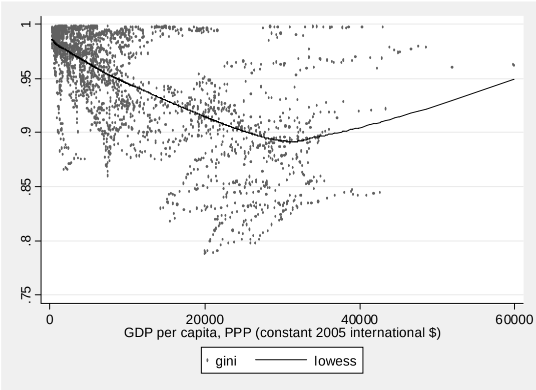
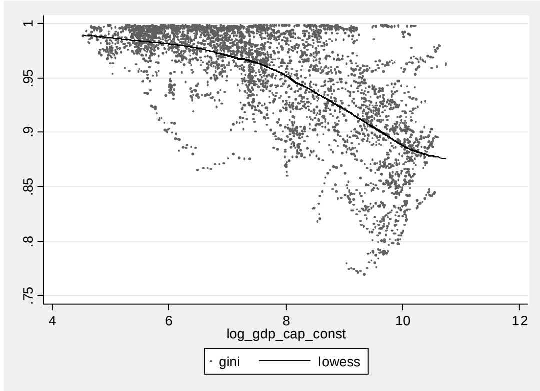


Figure 4.17. Export specialization, SITC 5-digit, logarithmic scale



To provide information on the location of particular countries, Figure 4.18 shows country abbreviations as data markers for the year 2000 for the SITC 5-digit dataset. Those countries that are both most specialized and have very high GDP per capita are typically oil-exporting countries, such as Kuwait (KWT), United Arab Emirates (ARE) or Norway (NOR). Thus the re-specialization part might not be a globally valid stylized fact of economic development; instead it only reflects the ability of oil-abundant countries to reach high levels of GDP per capita without diversifying their economies.[68]

Figure 4.18. Export specialization, SITC 5-digit, 2005

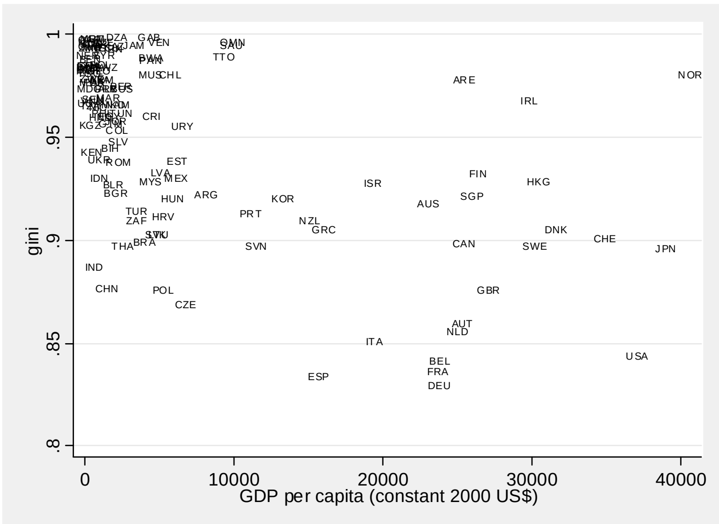


Figure 4.19 distinguishes between five different income groups, with the plot showing slightly less distinction between the different groups than the corresponding plot for MVA. Low-income and middle-income countries are concentrated on the upper left side of the panel,

[68] This issue is further analysed in chapter 4.5.

while high-income countries are spread widely across the plot. Contrary to the MVA data, OECD countries overlap much more with the non-OECD countries.

Figure 4.19. Export specialization, with country groups

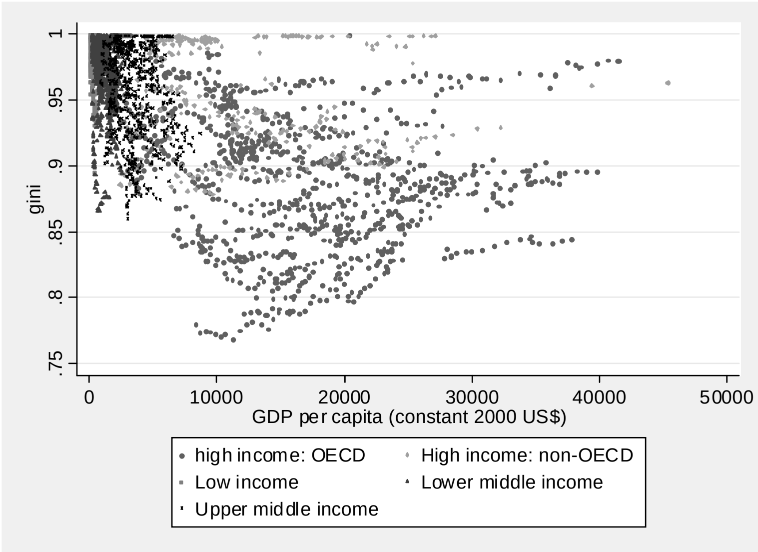


Figure 4.20 shows the evolution of specialization over the period 1963 to 2007 for six selected countries – Chile, Germany, Republic of Korea, Mexico, Nigeria and the USA. Of these, Germany is the most diversified economy, but with a trend towards more specialization. The USA began with a much higher level of specialization than Germany, but its economy diversified in the 1960s and at the end of the 1980s, leaving its specialization level similar to that of Germany. Mexico experienced different phases of specialization and diversification, with a slight increase in specialization during the past ten years. The Republic of Korea and Chile started from almost the same level in 1963, but faced different evolutions of specialization: The Republic of Korea increased its level of diversification until the mid-1990s when a trend towards re-specialization occurred. Chile also showed a slight trend towards diversification for much of the period, but only on a small scale. Ghana shows a constant trend towards specialization, but – as for MVA data – it should be noted that Ghana faced an economic decline over the period. This pattern does not show a re-specialization trend therefore, but rather specialization with disadvantageous economic consequences.

Figure 4.20. Export specialization of over time

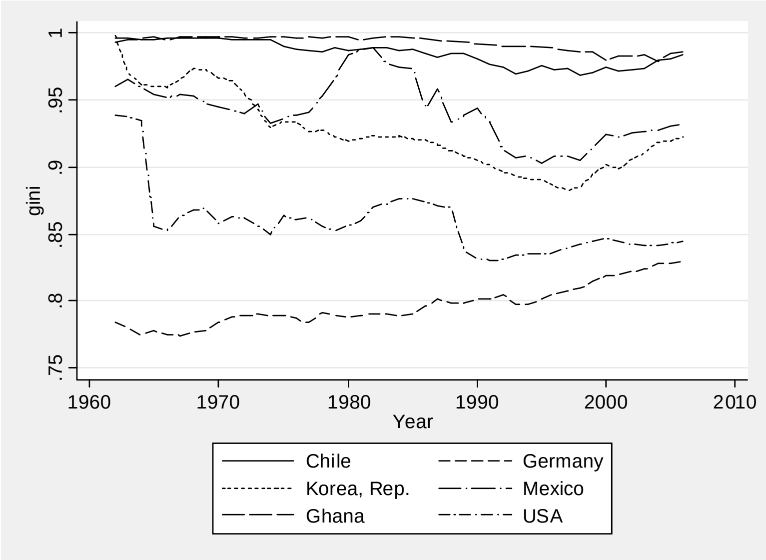


Figure 4.21 shows the relationship between the demeaned values of the Gini coefficient and the demeaned values of GDP per capita for the SITC 5-digit dataset. An average country seems to specialize with rising GDP per capita, although the variation of the slope is small and shows a trend towards diversification around the within-country mean of GDP per capita. Hence, it displays the specialization path of an average country. For the Feenstra dataset (Figure 4.22), the within-variation of the level of specialization first rises, then falls, then rises again with demeaned values GDP per capita. With the exception of the left part of the figure, a U-curved within-country relationship between specialization and GDP per capita could be confirmed, although at small magnitude. However, the HS dataset (Figure 4.23), which covers a short period at a high level of disaggregation, shows that an average country specializes with rising GDP per capita.

Figure 4.21. Within-country relationship between export specialization and GDP per capita, SITC 5-digit

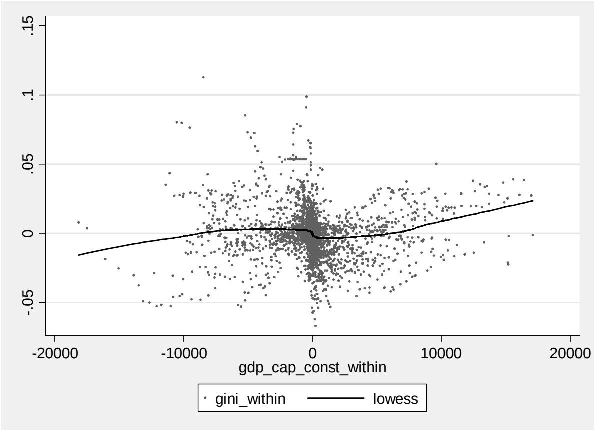


Figure 4.22. Within-country relationship between export specialization and GDP per capita, Feenstra 4-digit

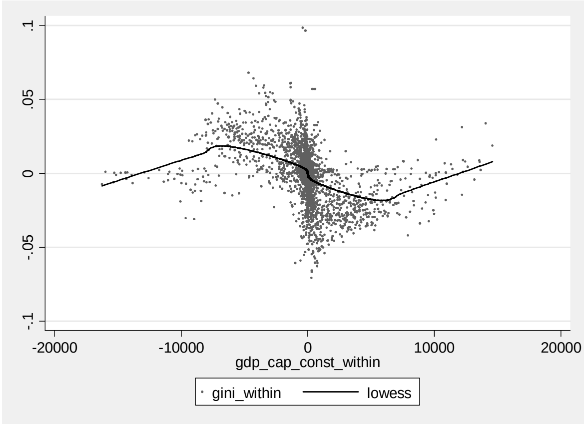
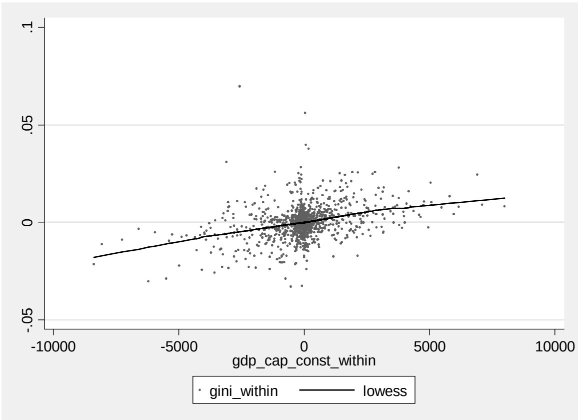


Figure 4.23. Within-country relationship between export specialization and GDP per capita, HS 6-digit



Summarized, although the observations are not clearly aligned along a U-shaped curve, as indicated by some studies, some conclusions can already be drawn from the simple scatter plots and non-parametric curves presented: Countries with a low GDP per capita have a highly specialized export structure which, on average, becomes more diversified with growing GDP per capita. This at least implies that for most countries it is definitely not *specialization* that accompanies economic growth. The trend to diversify decreases at higher levels of GDP per capita, and even slightly reverses at the highest levels of GDP per capita. As with the pattern when using production data, the trend towards re-specialization for high-income countries is not symmetric to the specialization trend of low-income countries, so the resulting shape might be called an “L-curve” instead of “U-curve”. Including countries with a population of less than one million inhabitants does not lead to different conclusions. The slope of the within-country variation depends on the dataset used, showing some kind of non-linearity in the long run, but a monotonous within-trend toward specialization in the short run.

These tentative conclusions based on non-parametric analysis, however, need to be further analysed using panel data regression techniques.

4.2.3. Regression results

The parametric regression analysis in Table 4.12 includes as explanatory variables a linear and a squared term for GDP per capita (see Appendix B.2 for results using PPP dollars), and excludes countries with fewer than one million inhabitants. The results are shown for the SITC 5-digit, Feenstra 4-digit and HS 6-digit data, basically confirming the conjectured U- or L-shaped relationship between specialization and GDP per capita.

Columns 1 and 2 in Table 4.12 show the results of the simple pooled OLS regression, where the time and cross-country dimensions of every observation are treated without methodological difference. The U-curve, i.e., a negative coefficient on the linear part and a positive coefficient on the squared part,[69] is highly significant at the 1-percent level for both indices and all three datasets. The results for the Theil and Hirschman indices, as well as for all indices when using PPP dollars, also show a significant U-curve (Appendix Tables 37 and 38). The estimated turning points of the U-curve vary a great deal across the different models, ranging from US$14,000 to US$28,000. Of particular interest are the turning points of the fixed effects estimates, describing the turning point of an average country, but even these turning points are not consistent between datasets and measures.

The results of the fixed effects regressions (columns 3 and 4) are of significant interest in this context, showing a significant U-shape relationship for the SITC and Feenstra datasets. For the HS dataset, the estimates do *not* show a U-curve, but this might be due to the short time span covered by the HS dataset, which is 19 years, compared with 44 years for the SITC dataset and 38 years for the Feenstra dataset. However, when using international PPP dollars (Appendix Table 34), the U-shape is only significant and robust in the Feenstra 4-digit

[69] Except for the number of export lines as a measure of diversification, for which an inverted-U-curved shape is expected.

dataset. When using the SITC 5-digit and HS 6-digit datasets, the coefficients are insignificant and, in most cases, are not of the expected sign. In principle, these results weaken the robustness of the proposed U-shaped correlation between specialization and economic level, although they might be influenced by the smaller sample size due to a smaller number of observations for PPP dollars than for constant US dollars.[70]

Columns 5 and 6 show the results of the between effects regression analysis, which estimates the correlation between the country *means* of diversification and the means of GDP per capita. The U-shaped relationship is found to be significant at the 1-percent level for all datasets when using the Gini index, but for the Herfindahl Index the estimates are surprisingly insignificant for the SITC and HS dataset. Appendix Tables 35 and 36 also indicate a lack of robustness for other indices and when using PPP dollars.

The second part of Table 4.12 uses SITC 5-digit data, but with potential outliers excluded.[71] Since the sign and significance of the coefficients is consistent with those when outliers are not discarded, it can be concluded that the U-curve is *not* driven by outliers. The absolute value and significance of the coefficients is even larger in the fixed effects regression, thus strengthening the conclusion of a U-shaped relationship.

The results of random effects regressions are presented in Appendix Tables 31 and 32. The Gini, Theil, Herfindahl and Hirschman indices show a U-curve that is significant at the 1-percent significance level for all specialization indices and datasets, except for the Theil and Herfindahl Index in the HS 6-digit dataset. The Hausman test for differences in the respective coefficients of the random and fixed effects models rejects the null hypothesis of no systematic difference at the 5-percent level, indicating the appropriateness of a fixed effects regression.

[70] When the regression with constant US dollar is restricted to the sample where PPP US dollar are available, the significance of the U-curve diminishes, indicating that the sample size cannot be excluded as potential reason for the differences in the results.

[71] Outliers are identified using the approach of Hadi (1992, 1994).

Table 4.12. Regression results for export specialization, SITC 5-digit, HS 6-digit, Feenstra 4-digit

SITC 5-digit	**(1) Gini Pooled**	**(2) Herfindahl Pooled**	**(3) Gini FE**	**(4) Herfindahl FE**	**(5) Gini BE**	**(6) Herfindahl BE**
GDP per capita	-9.197e-06***	-1.862e-05***	-4.445e-06***	-4.546e-06*	-1.014e-05***	-1.900e-05**
	(2.497e-07)	(1.342e-06)	(4.464e-07)	(2.470e-06)	(1.311e-06)	(9.497e-06)
GDP per capita squared	2.021e-10***	4.039e-10***	1.118e-10***	1.648e-10**	2.437e-10***	4.359e-10
	(8.792e-12)	(4.831e-11)	(1.201e-11)	(7.267e-11)	(5.161e-11)	(3.739e-10)
Constant	9.851e-01***	2.827e-01***	9.655e-01***	2.216e-01***	9.863e-01***	2.933e-01***
	(6.019e-04)	(5.933e-03)	(1.643e-03)	(8.566e-03)	(3.805e-03)	(2.757e-02)
Observations	3862	3862	3862	3862	3862	3862
Number of countries	142	142	142	142	142	142
R-squared	0.495	0.073	0.483	0.0226	0.490	0.0732
Turning point	22,754	23,050	19,879	13,792	20,804	
SITC 5-digit without outliers						
GDP per capita	-9.023e-06***	-2.526e-05***	-5.169e-06***	-6.879e-06***	-8.668e-06***	-1.651e-05
	(2.688e-07)	(1.239e-06)	(4.072e-07)	(2.110e-06)	(1.459e-06)	(1.011e-05)
GDP per capita squared	1.921e-10***	5.412e-10***	1.340e-10***	2.341e-10***	1.811e-10***	3.376e-10
	(9.830e-12)	(4.483e-11)	(1.103e-11)	(6.174e-11)	(6.100e-11)	(4.125e-10)
Constant	9.847e-01***	4.802e-01***	9.676e-01***	2.287e-01***	9.841e-01***	2.897e-01***
	(6.122e-04)	(5.269e-03)	(1.518e-03)	(7.628e-03)	(3.969e-03)	(2.800e-02)
Observations	3849	3853	3849	3858	3849	3858
Number of countries	142	142	142	142	142	142
R-squared	0.497	0.154	0.477	0.0370	0.497	0.0737
Turning point	23,485	23,337	19,287	14,692	23,932	
Feenstra 4-digit						
GDP per capita	-9.492e-06***	-2.508e-05***	-8.624e-06***	-1.073e-05***	-1.154e-05***	-2.949e-05***
	(2.535e-07)	(1.241e-06)	(3.852e-07)	(1.120e-06)	(1.461e-06)	(8.897e-06)
GDP per capita squared	2.056e-10***	6.627e-10***	1.559e-10***	3.211e-10***	3.123e-10***	8.936e-10**
	(9.723e-12)	(5.035e-11)	(9.108e-12)	(3.097e-11)	(6.151e-11)	(3.746e-10)
Constant	9.873e-01***	2.748e-01***	9.869e-01***	2.307e-01***	9.881e-01***	2.847e-01***
	(5.524e-04)	(4.663e-03)	(1.272e-03)	(3.615e-03)	(4.056e-03)	(2.469e-02)
Observations	4008	4008	4008	4008	4008	4008
Number of countries	135	135	135	135	135	135
R-squared	0.516	0.127	0.510	0.123	0.490	0.121
Turning point	23,084	18,923	27,659	16,708	18,476	16,501
HS 6-digit						
GDP per capita	-6.702e-06***	-1.158e-05***	1.301e-06***	-1.391e-06	-6.579e-06***	-1.310e-05*
	(3.720e-07)	(1.350e-06)	(4.631e-07)	(1.735e-06)	(1.094e-06)	(6.646e-06)
GDP per capita squared	1.304e-10***	2.306e-10***	1.542e-11*	4.766e-11	1.267e-10***	2.734e-10
	(1.201e-11)	(4.244e-11)	(9.352e-12)	(3.395e-11)	(3.734e-11)	(2.268e-10)
Constant	9.852e-01***	1.739e-01***	9.442e-01***	1.270e-01***	9.877e-01***	2.026e-01***
	(1.060e-03)	(6.548e-03)	(2.206e-03)	(7.860e-03)	(3.883e-03)	(2.359e-02)
Observations	1612	1612	1612	1612	1612	1612
Number of countries	134	134	134	134	134	134
R-squared	0.434	0.076	0.344	0.0111	0.434	0.0758
Turning point	25,698	25,108			25,963	

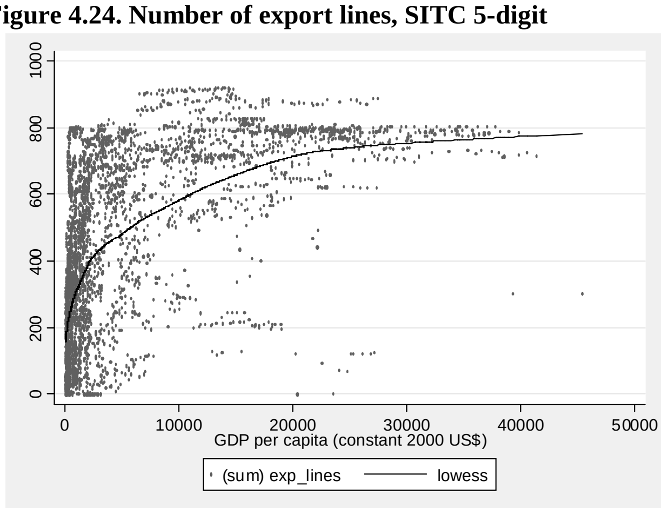
Robust standard errors in parentheses (non-robust standard errors for BE)
*** p<0.01, ** p<0.05, * p<0.1

The LAD regression, which is less sensitive to outliers, confirms the U-curve for the Feenstra dataset, as the estimated coefficients for all five specialization indices and both measures of GDP per capita are of the expected sign and significant at the 1-percent level. However, for the SITC 5-digit dataset, the U-curve is not significant when using the Herfindahl Index with constant US dollars, and when using PPP dollars it is only significant for the Gini Index and number of export lines. The HS 6-digit dataset again shows the least significant U-curve, as it is only significant for export lines, the results for the Gini coefficient indicate a significant and increasing positive slope (Appendix Tables 39 and 40).

Overall, the evidence in favour of a U-curve is mixed. While for some specifications the U-shaped curve is distinct and highly significant, this is not the case for all specifications. If the average export structure of a country would indeed follow a U-curve, then this fact should be observed for all specifications and regression methods, in particular, for the fixed effects regression. As this is not the case, it remains questionable if the proposed U-curve in the discussed literature is a statistical artifact or a stylized fact of development.

Taking a closer look at the number of export lines provides additional insights into the U-shaped curve relationship (Figure 4.24). As economies grow, they add new product lines to their exports, or, more precisely, products in a certain classification system which have previously been zero now turn into a positive value. As this continues, the number of remaining zeros decreases and eventually reaches a point where new products fall into an old category simply due to the non-existence of remaining categories that can be opened. Due to the boundedness of the maximum number of different products, the speed of diversification *has* to slow down eventually. When this slowdown is mathematically modeled through an interaction of a negative linear term and a positive squared term, then the result is a U-curve if the x-axis is wide enough to allow for a turning point, otherwise it will appear as an L-curve. This result also contradicts the findings of Carrère, Strauss-Kahn and Cadot (2007), who find a decrease in the number of product lines – the "extensive margin" in their terminology – for high-income countries.

Figure 4.24. Number of export lines, SITC 5-digit



The non-existence of a downward-sloping part, when looking at the scatter plot of product lines, does not fully negate the existence of an upward-sloping part when looking at specialization measures. Although a country exports more product lines, it can still be more specialized in a small number of these product lines. However, the product-line effect should not be discarded too quickly.

The fixed effects panel regression shows a significant inverted U-curved relationship between export lines and GDP per capita, with a turning point within the range of the dataset, although at very high levels of GDP per capita (Appendix Tables 31-40, last column). In combination with the above scatter plot (Figure 4.24), these results indicate that a U-curve in panel regressions can be questioned.

Although this puts a big question mark over the discussed upward-sloping part of the U-curve, one strong conclusion can still be made. It is definitely diversification that goes hand in hand with economic growth, and any market forces that might encourage specialization seem to be weaker than those encouraging diversification.

This chapter has so far analysed *all* traded goods, so diversification in this context reveals the well-known structural change by shifting exports away from agricultural products into processed products. Given this, it is even more surprising that the U-shape is not more significant. Nevertheless, any change in the structure of the economy away from agriculture will appear as an increase in diversification, whether diversification has taken place or not, because in the current classification systems agricultural goods are less disaggregated than non-agricultural goods. To examine whether the results are sensitive to this distinction and to allow a more ready comparison with the results using MVA data, the export data is restricted to manufactured products only.

When only manufactured products are considered, the U-curve is *more* significant than when non-manufactured products are also included (see Appendix B.1). In addition, the turning points are – although not constant among the different datasets and indices – on average higher than for MVA. This could indicate that export patterns indeed follow production patterns. But still, these results should not be overemphasised, as the within-country variation is smaller than the between-country variation, and the within-country U-shape is not robust when using international PPP dollars. Moreover, although the U-curve is significant in the pooled panel, a large amount of the variation in the data may be due to other explanatory factors – other than the level of economic development – that determine the level of specialization.

4.2.4. Capital-labour ratio as determinant

By replacing GDP per capita with the capital-labour ratio in the regression analysis above it is possible to test the theoretical model of Batista and Potin (2007), which is based on the Heckscher-Ohlin model. They argue that the export structure of low-income countries mainly consists of labour-intensive goods, while that of high-income countries mainly consists of capital-intensive goods. At intermediate income levels there is a transition period, where both labour- and capital-intensive goods are exported.

Given that the correlation between GDP per capita and the capital-labour ratio is 0.93 in the SITC 5-digit dataset, few major differences from implementing this change are expected. The regression results confirm a U-shaped relationship: countries with low capital-labour ratios are specialized, but their specialization levels decrease as the capital-labour ratios rise, and increases again at the highest capital-labour-ratios (Table 4.13). This U-shaped behavior is predicted by the Heckscher-Ohlin model in Batista and Potin (2007).

Table 4.13. Regression results for export specialization and capital-labour-ratio, SITC 5-digit

	(1) Gini Pooled	**(2) Herfindahl Pooled**	**(3) Gini FE**	**(4) Herfindahl FE**	**(5) Gini BE**	**(6) Herfindahl BE**
Capital-labour ratio	-1.723e-06***	-3.987e-06***	-1.214e-06***	-2.258e-06***	-1.171e-06***	-3.037e-06
	(6.460e-08)	(3.534e-07)	(7.777e-08)	(4.611e-07)	(2.779e-07)	(1.962e-06)
Capital-labour ratio squared	6.788e-12***	1.647e-11***	6.478e-12***	1.461e-11***	9.530e-13	4.198e-12
	(5.307e-13)	(2.826e-12)	(4.766e-13)	(3.179e-12)	(2.275e-12)	(1.606e-11)
Constant	9.910e-01***	2.901e-01***	9.744e-01***	2.359e-01***	9.892e-01***	3.079e-01***
	(7.373e-04)	(7.150e-03)	(1.600e-03)	(8.344e-03)	(4.419e-03)	(3.119e-02)
Observations	2805	2805	2805	2805	2805	2805
Number of countries	100	100	100	100	100	100
R-squared	0.538	0.110	0.506	0.0800	0.504	0.104

Robust standard errors in parentheses (non-robust standard errors for BE)
*** p<0.01, ** p<0.05, * p<0.1

4.3. Export of products – relative specialization

4.3.1. Descriptive statistics

The idea of relative diversification can be graphically represented in several ways. Following De Benedicts, Gallegati and Tamberi (2007:4-5), the sectoral market shares can be presented by country and year – Figures 4.25 - 4.26 show the data for the Republic of Korea using SITC 5-digit data as an example. Each bar in Figure 4.25 represents the ratio of the value of national total exports of a respective sector to world exports in that sector in the year 2005. The horizontal line equals the share of the Republic of Korea's exports in world total exports. Figure 4.26 shows the same relationship for the year 1963. These figures show clearly how the Republic of Korea's export structure has changed since 1963. In that year, the Republic of Korea's major export sector was "Ores & concentrates of nickel" (SITC code 28321), which accounted for 45 percent of world exports in that sector, while in 2005, the Republic of Korea's major export sector was "Special purpose vessels (e.g. light vessel dredgers)" (SITC 73592), accounting for 31 percent of global exports in that sector. Every value that exceeds the horizontal line indicates a sector with a so-called "revealed comparative advantage", i.e., this sector is exported on a higher scale than the average export intensity of that country. Dividing each sectoral share by the share of the Republic of Korea's total exports in total world exports in the respective year yields the sectoral Balassa Indices.

Figure 4.25. Relative specialization of the Republic of Korea, sectoral shares and total share, 2005

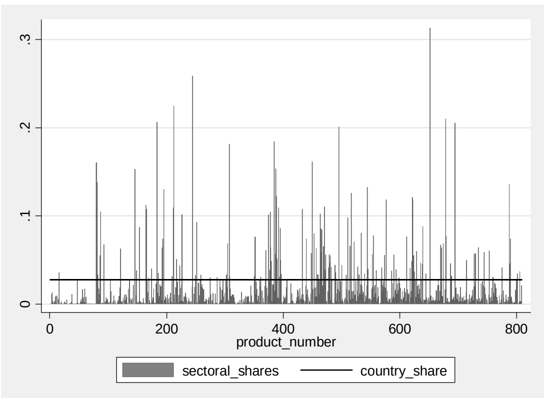
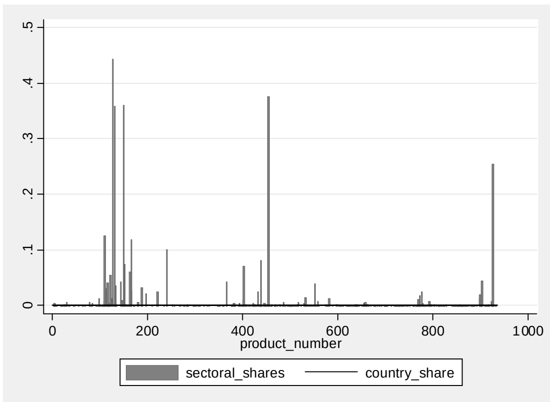


Figure 4.26. Relative specialization of the Republic of Korea, sectoral shares and total share, 1963



As described in Section 3, the median of the Balassa Indices of a country in a particular year is a good indicator of diversification,[72] with the Balassa Index also serving as a basis for the construction of the relative Gini and Theil indices. The ten most and ten least specialized countries, in terms of relative specialization, are listed in Table 4.14. The world's largest economy, the USA, heads the list, followed by other OECD countries plus China. The ten most specialized countries all lie in Sub-Saharan Africa, with the exception of Algeria. This ranking is probably an outcome of the construction of the relative specialization index itself, since big exporters determine the benchmark – the global average export structure – to a large extent, so by definition they are diversified. Whether this counteracts any trend for relative re-specialization is analysed thoroughly in this chapter.

Table 4.14. Ten most and ten least specialized countries, HS 6-digit, year 2005

Rank	Country	Relative Gini	Relative Theil	Relative DI	Median Balassa
1	United States	0.49	0.45	0.37	0.71
2	Germany	0.49	0.44	0.37	0.62
3	United Kingdom	0.51	0.50	0.36	0.47
4	Italy	0.55	0.72	0.46	0.68
5	France	0.55	0.56	0.41	0.57
6	Spain	0.61	0.79	0.47	0.51
7	Netherlands	0.61	0.67	0.45	0.37
8	China	0.61	0.84	0.53	0.54
9	Belgium	0.62	0.71	0.47	0.40
10	Austria	0.67	0.90	0.50	0.26
107	Gambia, The	0.99	5.81	0.96	0.00
108	Algeria	0.99	2.38	0.88	0.00
109	Gabon	0.99	2.91	0.91	0.00
110	Benin	0.99	5.50	0.96	0.00
111	Ethiopia (excludes Eritrea)	0.99	7.08	0.98	0.00
112	Sudan	1.00	3.29	0.95	0.00
113	Central African Republic	1.00	6.22	0.97	0.00
114	Burundi	1.00	5.38	0.98	0.00
115	Mali	1.00	5.33	0.97	0.00
116	Mauritania	1.00	6.76	1.00	0.00

The summary statistics of the variables used in the following analysis are presented in Table 4.15. Compared to the absolute specialization indices (Table 4.9), the differences between the minima and maxima are much larger, as are the standard deviations, since the deviation from the global export distribution is smaller, on average, than the deviation from the artificial equal distribution that was implicitly used in absolute specialization measures.

[72] The median of the Balassa Index has the opposite sign to the other specialization indices.

Table 4.15. Summary statistics of relative export specialization, SITC 5-digit

Variable	Observations	Mean	Std. Dev.	Min	Max
Relative Gini	5340	0.87	0.15	0.30	1.00
Relative Theil	5340	2.99	1.88	0.24	10.67
Relative DI	5340	0.77	0.18	0.24	1.00
Median Balassa	5340	0.08	0.18	0.00	1.10
Population	4960	3.12E+07	1.10E+08	40740	1.31E+09
GDP per capita	4567	6332	8305	92	54178
GDP per capita (PPP)	3042	10956	11361	319	79032

Table 4.16 presents the correlation between the various absolute and relative diversification indices, which varies a great deal between pairs and, in particular, between the relative and absolute diversification measures. While the absolute Gini Index and the relative Gini Index seem to be highly correlated, other measures, such as the absolute and relative Theil Indices, are less correlated. This difference is not due to non-linearities, since the rank correlations are also much lower between relative and absolute measures when compared with rank correlations within the two groups of measures (Table 4.17). These results provide an additional motivation to test whether a U-curved relationship can be observed in relative specialization, as the results from absolute specialization cannot be directly applied to relative specialization.

Table 4.16. Correlation between relative and absolute export specialization, SITC 5-digit

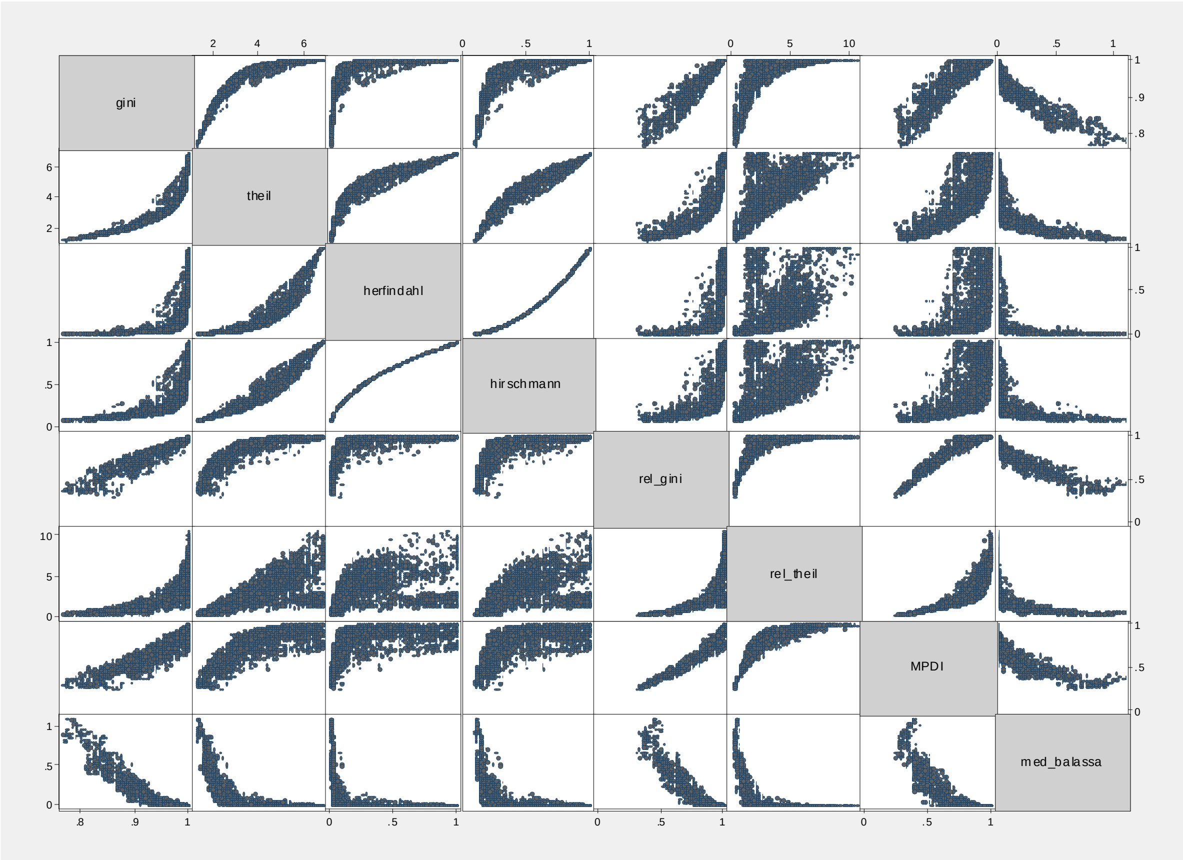
	Gini	Theil	Herfindahl	Hirschman	Rel. Gini	Rel. Theil	Rel.DI	Median Balassa
Gini	1.00							
Theil	0.85	1.00						
Herfindahl	0.57	0.89	1.00					
Hirschman	0.70	0.96	0.97	1.00				
Relative Gini	0.97	0.81	0.54	0.66	1.00			
Relative Theil	0.68	0.67	0.45	0.56	0.71	1.00		
Relative DI	0.92	0.80	0.52	0.65	0.96	0.83	1.00	
Median Balassa	-0.89	-0.61	-0.34	-0.46	-0.89	-0.52	-0.80	1.00

Table 4.17. Rank correlation between relative and absolute export specialization, SITC 5-digit

	Gini	Theil	Herfindahl	Hirschman	Rel. Gini	Rel. Theil	Rel. DI	Median Balassa
Gini	1.00							
Theil	0.99	1.00						
Herfindahl	0.95	0.98	1.00					
Hirschman	0.95	0.98	1.00	1.00				
Relative Gini	0.97	0.94	0.89	0.89	1.00			
Relative Theil	0.76	0.71	0.67	0.67	0.84	1.00		
Relative DI	0.87	0.83	0.77	0.77	0.93	0.94	1.00	
Median Balassa	-0.82	-0.77	-0.71	-0.71	-0.83	-0.79	-0.82	1.00

Figure 4.27 further emphasises the difference between relative and absolute specialization, showing, for example, that the difference between the two Gini indices and, in particular, the two Theil indices, can not be ignored.

Figure 4.27. Correlation matrix between absolute and relative export specialization, SITC 5-digit



4.3.2. Non-parametric results

Figure 4.28 plots relative specialization, measured by the relative Gini Index, against GDP per capita, together with a non-parametric lowess curve. Most observations are scattered in the upper-left part of the plot, indicating countries with an export structure that highly diverges from the global export structure. The figure reveals that as GDP per capita rises, countries' export structures become more similar to the global export structure, but the additional increase in relative diversification diminishes at higher levels of GDP per capita, and eventually reverses at the highest levels of GDP per capita. Figures 4.29 and 4.30 display a similar pattern for the Feenstra and HS datasets, with greater divergence from the global export structure for countries with low GDP per capita, and increasing similarity towards the global distribution with increasing GDP per capita, but at a decreasing rate, with a slight tendency towards re-specialization. As with the results in the previous sections, these stylized facts might better be called an "L-curve" rather than a "U-curve".

The Hadimvo procedure identifies a number of outliers on the upper-right side of the scatter plot (see the marked observations in Figure 4.31). When these outliers are excluded from the Lowess calculation, the re-specialization part of the curve entirely disappears. This preliminary conclusion based on the pooled panel, however, remains to be tested by employing panel data regression methods.

Figure 4.28. Relative export specialization, SITC 5-digit

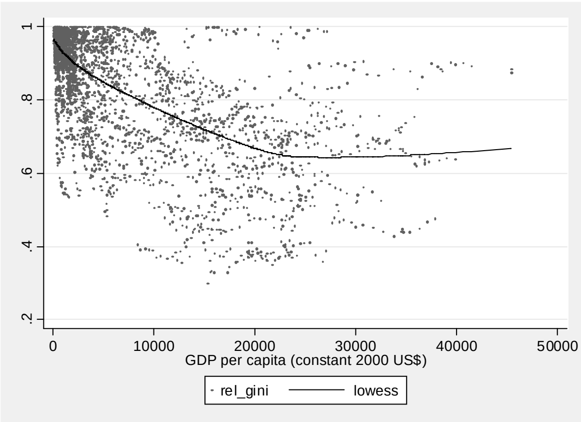


Figure 4.29. Relative export specialization, HS 6-digit

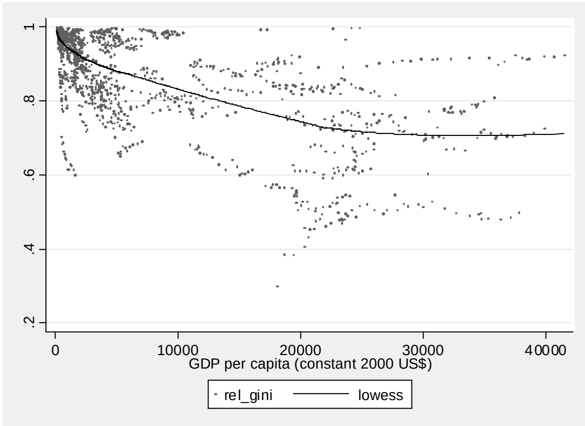


Figure 4.30. Relative export specialization, Feenstra 4-digit

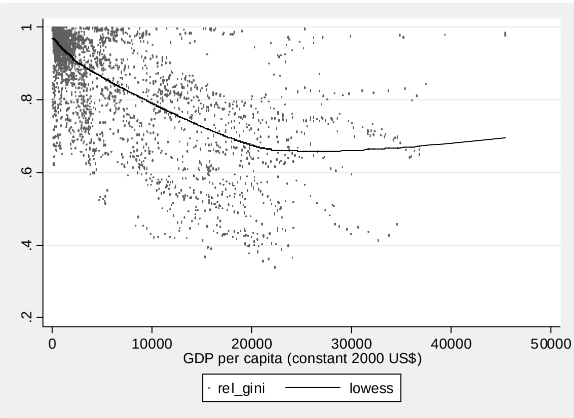


Figure 4.31. Relative export specialization, SITC 5-digit, Lowess excl. outliers

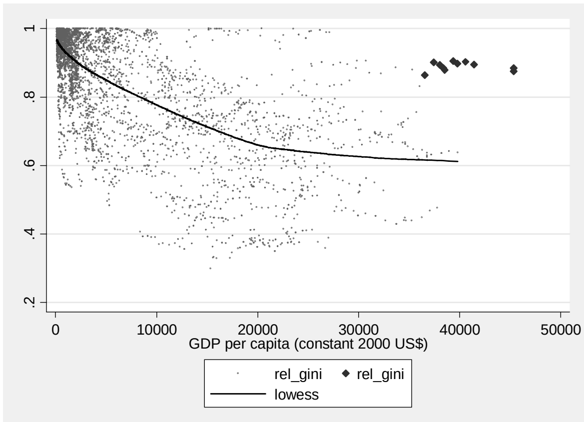


Figure 4.32 plots the same relationships as above for the SITC dataset, but with data on GDP per capita using constant PPP dollars, which is the measure used by De Benedictis, Gallegatis and Tamberi (2007) in their analysis of relative diversification. The conclusions are the same as for constant US dollars, but the upward-sloping path is more significant, which is

presumably due to a small number of observations with high GDP per capita and high relative specialization.

Figure 4.33 presents the scatter plot between relative specialization in the SITC dataset and the logarithm of GDP per capita to visualize observations with low GDP per capita. Even at the lowest levels of GDP per capita, it can be seen that rising GDP per capita is connected with a higher variance of specialization through an increasing number of countries that converge to the global export structure, while some countries remain relatively specialized.

Figure 4.32. Relative export specialization, SITC 5-digit, PPP dollars

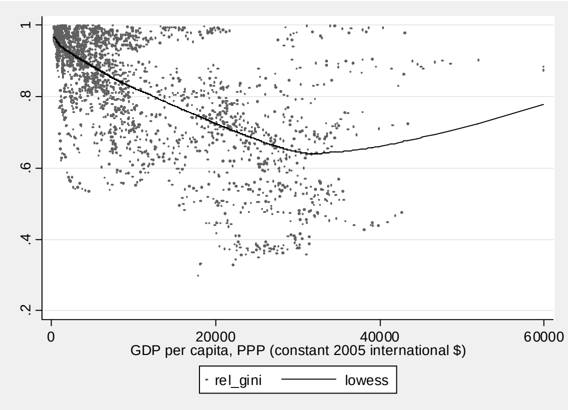


Figure 4.33. Relative export specialization, SITC 5-digit, logarithmic scale

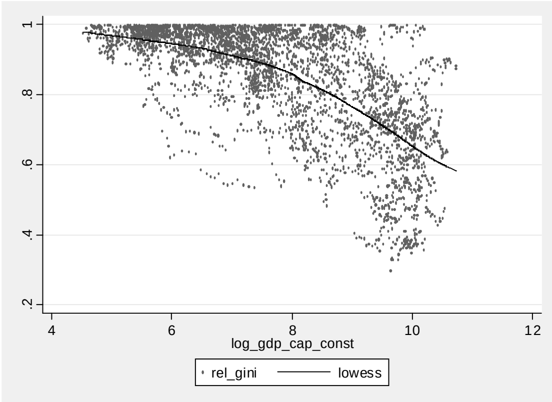
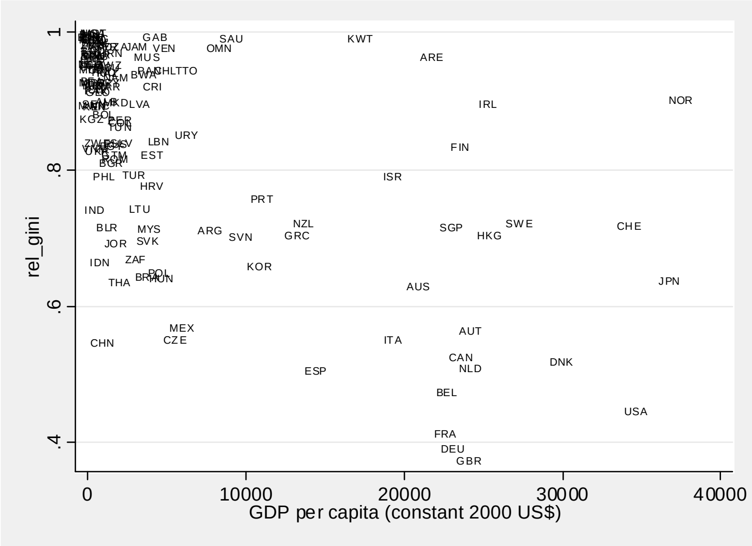


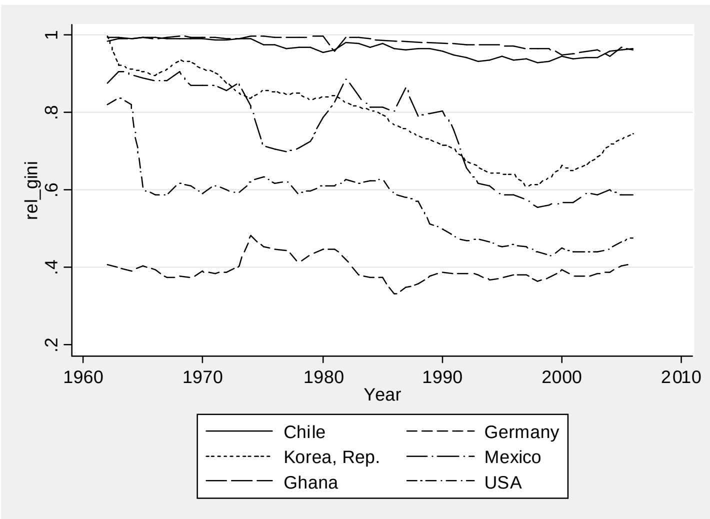
Figure 4.34 presents SITC 5-digit data for the year 2000 to provide information about the location of specific countries. Possibly as a result of the way the relative specialization measure is calculated, as mentioned above, large economies such as the United Kingdom (GBR), Germany (DEU), France (FRA) and the USA, are most diversified, as they probably highly influence the benchmark global export structure. Some oil-exporting countries, like Kuwait (KWT), United Arab Emirates (ARE) and Norway (NOR), are highly specialized relative to all other countries, despite being in the middle or upper range of GDP per capita.

Figure 4.34. Export specialization and GDP per capita, 2000



The evolution of specialization over the period 1963 to 2007 for six selected countries is shown in Figure 4.35. Among these, the Republic of Korea is the only country with an export structure emerging as a U-curve. Germany is the most diversified country over the whole period, and the USA is approaching Germany's export structure. Ghana is the country with the greatest distance to the global average export structure. Chile also remains highly specialized, while Mexico's relative structure varies a great deal, but shows a tendency to move towards the global export structure from the late 1980s onwards.

Figure 4.35. Relative export specialization over time, selected countries



The within component of the relationship between specialization and GDP per capita shows that countries first specialize, then diversify, then specialize again with rising GDP per capita, although the magnitude of the within-variation is relatively small (Figures 4.36-4.38).

Figure 4.36. Within-country relationship between relative export specialization and GDP per capita, SITC 5-digit

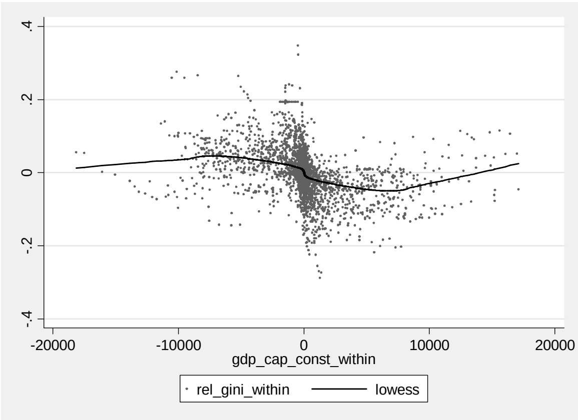


Figure 4.37. Within-country relationship between relative export specialization and GDP per capita, Feenstra 4-digit

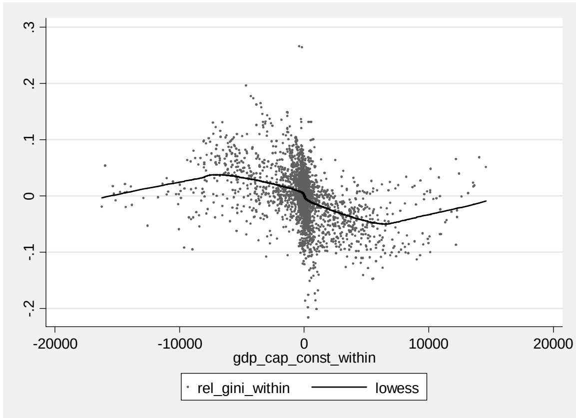
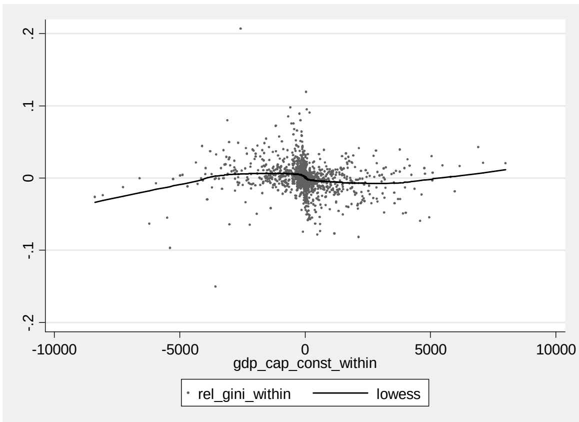


Figure 4.38. Within-country relationship between relative export specialization and GDP per capita, HS 6-digit



4.3.3. Regression results

The above presented non-parametric estimates indicate a negative correlation between relative export specialization and GDP per capita, with the slope coefficient decreasing at higher levels of GDP per capita, but without a pronounced trend towards re-specialization, except for the within-country variation. The regression results (Table 4.18, see also Appendix Tables 41-50) show a significant and quite robust U-curved correlation between specialization and GDP per capita. The pooled regression (columns 1 and 2) is significant at the 1-percent level for the four measures and three datasets, as well as for constant US dollars and constant PPP dollars. The coefficients on the median Balassa Index occasionally returns an unexpected sign for the Feenstra dataset for the between effects regression with constant PPP dollars. The LAD regression also produces unexpected signs for the coefficient on the median of the Balassa index for the SITC 5-digit and the HS dataset. However, as already noted, the estimates for the vast majority of settings are as expected and highly significant.

Note in particular that when excluding outliers in the SITC 5-digit dataset, the fixed effects regression results for the Gini, Theil and PDI figures become even more robust, with a slightly larger absolute value of the coefficients and slightly smaller standard errors.[73]

These results indicate that the export structure of low-income countries becomes increasingly similar to the world average, but that this process is slowing down and countries do not actually reach the world average structure. Eventually, high-income countries tend to diversify away from the global average, possibly due to specific products that can only be produced by countries with the highest incomes. These products are potentially high value-added products, which require a high level of technology and are as a result sold at high prices to a narrow range of consumers.

These conclusions also hold when non-manufacturing data are excluded from the regressions. In this case, the results are even more robust than when including non-manufacturing data (see Appendix B.1).

However, the observed re-specialization trend should be treated with caution. The chance that this result is an outcome of the employed methodology is high, as fitting a squared function into a downward-sloping function that eventually becomes flat will erroneously indicate a U-shaped curve. The high values of the turning points point towards this conclusion, which can be tested by using a threshold model where the threshold is imposed as the potential turning point derived from the quadratic results. If then a linear function is estimated for the parts before and after the threshold, the estimated coefficients are negative, contradicting the upward-sloping part of the quadratic function.

[73] The Hadimvo procedure excluded an absurdly large number of outliers for the median Balassa index, and is therefore not reported here.

Table 4.18. Regression results for relative export specialization, SITC 5-digit, HS 6-digit and Feenstra 4-digit

SITC 5-digit	(1) Relative Gini Pooled	(2) Median Balassa Pooled	(3) Relative Gini FE	(4) Median Balassa FE	(5) Relative Gini BE	(6) Median Balassa BE
GDP per capita	-2.626e-05***	2.696e-05***	-2.389e-05***	1.858e-05***	-3.093e-05***	3.073e-05***
	(7.509e-07)	(1.308e-06)	(1.331e-06)	(1.348e-06)	(4.003e-06)	(5.276e-06)
GDP per capita squared	5.331e-10***	-4.954e-10***	4.405e-10***	-2.829e-10***	7.576e-10***	-6.759e-10***
	(2.695e-11)	(4.790e-11)	(3.479e-11)	(3.639e-11)	(1.576e-10)	(2.077e-10)
Constant	9.545e-01***	-1.262e-02***	9.496e-01***	1.642e-02***	9.580e-01***	-1.294e-02
	(1.911e-03)	(2.279e-03)	(4.964e-03)	(5.148e-03)	(1.162e-02)	(1.532e-02)
Observations	3862	3862	3862	3862	3862	3862
Number of countries	142	142	142	142	142	142
R-squared	0.487	0.385	0.485	0.382	0.470	0.378
Turning point	24,630	27,210	27,117	32,838	20,413	22,733
SITC 5-digit excl. outliers						
GDP per capita	-2.538e-05***		-2.430e-05***		-2.723e-05***	
	(7.985e-07)		(5.077e-06)		(4.429e-06)	
GDP per capita squared	4.914e-10***		4.496e-10***		6.077e-10***	
	(2.989e-11)		(1.336e-10)		(1.846e-10)	
Constant	9.530e-01***		9.506e-01***		9.526e-01***	
	(1.930e-03)		(1.862e-02)		(1.206e-02)	
Observations	3851		3851		3851	
Number of countries	142		142		142	
R-squared	0.489		0.489		0.483	
Turning point	25,824		27,024		22,404	
Feenstra 4-digit						
GDP per capita	-2.809e-05***	3.006e-05***	-2.073e-05***	1.903e-05***	-3.350e-05***	3.439e-05***
	(7.329e-07)	(1.219e-06)	(9.937e-07)	(1.402e-06)	(3.925e-06)	(5.405e-06)
GDP per capita squared	6.184e-10***	-6.068e-10***	3.799e-10***	-3.345e-10***	8.955e-10***	-8.263e-10***
	(2.859e-11)	(4.648e-11)	(2.466e-11)	(3.379e-11)	(1.661e-10)	(2.287e-10)
Constant	9.691e-01***	-1.671e-02***	9.510e-01***	1.715e-02***	9.728e-01***	-1.975e-02
	(1.463e-03)	(1.640e-03)	(3.262e-03)	(4.623e-03)	(1.100e-02)	(1.514e-02)
Observations	4047	4047	4047	4047	4047	4047
R-squared	0.548	0.442	0.541	0.440	0.528	0.434
Number of countries	136	136	136	136	136	136
Turning point	22,712	24,769	27,283	28,445	18,705	20,810
HS 6-digit						
GDP per capita	-1.870e-05***	1.812e-05***	-9.538e-06***	5.555e-06**	-1.837e-05***	1.666e-05***
	(1.074e-06)	(1.687e-06)	(1.627e-06)	(2.237e-06)	(3.006e-06)	(3.806e-06)
GDP per capita squared	3.414e-10***	-3.027e-10***	1.747e-10***	-1.731e-10***	3.347e-10***	-2.555e-10*
	(3.588e-11)	(5.584e-11)	(3.403e-11)	(4.149e-11)	(1.026e-10)	(1.299e-10)
Constant	9.615e-01***	-7.414e-03**	9.196e-01***	6.430e-02***	9.676e-01***	-7.318e-03
	(2.773e-03)	(3.595e-03)	(7.593e-03)	(1.143e-02)	(1.067e-02)	(1.351e-02)
Observations	1612	1612	1612	1612	1612	1612
R-squared	0.472	0.351	0.472	0.106	0.472	0.351
Number of countries			134	134	134	134
Turning point	27,387	29,931	27,298	16,046	27,442	32,603

Robust standard errors in parentheses (non-robust standard errors for BE)
*** p<0.01, ** p<0.05, * p<0.1

Even if the correct relationship is L-shaped, the case can be made against a static interpretation of the idea of comparative advantage, since diversification always goes hand in hand with economic growth. There is no evidence of low- or middle-income countries exhibiting rising GDP per capita without diversifying its export structure.

The high level of relative diversification for high-income countries also has a dynamic interpretation. As the global export structure changes over time, the benchmark of relative specialization also changes. The fact that high-income countries are more diversified, when global trade patterns change these countries are able to adabt to new demand structures more quickly than low- and middle-income countries, otherwise they would – by definition – be more specialized.

Overall, these finings contradict two statements that are often brought forward in the respective literature: First, it is wrong to say that specializing in a few products is a way out of poverty. Second, and more important in the context of the recent discussion in the literature, the trend towards re-specialization of high-income countries is not robust. Even if the re-specialization trend is significant, it is very small and appears at highest levels of GDP per capita only.[74]

4.4. Export markets

The methods described and employed above are commonly used for production and/or export specialization. To my knowledge, there exists no publication that analyses global patterns of specialization in export *markets*, where “market” means the geographic destination of a country’s exports. There is, however, a rationale for analysing such market specialization along with product specialization: If diversification of production or exports is seen as a way of decreasing the vulnerability of an economy by making it less prone to negative demand shocks on a single or a few products, then looking *only* at products might not reveal all dimensions of vulnerability. In addition to the structure of exports, the stability of exports will also depend on the stability of demand from its export markets, which can be affected by recessions and so on in the importing country. Exporters that export to a large number of

[74] The shape of the specialization-income-relationship can also be determined using a threshold regression model, such as the endogenous threshold models of Hansen (1996, 1999). This method tests whether there is a structural break in the dataset, and returns the position of the structural break along with linear regressions for the parts before and after the breakpoint, hence testing for an L-curve or a V-curve. If the U-curve in the above panel regressions would be robust, then the threshold model would return a negative slope before the threshold and a positive slope after the threshold. The results do not allow for robust conclusions however. The threshold value highly varies among the datasets and specialization specification employed, and the sign for the lower and upper parts vary across the datasets and specialisation measures. Further analysis, including testing for the optimal number of thresholds, would go beyond the scope of this study and is therefore left for further research.

markets are able to cushion themselves from lower demand in some of their markets, but this is not the case for exporters serving only a small number of markets, even if its export structure is highly diversified. Therefore, the export structure of a country should be measured along the two dimensions of product and market diversification to take into account the fact that stability is maximized only when the export structure of a country is diversified both in products and markets. In other words, a country is most vulnerable to external trade shocks when its export structure is highly specialized in a few sectors *and* serves only a few foreign markets.[75]

In the context of this study, the relevance of market specialization implies that verifying the existence of a U-shaped curve of production or export of goods alone is not sufficient to understand trends in specialization. Even if a U-curve in production or exports exists, any conclusion that does not take the pattern of export destinations into account falls short of describing general specialization trends. Policy recommendations based on this single-dimensional view should be treated with caution.

Methodologically, the calculation of market diversification is the same as for product diversification, where the values of exported products are replaced by the values of total exports to each country in the world. This holds for both absolute and relative market diversification. In order to avoid disturbances stemming from small countries, every country with a population below 500,000 inhabitants is excluded.

Interpreting the difference between absolute and relative market diversification in this context is slightly different from the comparison for products. The measure of *relative* diversification has even more explanatory power compared to absolute diversification in this context, because the global geographic trade structure reveals information on the size of the importing countries. Relative diversification implicitly incorporates the size of the importing county, which is otherwise neglected when the un-weighted absolute diversification measure is used. Concerning the drivers of market diversification, it can be assumed that size itself determines the destination of exports to a certain extent. Bigger countries might have more diversified export destinations due to the fact that they share borders with a larger number of countries. On the other side, the geographic flows of exports are also dependent on other geographic

[75] The author is thankful to Manuel Albaladejo (UNIDO) for the idea of market diversification.

characteristics as well as economic and political determinants. In the context of low-income countries, former colonial ties constitute an additional relevant determinant (see Bhattacharjea (2004) for an overview on this discussion).

4.4.1. Absolute market specialization

There is no existing hypothesis concerning the relationship between GDP per capita and market diversification, although it can be expected that countries with higher GDP per capita have the capacity, infrastructure and technology to serve a larger number of different geographical markets. Generally, the results reveal a high overall level of market specialization, which means that a small number of importers dominate the global import structure. Countries at low levels of GDP per capita show both relatively large and small values of market specialization, with this variance becoming smaller at higher levels of GDP per capita. There seems to be a trend towards greater market diversification at higher levels of GDP per capita (Figure 4.39). Transforming the horizontal axis into a logarithmic scale to better illustrate the dense left part of the scatter plot reveals a negative but very low correlation between market specialization and GDP per capita (Figure 4.40).

Figure 4.39. Market specialization

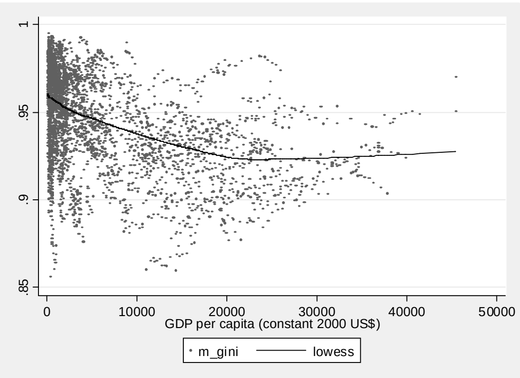
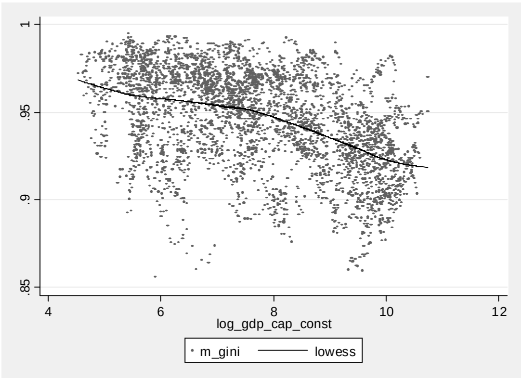
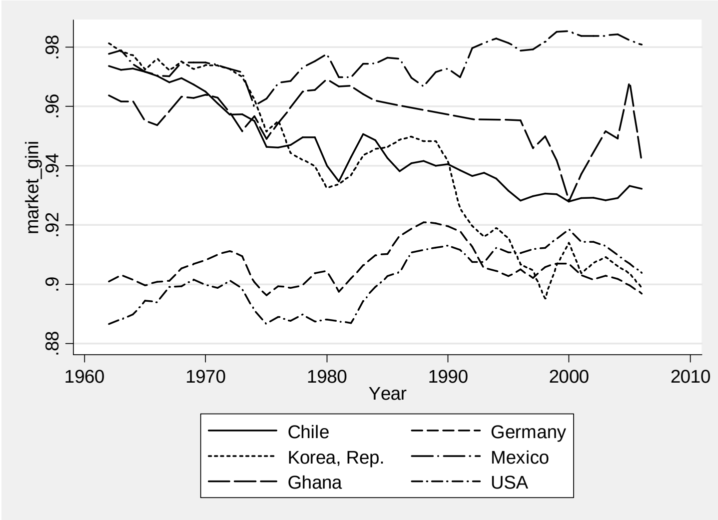


Figure 4.40. Market specialization, logarithmic scale



Considering individual countries, the evolution of market diversification over time varies considerably from country to country, but shows some interesting trends (Figure 4.41). In the late 1960s, these six countries were at one of two concentration levels: The USA and Germany were quite diversified in their export destinations, while Chile, the Republic of Korea, Mexico and Ghana served only a few foreign markets. Mexico remained at its level of market specialization, but Chile and especially the Republic of Korea managed to reach into new markets, making the Republic of Korea as interlinked with the world market as Germany and the USA.

Figure 4.41. Market diversification over time, selected countries



The ten most and least diversified countries in the year 2005 are presented in Table 4.19. Surprisingly, the list is not headed by OECD countries, but by large middle income countries, which have the potential to easily serve many export markets as they border many other countries, and are at a level of economic development high enough to benefit from this advantage.

Table 4.20 presents the surprising result that there seems to be a U-curved relationship between export market diversification and GDP per capita. As economies grow, they enter new markets, but this increasing diversification stops and turns towards re-specialization at high GDP per capita levels. High-income countries obviously do not benefit from entering new markets, but from concentrating on a fewer number of export destinations and decreasing non-profitable trade with other partners. An explanation for this pattern might lie in the technological content of exports and the related demand pattern. At middle incomes, countries are highly diversified, exporting a relatively large number of products. Given the wide variety of products exported, it is likely that the country can meet the demands of many different countries. At higher levels of GDP per capita, a country becomes more specialized (in higher-tech products), with demand for such products coming from a smaller number of (advanced) countries that demand such products. If this is the case, then countries with the highest levels of GDP per capita would export mainly to similiarly advanced countries, i.e., the average GDP per capita of its trading partners would be higher than for middle-income countries.

Table 4.19. Ten most and ten least specialized countries, market specialization, 2005

Rank	Country	Gini	Theil	Herfindahl	Hirschman	Export Destinations
1	Ukraine	0.87	1.90	0.06	0.26	169
2	India	0.88	1.92	0.05	0.23	220
3	Brazil	0.88	1.95	0.06	0.25	210
4	Turkey	0.88	1.90	0.04	0.22	204
5	Italy	0.89	1.99	0.05	0.24	221
6	Greece	0.89	2.00	0.05	0.23	198
7	Russian Federation	0.89	1.97	0.04	0.21	173
8	South Africa	0.90	2.02	0.05	0.23	212
9	France	0.90	2.14	0.06	0.25	220
10	Pakistan	0.90	2.20	0.08	0.29	211
114	Venezuela	0.98	4.06	0.49	0.70	121
115	Central African Republic	0.98	3.53	0.17	0.42	34
116	Montserrat	0.98	3.58	0.19	0.43	16
117	Cook Islands	0.98	3.75	0.23	0.49	24
118	Mexico	0.98	4.64	0.74	0.86	184
119	Sudan	0.99	4.37	0.58	0.76	58
120	Swaziland	0.99	4.35	0.57	0.75	73
121	Mongolia	0.99	4.29	0.51	0.71	67
122	Albania	0.99	4.35	0.54	0.73	75
123	Botswana	0.99	4.54	0.59	0.77	104

Table 4.20. Regression results for absolute market specialization

	(1) Gini Pooled	(2) Herfindahl pooled	(3) Gini FE	(4) Herfindahl FE	(5) Gini BE	(6) Herfindahl BE
GDP per capita	-3.406e-06***	-5.252e-06***	-2.494e-06***	-5.247e-06***	-3.434e-06***	-6.669e-06
	(1.228e-07)	(6.018e-07)	(2.630e-07)	(1.101e-06)	(9.071e-07)	(4.944e-06)
GDP per capita squared	7.347e-11***	7.976e-11***	6.650e-11***	1.066e-10***	7.326e-11**	1.146e-10
	(3.866e-12)	(1.745e-11)	(6.433e-12)	(2.340e-11)	(3.572e-11)	(1.947e-10)
Constant	9.594e-01***	1.910e-01***	9.546e-01***	1.881e-01***	9.611e-01***	2.029e-01***
	(5.392e-04)	(2.940e-03)	(1.012e-03)	(4.711e-03)	(2.633e-03)	(1.435e-02)
Observations	3853	3853	3853	3853	3853	3853
R-squared	0.245	0.041	0.228	0.0402	142	142
Number of countries	142	142	142	142	0.245	0.0411
Turning point	23,180	32,924	18,752	24,611	23,437	

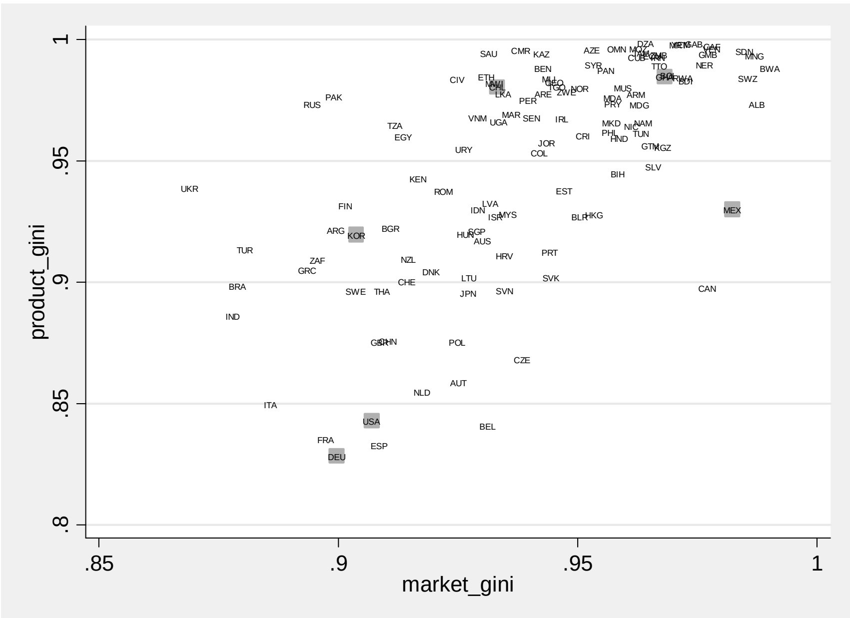
Robust standard errors in parentheses (non-robust standard errors for BE)
*** p<0.01, ** p<0.05, * p<0.1

4.4.2. Combining absolute market and product specialization

When the two measures of absolute specialization – product and market specialization – are combined, they allow for a two-dimensional analysis of a country’s trade vulnerability. Figure 4.42 shows market diversification on the horizontal axis and product diversification (using

SITC 5-digit) on the vertical axis. Countries at the top right corner are specialized both in export products and export markets, while countries in the bottom-left corner are diversified along both dimensions. In order to minimize vulnerability along both dimensions, a country should look towards moving to the bottom-left corner of the graph. When considering the specific countries used as examples above, we find that Germany and the USA are highly diversified in markets as well as in products, and can therefore be considered “secure” in terms of vulnerability to external shocks. The Republic of Korea is more specialized in products, but remains equally specialized in markets as Germany and the USA. Chile and Mexico differ very much from each other: Mexico is specialized in markets – presumably mostly accounted for by the USA – and less in products, while Chile is much less specialized in markets, but more specialized in products. Although both countries are more vulnerable to external shocks than the USA and Germany, it is impossible to judge which of them is less vulnerable, once both dimensions are taken into account.

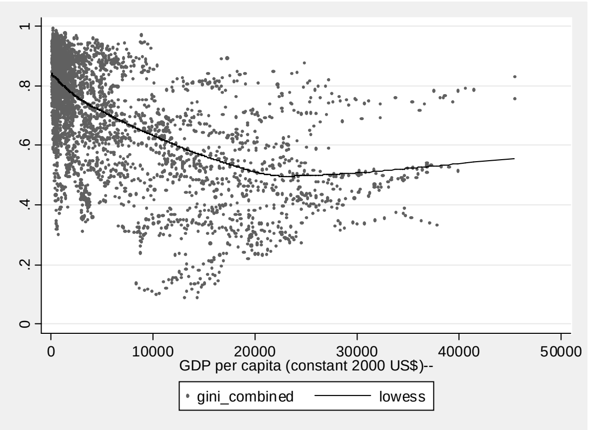
Figure 4.42. Market specialization and product specialization, 2005



This result has implications for how countries are classified. Until now, only the export or production dimension is taken into account when attempting to classify countries in terms of their vulnerability. For example, export product specialization is one component of the Economic Vulnerability Index of the United Nations, which is used, inter alia, in the classification of Least Developed Countries (cf. United Nations, 2006:26-29, 2003:45-47, 1999:5-6; and the discussion in Guillaumont, 2008). If only product specialization is considered as a measure of export vulnerability, then countries such as Mexico would be rated as less vulnerable than economies such as Chile, as it exports a wider set of products. But this higher level of product diversification might not prevent Mexico's exports from being affected by negative shocks from another country, since its trade structure is dependent on very few export partners. Any benefits from Mexico's diversified export sector are thus being offset by being dependent on few trading partners. As such, a crisis in one of these countries can have a bigger impact on Mexico despite its broad product portfolio. Chile faces the opposite problem; while a decrease in demand from one of its trade partners is unlikely to affect Chile's exports a great deal, falling demand for one of its products would have a large impact, by such Chile could face diminishing export receipts despite having a relatively large number of trading partners.

A composite index can be calculated via scaling each specialization value to range between zero and one and then calculate the arithmetic mean of the two scaled indices. The resulting specialization value is therefore a combined index of a country's export product and market specialization. The scatter plot reveals a similar structure to that of product specialization, with a U-curve that shows a distinct downward trend and a slight upward trend (Figure 4.43).

Figure 4.43. Combined specialization (market and product)



The composite index follows a distinct and significant U-curve when analysed as pooled panel, and in particular when analysing the within- and between-variation (Table 4.21). This also holds when using PPP dollars.

Table 4.21. Regression results for combined specialization

	(1) Gini Pooled	(2) Gini FE	(3) Gini BE
GDP per capita	-3.232e-05***	-1.864e-05***	-3.433e-05***
	(8.840e-07)	(1.645e-06)	(5.453e-06)
GDP per capita squared	7.060e-10***	4.824e-10***	7.916e-10***
	(3.013e-11)	(4.306e-11)	(2.145e-10)
Constant	8.386e-01***	7.781e-01***	8.470e-01***
	(2.848e-03)	(6.093e-03)	(1.590e-02)
Observations	3843	3843	3843
Number of countries	141	141	141
R-squared	0.435	0.417	0.434
Turning point	22,890	19,320	21,684

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.4.3. Relative market specialization

Applying the idea of relative specialization to export markets reveals how countries comply with or diverge from geographic demand structures. The underlying question in this case is whether exporting to those destinations where other counties also export to is related to lower economic development, or whether it is favourable for countries to comply with global trade patterns as they indicate the demand of customers.

The results reveal an interesting picture. The list of most diversified economies is headed by India, followed by Brazil and South Africa (Table 4.22). These countries best react to global demand patterns, as their distribution of export destinations comes closest to the geographic distributions of demand.

As with absolute diversification, the combination of relative export and relative market diversification is of particular interest, because when diversification is seen as an insurance against vulnerability, then it is important to measure vulnerability to shocks in the demand of the most-traded products as well as in overall demand from the biggest importers. For example, if a country exports to countries that are otherwise not big importers, and exports goods that are niche products, then this might be profitable for the exporter in the short run due to low competition, but at the same time constitutes a highly vulnerable situation. Demand for niche products can be unstable, and the fact that only few countries import these products further emphasises the low global demand for these products. If the importer decreases its imports, it might be hard to find new buyers in the short run.

Table 4.22. Ten most and ten least specialized countries, relative market specialization, 2005

Rank	Country	Relative Gini	Relative Theil	Relative DI	Median Balassa
1	India	0.31	0.45	0.30	0.61
2	Brazil	0.36	0.58	0.33	0.46
3	South Africa	0.36	0.65	0.34	0.28
4	Pakistan	0.38	0.70	0.36	0.49
5	New Zealand	0.42	0.80	0.37	0.34
6	United Kingdom	0.44	0.34	0.30	0.49
7	Thailand	0.44	0.48	0.37	0.40
8	Switzerland	0.44	0.23	0.27	0.34
9	Korea, Rep. of	0.45	0.39	0.34	0.36
10	Viet Nam	0.45	0.51	0.39	0.19
120	Mexico	0.88	1.37	0.73	0.01
121	Qatar	0.89	1.66	0.76	0.00
122	Gambia, The	0.90	4.59	0.78	0.00
123	Mongolia	0.90	1.75	0.69	0.00
124	Albania	0.90	2.65	0.87	0.00
125	Swaziland	0.92	4.13	0.88	0.00
126	Botswana	0.92	2.66	0.90	0.00
127	Central African Republic	0.93	2.43	0.80	0.00
128	Montserrat	0.93	4.01	0.78	0.00
129	Sudan	0.94	2.02	0.80	0.00

4.4.4. Combining relative market and product specialization

The combination of relative product and market specialization is presented in Figure 4.44 for the year 2005. The resulting scatter plot is similar to the one for absolute product and market diversification, but with more distinct differences between countries, meaning that countries are more spread. The structural difference between Chile and Mexico, for example, is now clearer, with Mexico, on the extreme side, being specialized in markets and diversified in products, and Chile having an opposing structure by being specialized in products and diversified in markets.

Similar to absolute market specialization, there also exists a U-curved relationship between relative market specialization and GDP per capita (Table 4.23). This relationship is driven largely by within-country variation, as the fixed effects regression results are highly significant, while the between effects results are not robust.

Figure 4.44. Relative market specialization and relative product specialization, 2005

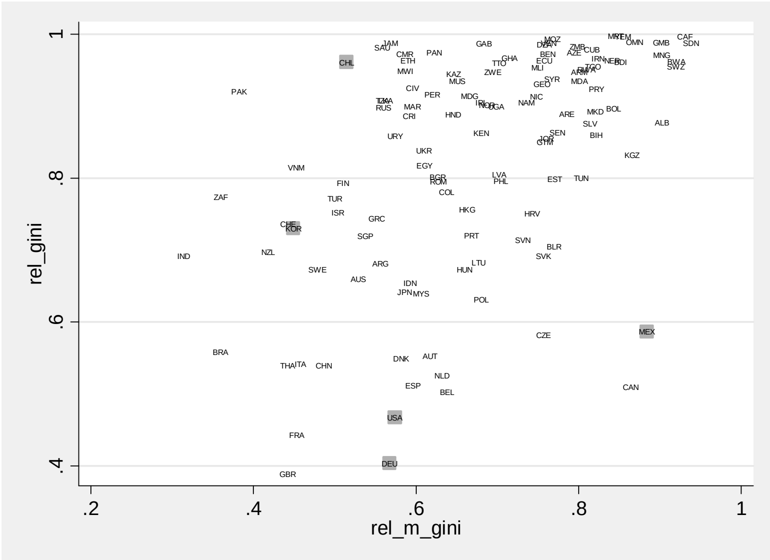


Table 4.23. Regression results for relative market specialization

	(1) Gini Pooled	(2) Median Balassa Pooled	(3) Gini FE	(4) Median Balassa FE	(5) Gini BE	(6) Median Balassa BE
GDP per capita	-1.842e-05***	2.580e-05***	-1.225e-05***	2.301e-05***	-2.177e-05***	1.833e-05***
	(7.126e-07)	(1.019e-06)	(1.318e-06)	(1.669e-06)	(5.274e-06)	(4.417e-06)
GDP per capita squared	4.213e-10***	-4.574e-10***	3.017e-10***	-5.796e-10***	5.345e-10**	-1.822e-10
	(2.276e-11)	(3.560e-11)	(2.949e-11)	(4.432e-11)	(2.077e-10)	(1.739e-10)
Constant	7.266e-01***	-2.688e-04	7.013e-01***	2.960e-02***	7.608e-01***	7.819e-03
	(3.379e-03)	(2.430e-03)	(5.363e-03)	(6.027e-03)	(1.531e-02)	(1.282e-02)
Observations	3853	3853	3853	3853	3853	3853
R-squared	0.194	0.437	0.192	0.395	0.193	0.423
Number of countries	142	142	142	142	142	142
Turning point	21,861	28,203	20,302	19,850	20,365	

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses (non-robust for BE)

The combined index again evolves as an L-shaped function (Figure 4.45), but the regression results indicate a U-curve (Table 4.24) Countries therefore increasingly manage to serve the global demand structure in terms of both products and markets as income grows, but high-income countries seem to show a tendency to specialize in niche products and markets.

Figure 4.45. Combined relative specialization

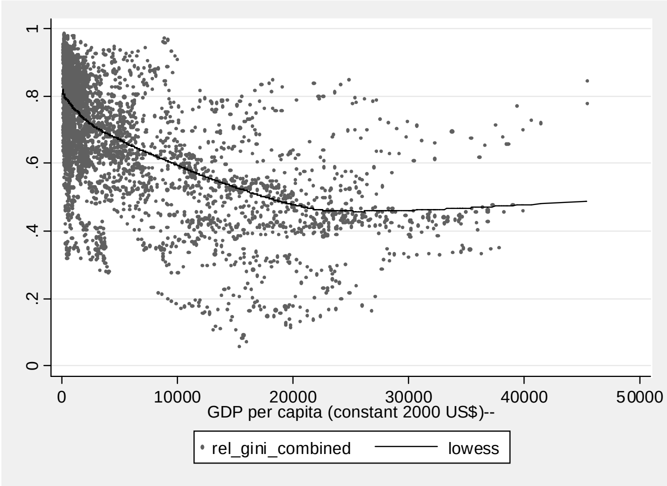


Table 4.24. Regression results for combined relative specialization

	(1) Relative Gini Pooled	(2) Relative Gini FE	(3) Relative Gini BE
GDP per capita	-3.050e-05***	-2.484e-05***	-3.589e-05***
	(8.133e-07)	(1.345e-06)	(5.110e-06)
GDP per capita squared	6.500e-10***	5.058e-10***	8.801e-10***
	(2.745e-11)	(3.336e-11)	(2.011e-10)
Constant	7.933e-01***	7.737e-01***	8.176e-01***
	(2.958e-03)	(5.234e-03)	(1.490e-02)
Observations	3843	3843	3843
R-squared	0.437	0.437	0.428
Number of countries	141	141	141
Turning point	23,462	24,555	20,390

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.5. Controlling for other determinants

The previous chapters revealed that the assumption of a U-curved relationship between economic specialization and GDP per capita is not robust to different measures and econometric specifications. These results, in particular the large influence of country fixed effects, indicate the importance of other factors that determine the level of production or export specialization. It is therefore reasonable to search for other robust determinants to understand the pattern of specialization on the one hand, and to verify if the proposed U-curve is robust to controlling for these determinants on the other.

4.5.1. Methodology (Bayesian Model Averaging)

A number of methods for searching for the robust determinants of a variable of interest have been considered. Model selection criteria, such as the general to specific methodology advocated by David Hendry are often used. An alternative is the Extreme Bounds Analysis of Leamer (1978, 1983). In this type of analysis, the variable of interest is regressed on the dependent variable including different sets of other explanatory variables. If the maximum and minimum of the resulting coefficients on this variable all have the same sign (and are significant) the relationship is classified as 'robust', in the other case as 'fragile' (see Levine and Renelt (1992) for a study using this approach).

However, these traditional approaches have crucial disadvantages. It might be that there is a similar but yet different model that also provides a good fit to the data, but leads to substantively different estimated coefficients or standard errors. And the method of removing and incorporating variables based on the p<5 *percent* rule of thumb has led to a publication bias in academic journals (Montgomery and Nyhan, 2008).

Bayesian Model Averaging (BMA) is a standard solution to model uncertainty, consisting of averaging over *all* models considered rather than one single regression model. Following Hoeting et al. (1999:383-384), the central idea of BMA is the calculation of the posterior distributions of the regression coefficients β_j, given data Y, according to

$$pr(\beta_j|Y) = \sum_{s=1}^{S} pr(\beta_j|M_s, Y)\, pr(M_s|Y) \qquad (21)$$

This is an average of the posterior distributions of β_j under each model M_s of the model space $M_1,\ldots,M_S$ (the first term of the sum), weighted by the posterior model probability (the second term of the sum). In general, posterior effect probabilities imply weaker evidence for effects than do p-values used in "classic" model selection, which do not account for model uncertainty. The posterior probability of model M_s is

$$pr(M_s|Y) = \frac{pr(Y|M_s)\, pr(M_s)}{\sum_{l=1}^{S} pr(Y|M_l)\, pr(M_l)} \qquad (22)$$

where

$$pr(Y|M_s) = \int pr(Y|\theta_s, M_s) pr(\theta_s|M_s) d\theta_s \qquad (23)$$

is the integrated likelihood of model M_s, $\theta_s = (\beta, \sigma^2)$ is the vector of parameters of model M_s, $pr(\theta_s|M_s)$ is the prior density of θ_s under model M_s, $pr(Y|\theta_s, M_s)$ is the likelihood, and $pr(M_s)$ is the prior probability that M_s is the true model, assuming that one of the models considered is true.

The posterior mean and variance of the regression coefficient β_j, which are of primary importance in this analysis, are then given by:

$$E(\beta_j|Y) = \sum_{s=1}^{S} \hat{\beta}_{j,s}\, pr(M_s|Y) \qquad (24)$$

$$Var(\beta_j, Y) = \sum_{s=1}^{S} \left[Var(\beta_j|Y, M_s) + \hat{\beta}_{j,s}^2 \right] pr(M_s|Y) - E(\beta_j|Y)^2 \qquad (25)$$

where $\hat{\beta}_{j,s}$ denotes the posterior mean of β_j under model M_s. The posterior mean is therefore the average of the model-specific posterior means, weighted by the model's posterior probabilities.

One problem with implementing BMA is that the total number of models S, and thus the number of terms in equation (21), can be enormous. When the number of potential regressors is r, then the number of all combinations – including the model with no regressors – would be 2^r. This fact makes it impossible – at current levels of computation capacity – to estimate all possible combinations within a reasonable amount of time.

There exist several ways to deal with the high number of terms in equation (21), which are summarized in Hoeting et al. (1999). The Occam's window method compares models pairwise and excludes models with the lower posterior model probability from equation (21). Additionally, when two nested models are compared, and the algorithm rejects the simpler model, then all sub-models of the simpler model are also rejected. Another approach is the Markov chain Monte Carlo model composition, which proceeds from a current model to a similar model if the posterior probability of the new model is higher then the current model, otherwise it remains in the current model, therefore describing a "path" towards the maximum posterior model probability.

Montgomery and Nyhan (2008:4) note that researchers should avoid engaging in model selection purely by automatic methods like BMA, but should instead use previous research and theory to specify the set of relevant independent variables and the statistical model. Thus, resulting from the literature review in section 2 and the econometric analysis in section 4, the following determinants are considered as potentially correlated with the various specialization measures.

- *GDP per capita and GDP per capita squared*

  The hypothesis of a U-curve implies that the signs of the coefficients are expected to be negative and positive, respectively.

- *Technology, proxied by the level of sophistication*

  Rising sophistication is expected to imply lower specialization, with a potential turning point. The "sophistication" of countries is defined according to Hausmann, Hwang and Rodrik (2006): First, the sophistication level of products is calculated as

  $$PRODY_k = \sum_c \left[\frac{(x_{ck}/X_c)}{\sum_c (x_{ck}/X_c)} Y_c \right] \quad (26)$$

  which means averaging the respective GDP per capita Y_c of each exporter c of a given product k, where the weights are the revealed comparative advantage of each country c in good k. X_c and x_{ck} denote total exports of country c and exports of good k of country c, respectively. The sophistication levels of countries are then calculated as the weighted average of all product sophistication levels, where the weights are the value shares of the products in the country's total exports:

  $$EXPY_c = \sum_k \left(\frac{x_{ck}}{X_c} PRODY_k \right) \quad (27)$$

- *Geography: Absolute latitude (of country centroid), island dummy, regional dummy, landlocked dummy, number of bordering countries*

  Countries in the tropics and small islands might have fewer options to diversify their economies due to limited production networks, and therefore are expected to be more specialized. Region-specific characteristics are expected to correlate with the specialization level, in particular Sub-Saharan Africa is expected to be more specialized due to its large agricultural sector. Landlocked countries may face more difficulties to export a broad variety of goods due to a lack of access to cheap transport routes, while a higher number of bordering countries might allow a country to serve a broader variety of demand.

- *Size: GDP, population*

  Bigger countries, both in terms of GDP or population, have more production facilities and therefore have a greater ability to produce and export a broad variety of products.

- *Factor endowments: labour force, human capital (proxied by years of schooling), capital stock, land area, share of agricultural land*

  Factor endowments determine trade patterns according to the Heckscher-Ohlin model and should therefore have a high influence on specialization patterns.

- *Demography and human capital: life expectancy, years of schooling*

  On the one hand, higher human capital enables a society to acquire and utilize the knowledge and skills necessary for product discovery and innovation. On the other hand, a skilled workforce can lead to specialization in products with high technological content.

- *Infrastructure: telephone lines, mobile phone connections*

  Better infrastructure allows for better integration into the world market, a better spread of know-how, and a higher ability to discover and innovate new products.

- *Macroeconomic structure: Agricultural value added, MVA, share of oil exports, share of agricultural raw materials exports, credit to the private sector*

  Different disaggregation levels for agricultural and non-agricultural products might result in a correlation between agricultural and MVA and specialization, as presumed by some publications mentioned in Section 2. However, the parametric analysis in Section 4 (see also Appendix B.1) has shown that this influence might be small. The share of oil exports is expected to be positively correlated with specialization, as oil-exporting countries are able to increase their GDP per capita without diversifying their economy.

- *Macroeconomic stability: inflation*

  A low inflation rate indicates a stable economy that allows for developing a wide range of products.

- *Openness: share of exports to GDP, share of trade to GDP, FDI inflows*

  According to Ricardian trade theory, the level of openness affects specialization levels according to comparative advantage. However, the actual sign of the influence is open to discussion (see Section 2). On the one hand, inflows of Foreign Direct Investment (FDI) might facilitate knowledge spillovers from foreign countries which can increase the ability of the recipient to produce a larger number of different goods, and hence reduce specialization. On the other hand, openness to trade and financial transactions can lead to specialization on a narrower range of products in which the country has a comparative advantage.

- *Politics: Political violence, political violence in neighbors*

  As political instability harms the development of a broad economic portfolio, political violence is expected to be positively correlated with specialization.

With these 33 determinants, the model space consists of over 17 billion different models. Tables 4.25 and 4.26 report the posterior expected values (EV), standard deviation (SD) and posterior effect probabilities $P(\beta_j \neq 0|Y)$, here written as *P!=0*, for the coefficient associated with each variable.[76] These parameter estimates and standard deviations already incorporate model uncertainty, as they are calculated as an average of the expected value of the respective coefficient over all models, weighted by the posterior probabilities of the models. Besides this, the best five models according to their posterior probability are presented for each setting in Appendix B.3.

BMA does not allow for gaps in the dataset, since it would imply estimating the different models on different samples. The panel can however be unbalanced. In order to obtain a dataset without gaps, only years after 1980 were included in the analysis, and only 5-year averages were used. Some countries had to be dropped, so the final dataset consists of 65 countries.

[76] This analysis was conducted using the BMA package for the statistics software R, available at http://cran.r-project.org/web/packages/BMA/index.html [9th March 2009]

4.5.2. Results

Table 4.25 presents the results for absolute specialization for the pooled SITC 5-digit dataset in the first three columns (see Appendix B.3 for other datasets). The variables with the highest posterior probability (100 percent) are the linear and squared terms of GDP per capita, with signs showing robust evidence for a U-curved relationship. As expected, lower specialization levels are correlated with higher levels of sophistication, thus exporting high-income goods implies having a diversified export structure. The level of specialization rises with the share of oil exports in total exports, indicating that oil exporters have weak incentives to diversify their economies, as discussed in the literature concerning the resource curse, or that they are unable to do so due to Dutch Disease. Also countries with a higher share of agriculture value added in total GDP are more specialized. This might reflect a statistical phenomenon discussed above, since the agriculture tends to be represented by fewer sectors in the available datasets. Alternatively, it could be due to real structural features of countries that depend heavily on agriculture and thus lack the industrial structure and know-how for a diversified economy. As the regression results in section 4 indicate an even stronger U-curve when excluding agricultural products (see also Appendix B.1), the latter explanation might be more relevant. Concerning geography, low- and middle-income countries in Europe and Central Asia are more diversified than Western Europe and North America,[77] while Latin America and Caribbean are more specialized. Islands are more specialized than non-islands, which shows that being geographically isolated and small is an obstacle to economic diversification. Interestingly, specialization increases with distance from the equator. Hence tropical countries are actually less specialized than one would expect given their level of income.

Variables with a posterior probability between 50 percent and 100 percent are also considered to be robust determinants.[78] Interestingly, the share of exports in GDP has a positive coefficient, thus more open economies are more specialized. Large countries in terms of population are more diversified, as a higher number of workers can produce a greater variety of products for exports. The number of schooling years is correlated with a higher level of

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[77] The dummy on Western Europe and North America (including Japan, New Zealand and Kuwait) was excluded from the regression. Each regional coefficient represents the deviation from the impact of being in Western Europe and North America on specialization therefore.

[78] This study follows much of the literature employing BMA and uses the posterior probability as a means of defining robustness. Since a prior inclusion probability of 0.5 for each variable is assumed, any variable with a posterior inclusion probability above 0.5 has seen an increase in its inclusion probability after observing the data.

specialization, as a skilled workforce leads to specialization in high-technology products. The share of agricultural land area in total land area correlates negatively with specialization.

The remaining variables have a posterior probability of less than 50 percent and should therefore not be considered as robust.

Most of these results also hold when relative specialization is considered, in particular the U-shaped curve and the sophistication-diversification relationship (Table 4.25, last three columns). However, some variables show a dramatically lower posterior probability, in particular the oil share in exports, the island dummy, the regional dummies and the agricultural indicators. Besides the U-curve and sophistication, only the share of manufactured exports in total exports has an inclusion probability of 100 percent. This constitutes evidence for a U-curve, as the specialization level of a country is mainly determined by its level of economic development, its sophistication and the manufacturing content of exports.

The turning point of the U-curve lies at US$24,500 for absolute specialization and US$21,500 for relative specialization, which is quite similar to the results of the simple U-curve without additional determinants. These results suggest that the U-curve is robust to the inclusion of other determinants.

The results for fixed effects regression are entirely different from the pooled regression (Table 4.26). Within countries, there seems to be no U-curved relationship once other influences are controlled for. This is the case both for absolute and relative specialization.

For absolute specialization (first three columns of Table 4.26) a higher oil share leads to higher export specialization. Whether this results from Dutch Disease, i.e. a decline of manufacturing activities, or a dominating position of oil exports without an effect on the absolute level of non-oil exports cannot be judged within the present methodological framework. Surprisingly, rising trade openness reduces specialization, contradictory to Ricardian theory. As Ricardian theory in fact has more relevance for within-country trade trends, i.e. how the trade structure of a country changes if this country opens up for trade, this result is stronger than the confirmation of Ricardian theory in the above pooled panel. A rising labour force increases diversification, as does increasing credit to the private sector.

Thus a growing banking sector stimulates the expansion of economic activities into new products. The estimates for telecommunications are inconclusive: a higher mobile phone ratio implies higher specialization, while a higher ratio of landline phones implies higher diversification. Landline telephones seems to represent a more sophisticated technological infrastructure, which implies higher export diversification, while a mobile phone network is a proxy for weak technological infrastructure leading to more specialization. Other determinants do not have a high inclusion probability.

Table 4.25. BMA results for absolute and relative specialization, pooled, SITC 5-digit

	Absolute Gini			Relative Gini		
	p!=0	EV	SD	p!=0	EV	SD
Intercept	100	9.90E-01	1.85E-02	100	1.07E+00	3.51E-02
GDP per capita	100	-5.64E-06	9.33E-07	100	-2.22E-05	3.24E-06
GDP per capita squared	100	1.15E-10	2.21E-11	100	5.17E-10	8.10E-11
Sophistication	100	-7.17E-06	8.22E-07	100	-2.48E-05	3.13E-06
Oil share	100	6.26E-02	8.75E-03	47.5	3.25E-02	3.97E-02
Agricultural value added	100	8.97E-04	1.82E-04			
Absolute latitude	100	7.25E-04	1.39E-04	72.7	1.01E-03	7.70E-04
Island dummy	100	1.87E-02	5.29E-03	22.5	9.82E-03	2.03E-02
Europe and Central Asia dummy	100	-2.71E-02	7.20E-03			
Latin America and Caribbean dummy	100	1.61E-02	4.19E-03			
Agricultural land share	98.3	-2.18E-04	7.57E-05			
Export in GDP share	97.3	2.55E-04	9.32E-05	75.1	5.86E-04	4.10E-04
Population	78	-4.21E-11	2.33E-11	66.2	-9.66E-11	7.24E-11
Years of schooling	75.6	5.11E-03	3.67E-03	80.4	1.88E-02	1.21E-02
FDI inflows	45.8	-4.97E-04	6.33E-04			
Life expectancy	39	-2.12E-04	3.06E-04			
Manufactured exports share				100	-1.57E-03	2.99E-04
South Asia dummy				88.4	6.39E-02	3.29E-02
Labour force				33.8	-9.48E-11	1.36E-10
OPEC dummy				23.6	1.40E-02	2.85E-02
Capital stock				22	-1.57E-15	3.21E-15
	Model with 13 best variables: R^2=0.83			Model with 10 best variables: R^2=0.84		

Concerning the relative specialization measure (final three columns of Table 4.26), only trade openness, the size of the labour force and the share of manufactured exports have a robust impact on specialization. The latter is different from absolute diversification, where a change in manufactured exports does not affect specialization. The results for the linear and squared GDP per capita terms on relative within-country specialization are of particular interest. Both variables have a posterior probability of below 50 percent, but are significant in the fourth-best model. This means that if they would have been included in a simple regression, they would have indicated a significant U-curve, possibly leading to the conclusion that the

U-curve is the development process of an average country. The position of the estimated turning point would then be around US$23,000. However, the BMA results show that this conclusion would have been wrong as 76 percent and 55 percent of the averaged posterior distributions associated with GDP per capita and GDP per capita squared, respectively, have their mass at zero.

Table 4.26. BMA results for absolute and relative specialization, demeaned (fixed effects) SITC 5-digit

	Absolute Gini			**Relative Gini**		
	p!=0	**EV**	**SD**	**p!=0**	**EV**	**SD**
Intercept	100	9.11E-08	5.00E-04	100	4.67E-07	1.85E-03
Oil share	100	3.43E-02	7.64E-03	45.7	3.16E-02	3.98E-02
Mobile phones	100	2.69E-04	5.48E-05	3.5	1.31E-05	8.17E-05
Exports in GDP share	99.4	-3.12E-04	1.02E-04	100	-1.43E-03	3.72E-04
Domestic credit to private sector	95.4	-1.26E-04	5.00E-05	3.7	-9.09E-06	5.50E-05
Telephones	94.8	-5.59E-04	2.26E-04	62.9	-1.14E-03	9.94E-04
Labour force	94.7	-3.89E-10	1.06E-10	100	-1.29E-09	6.58E-10
Agricultural land share	36.2	-2.21E-04	3.34E-04			
Life expectancy	34.7	-1.79E-04	2.84E-04	2.9	-4.59E-05	3.01E-04
Years of schooling	25.1	-1.29E-03	2.54E-03	2.1	-3.79E-04	2.92E-03
MVA	24.3	-1.09E-04	2.24E-04	14.2	-2.31E-04	6.46E-04
Urban population share	12.7	-4.75E-05	1.39E-04	13.8	-1.80E-04	5.12E-04
Manufactured exports share				100	-1.33E-03	3.13E-04
Capital stock				48.2	-6.90E-15	8.10E-15
GDP per capita squared				44.6	1.56E-10	2.11E-10
GDP per capita				34.1	-7.14E-06	1.06E-05
Population				21.7	1.46E-10	3.16E-10
Political violence				7.6	-8.00E-05	3.22E-04
	Model with 7 best variables: R^2=0.516			Model with 5 best variables: R^2=0.562		

The results are largely similar when using the Feenstra and HS dataset (see Appendix B.3). Note that the Feenstra dataset does not report data beyond 2000, while the HS dataset does not report data before 1985. Thus the results are weaker than the results based on the SITC dataset. When using the pooled regression, a distinct U-curve will always be observed for both absolute and relative specialization, with a turning point similar to the case without including additional determinants. In the Feenstra dataset, the within-country U-curve has a higher probability than in the SITC dataset. However, in the HS dataset, which represents the most disaggregated data, the within-country U-curve is entirely non-existent.

5. Conclusions

This study has analysed the relationship between economic specialization and national income per capita. For development policy, it is crucial whether a country focuses on improving its production or export capacity within a certain narrow range of products where comparative advantage is exhibited, or if a country aims at diversifying its production structure to be less vulnerable to economic shocks. In the related literature, arguments are put forward for both specialization and diversification, and the seminal econometric paper by Imbs and Wasciarg (2003) presents empirical evidence that both trends are taking place, but at different economic stages. Their finding of a "U-curve" between specialization and income per capita has stimulated a large number of studies that have expand their analysis by either criticising the methodology or by confirming these findings and adding more dimensions.

However, several criticisms can be made of this literature. By combining the various methodological approaches, the econometric analysis presented in this study contributes to the discussion concerning the existence of a particular specialization trend. While the diversification trend of low-income countries can be empirically confirmed, it can be questioned whether this trend eventually turns around towards re-specialization, although it can be confirmed that the trend declines as GDP per capita increases. Although this critique does not diminish the importance of diversification, it challenges the recent discussion about the existence of a U-curve relationship between specialization and income per capita.

The main results from the analysis are as follows:

First, in the literature, theoretical arguments for the pattern of exports are often used for the pattern of production, although exports and production might be driven by different – although related – forces. And while the main interest in the context of structural change lies in the pattern of production, production data are only available at relatively aggregated levels, whereas export data are available at highly disaggregated levels. In some studies this fact serves as a justification for using export data instead of production data. However, theories and conclusions concerning export patterns cannot be directly applied to production patterns. In particular, the meaning of "specialization" becomes unclear when production and exports are mixed: If a country opens up to trade, its production responds to the changed incentives created by foreign demand. An increase in the production of a certain good as a response to an increase in openness denotes an increase in export specialization of that good, but if this particular good was previously produced on a small scale, then the overall level of production specialization is reduced. The econometric results in this study show similar trends for production and exports, suggesting that these issues may not be of great concern.

Second, another dimension of the meaning of “specialization” is the particular benchmark used for maximum diversification. Most studies use specialization measures that quantify the deviation from a distribution where every product has the same share. However, it is questionable whether this particular method of measuring specialization is relevant in the context of exports, because countries eventually benefit by serving global demand regardless of how specialized or diversified global demand is structured. Therefore, the distribution of global demand itself should serve as a benchmark, and “specialization” should measure how much a country diverges from this benchmark. However, the empirical results in this study show that this concern can be neglected, because the U-shape is not less significant when using relative specialization.

Third, when using a dataset consisting of several countries and years, of crucial importance is whether the data are analysed as a pooled panel (ignoring the fact that different data points can stem from different years, different countries, or both), or whether the within- and between-country variation is examined. If the U-curve is interpreted as a typical “path of development”, then only the structure of an average country – the fixed effects regression – is relevant. However, if the U-curve is merely driven by the means of the specialization levels of each country, then countries experience a specific time-invariant economic structure, and are thus just “placed” at different positions along a U-curve without following in itself a U-shaped trend. The empirical evidence in this study shows that both within and between effects are relevant, but that between effects explain more the variation of the overall U-curve than within effects.

Fourth, the upward-sloping path of GDP per capita might be driven by a small number of observations or even outliers. Methods that are less sensitive to outliers reveal that the U-curve is not robust.

Fifth, there exist several specialization measures, and if the U-curve is a distinct general pattern of every country, then the results should be robust to the different measures (assuming that all the measures are appropriate). The empirical evidence in this study shows that this is not the case, indicating that the U-curve is not robust.

Sixth, lower levels of disaggregation in data on agriculture than in data on manufacturing can result in an observed diversification trend when countries change their production from agriculture into manufacturing as their level of development increases. The empirical evidence in this study shows that this issue is largely irrelevant however.

Seventh, data on services, particularly export data, are hard to obtain, and therefore neglected in most econometric studies. Whether the observed U-curve is a pattern of the whole economy or only of the agriculture and manufacturing sector remains an open question.

Eighth, the method of testing for a non-linear relationship itself might create the image of a U-shape. Assume that low-income countries diversify until a certain income per capita level is reached, and then remain at the same level of specialization while the economy continues to grow. To run a parametric test for the existence of a U-curve, one has to regress specialization on a linear term and a squared term of GDP per capita, because a negative linear term and a positive squared term add up to a U-shaped function. However, also an L-curve can be described with a negative linear term and a positive squared term, as such a pattern of coefficients will fit the data better than just a negative linear term. The upward-sloping part found for high-income countries might therefore be a result of the attempt to fit a non-linear function to an L-shaped dataset. Based on the empirical results in this study, it can be presumed that the upward-sloping part might be artificially created, or at least overemphasised, due to the econometric method.

Ninth, the method of classifying different economic activities highly influences the econometric outcome. There exist several nomenclatures to disaggregate economic production or exports into different sectors or products, but every system exhibits a constant maximum number of sectors or products. If a country continuously increases its range of products, then the maximum number of products limits the variety that can actually be observed, thus artificially creating a diminishing diversification trend. The result might look like an L-curve although it should be better described as a negative linear trend. A U-curve might then be observed erroneously, as described in the previous argument.

Tenth, although the attempt to overcome the previous two criticisms through the use of non-parametric regression methods is promising, the upward-sloping part is still driven by very few observations. Eliminating outliers from the regression reduces the significance of the upward-sloping path.

Eleventh, the discussion in the recent literature has only dealt with the pattern of production or exports, but the pattern of export destinations might also be relevant, in particular when thinking about diversification as a means of overcoming economic vulnerability. For example, a country might export a wide range of different products, but exports these products only to a small number of countries. A sectoral shock might not harm the economy of the exporter, but a recession in one of its trading partners might. Diversification therefore should be seen as two-dimensional: diversification in products and diversification in markets. Interestingly, the relationship between market specialization and economic development also appears to follow a U-curve, as does a combined index of product and market specialization.

Finally, the U-curve might be determined by factors other than GDP per capita. The econometric results in this study show that GDP per capita matters when the pooled panel is considered, but not in the case of fixed effects. Thus, the proposed U-curved relationship between specialization and income per capita does not represent the "economic development path" of an average country.

Overall, the evidence of this study is mixed: Countries diversify their economic structure as GDP per capita grows, and this trend declines as GDP per capita increases. Whether re-specialization occurs at high levels of GDP per capita cannot be confirmed. The large number of potential methodological and conceptual issues indicates that the actual shape of the specialization pattern might better be coined as "L-curve".

Several issues have not been analysed empirically in this study and are left for future research:

First, the theoretical rationale for the stages of economic diversification result needs to be elaborated on. In particular, the drivers of the production structure have to be separated from the drivers of the export structure.

Second, this study began with production data but moved to export data due to the improved availability and disaggregation of the latter, as suggested by other studies. However, to understand the evolution of national economies better, the production structure is of primary interest. Therefore the collection and usage of disaggregated production data would allow for more relevant conclusions on the evolution of the economic structure to be drawn.

Third, the nature of the products into which economies specialize or diversify has not been touched upon in this study, and other studies have so far only analysed the economic risk associated with specific sectors. Other relevant dimensions could include the technological content of products or their capital and labour intensities.

Fourth, the determinants of market diversification, as well as a theoretical rationale for a changing level of market diversification remain to be researched, in particular in relation with product diversification.

Fifth, regional characteristics have only marginally been incorporated in this study and need to be elaborated in a more thorough way. Different forces might be relevant in different regions or even countries, counteracting the attempt to draw general conclusions that are valid globally.

Sixth, diversification can be split into diversification at the extensive and the intensive margins. Only a small number of studies have considered such margins. As the U-curve is found to be less robust than these studies propose, the analysis of the extensive and intensive margins should be reconsidered using different concepts and measures of specialization, as well as different datasets.

Seventh, the relationship between the structure of specialization and economic growth has been analysed by some authors, but not targeted in this study. Further effort has to be made – both theoretically and empirically – to investigate the relationship between the level and nature of specialization and sustainable economic growth.

Finally, the implications for development policy remain vague. Several authors put forward arguments for industrial policy resulting from recent discussions on specialization. However, due to the open debate on the pattern of specialization, and due to the lack of theoretical understanding of the forces of specialization, solid advice for policy makers beyond the mere relevance of acquiring the ability for economic diversification can therefore not be drawn.

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Appendix A

A.1. English summary

This study analyses the relationship between economic specialization and the level of income per capita and, in particular, tests the hypothesis of a U-shaped relationship between the two. Whether a country should focus its economic activity on a narrow range of products, or whether a country should attempt to diversify its production into a wide range of sectors proves to be an important question for development policy makers. This study outlines the arguments in the respective literature and contributes to the discussion by combining various specialization measures, panel data regression methods, relative and absolute specialization, production and export specialization, and product and market specialization to examine the U-shaped relationship in greater detail.

In the respective literature, economic arguments and political advice are presented in favour of specialization as well as diversification. Recent empirical studies propose that both forces are relevant, albeit at different levels of income per capita. Low-income countries diversify their production with rising income per capita until they reach a certain level of economic development, at which point specialization sets in, thus resulting in a U-curve. This pattern has been confirmed for the production structure as well as that for exports, but some studies criticize the measures and methodology used in this context.

The econometric analysis in this study shows that the conjectured U-curve is not robust, as it depends on the dataset used and the specialization measure applied. Even in cases where a significant U-curve is observed, it is driven by country-specific fixed effects rather than within-country variation. While it can be shown that low-income countries diversify their production and export structure as income per capita rises, no robust conclusions can be drawn concerning a trend towards re-specialization for high-income countries. Controlling for other determinants reveals that the within-country variation is determined by factors other than income per capita. Accordingly, the proposed U-curve does *not* represent the "development path" of an average country.

A.2. German summary

Diese Arbeit analysiert den Zusammenhang zwischen dem Spezialisierungsgrad einer Ökonomie und dem Level des Pro-Kopf-Einkommens, und prüft insbesondere die Hypothese eines U-förmigen Zusammenhanges zwischen diesen Größen. Ob ein Land seine ökonomische Aktivität auf eine geringe Zahl von Produkten spezialisieren soll, oder ob ein Land versuchen soll, seine Wirtschaftsleistung auf eine große Bandbreite von Gütern auszudehnen, ist eine zentrale Frage für entwicklungspolitische Entscheidungsträger. Diese Arbeit fasst die betreffenden Argumente und Sichtweisen zusammen und trägt zu dieser Diskussion bei durch Verbindung von verschiedenen Regressionsverfahren, verschiedenen Messgrößen des Spezialisierungsgrades, relativer und absoluter Spezialisierung, Produktions- und Exportspezialisierung sowie Produkt- und Marktspezialisierung.

In der betreffenden Literatur werden theoretische Argumente und politische Empfehlungen sowohl für mehr Spezialisierung als auch für mehr Diversifizierung vorgebracht. Neuere empirische Studien zeigen, dass beide Kräfte relevant sind, aber in unterschiedlichen Bereichen des Pro-Kopf-Einkommens eines Landes. Niedrigeinkommensländer diversifizieren ihre ökonomische Struktur mit steigendem Pro-Kopf-Einkommen bis zu einem gewissen ökonomischen Niveau bei dem Re-Spezialisierung einsetzt, wodurch eine U-Kurve entsteht. Diese Form wurde empirisch sowohl für die Produktionsstruktur als auch für die Exportstruktur bestätigt, obwohl einige Studien die verwendeten Methoden kritisieren.

Die ökonometrische Analyse in dieser Arbeit zeigt, dass die vermutete U-Kurve nicht robust ist, da sie sowohl von dem verwendeten Datensatz sowie in der Messmethode abhängt. Sogar in jenen Fällen, in denen eine signifikante U-Kurve beobachtet werden kann, wird diese Kurve eher von länderspezifischen Charakteristika als von einer Variation innerhalb der jeweiligen Länder geprägt. Obwohl gezeigt werden kann, dass Niedrigeinkommensländer ihre Produktions- und Exportstruktur mit steigendem Pro-Kopf-Einkommen diversifizieren, können keine robusten Schlussfolgerungen bezüglich eines Re-Spezialisierungtrends bei Hocheinkommensländern getroffen werden. Das Kontrollieren für den Einfluss von anderen Determinanten des Spezialisierungsgrades zeigt, dass andere Faktoren als das Pro-Kopf-Einkommen die Variation innerhalb von Ländern vollständig beschreiben. Folglich beschreibt die vorgeschlagene U-Kurve *nicht* den „Entwicklungspfad“ eines durchschnittlichen Landes.

A.3. Curriculum vitae

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Appendix B

B.1. Exports of manufactured products

This chapter analyses specialization in export products only within the manufacturing, defined by all 5-digit products that fall within SITC Revision 1 categories 5-9. As UNIDO's MVA data are only available for manufacturing, it is useful to restrict export data also to manufactured products. Through this restriction, potential methodological shortcomings can be reduced. Firstly, the SITC nomenclature itself may produce a certain structure of the panel data set through its construction, because manufactured products are split into more individual product lines than agricultural products, therefore a simple shift of economic activity from agriculture into services might appear as a decrease in specialization. Secondly, exports of unmanufactured activities might be driven by geographical factors, which complicates interpreting the results.

Interestingly, the data show a U-curved behavior also when analysing only manufactured exports. This U-curve is significant in the pooled panel as well as when analysing only between and within effects. Only when using PPP dollars, the U-curve is not significant in all measures of absolute specialization. Otherwise, the U-curve is exceptionally distinct when analysing relative specialization.

B.1.1. Absolute specialization

Appendix Table 1. Random effects regression

	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman	(5) Export lines
GDP per capita	-5.064e-06***	-8.605e-05***	-1.095e-05***	-1.218e-05***	2.899e-02***
	(3.756e-07)	(7.318e-06)	(1.374e-06)	(1.473e-06)	(1.625e-03)
GDP per capita squared	1.189e-10***	1.906e-09***	2.351e-10***	2.682e-10***	-5.868e-07***
	(9.630e-12)	(1.962e-10)	(3.553e-11)	(3.901e-11)	(4.016e-08)
Constant	9.632e-01***	3.059e+00***	1.947e-01***	3.845e-01***	2.465e+02***
	(2.872e-03)	(6.677e-02)	(1.507e-02)	(1.455e-02)	(1.385e+01)
Observations	3847	3847	3847	3847	3847
Number of countries	142	142	142	142	142
R-squared	0.520	0.382	0.137	0.234	0.404
Turning point	21,295	22,573	23,288	22,707	24,702

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 2. Random effects regression, PPP

	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman	(5) Export lines
GDP per capita (PPP)	-3.077e-06***	-5.253e-05***	-6.640e-06***	-7.524e-06***	2.309e-02***
	(4.229e-07)	(9.377e-06)	(1.687e-06)	(1.853e-06)	(1.830e-03)
GDP per cap. (PPP) squared	5.574e-11***	8.233e-10***	8.990e-11**	1.076e-10***	-3.466e-07***
	(9.235e-12)	(2.072e-10)	(3.557e-11)	(4.005e-11)	(3.886e-08)
Constant	9.629e-01***	3.045e+00***	1.889e-01***	3.807e-01***	2.211e+02***
	(3.424e-03)	(8.459e-02)	(1.919e-02)	(1.871e-02)	(1.592e+01)
Observations	2552	2552	2552	2552	2552
Number of countries	139	139	139	139	139
R-squared	0.509	0.402	0.153	0.247	0.443
Turning point	27,601	31,902	36,930	34,963	33,309

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 3. Fixed effects regression

	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman	(5) Export lines
GDP per capita	-4.388e-06***	-6.861e-05***	-7.617e-06***	-7.651e-06***	2.761e-02***
	(4.212e-07)	(8.129e-06)	(1.482e-06)	(1.591e-06)	(1.969e-03)
GDP per capita squared	1.052e-10***	1.545e-09***	1.650e-10***	1.745e-10***	-5.554e-07***
	(1.039e-11)	(2.123e-10)	(3.832e-11)	(4.130e-11)	(4.712e-08)
Constant	9.560e-01***	2.902e+00***	1.704e-01***	3.506e-01***	2.597e+02***
	(1.656e-03)	(3.053e-02)	(5.802e-03)	(6.083e-03)	(7.966e+00)
Observations	3847	3847	3847	3847	3847
Number of countries	142	142	142	142	142
R-squared	0.517	0.382	0.138	0.233	0.404
Turning point	20,856	22,204	23,082	21,923	24,856

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 4. Fixed effects regression, PPP

	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman	(5) Export lines
GDP per capita (PPP)	-1.664e-06***	-1.601e-05	-9.160e-07	8.620e-07	2.032e-02***
	(4.662e-07)	(1.035e-05)	(1.831e-06)	(2.020e-06)	(2.286e-03)
GDP per cap. (PPP) squared	3.444e-11***	2.590e-10	-6.106e-13	-2.273e-11	-2.984e-07***
	(9.318e-12)	(2.137e-10)	(3.797e-11)	(4.117e-11)	(4.640e-08)
Constant	9.467e-01***	2.662e+00***	1.314e-01***	2.996e-01***	2.587e+02***
	(3.029e-03)	(6.414e-02)	(1.119e-02)	(1.259e-02)	(1.454e+01)
Observations	2552	2552	2552	2552	2552
R-squared	0.478	0.403	0.128	0.136	0.441
Number of countries	139	139	139	139	139
Turning point	24,158				34,048

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 5. Between effects regression

	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman	(5) Export lines
GDP per capita	-1.097e-05***	-1.979e-04***	-2.605e-05***	-3.284e-05***	4.849e-02***
	(1.318e-06)	(2.746e-05)	(5.620e-06)	(5.702e-06)	(6.313e-03)
GDP per capita squared	2.573e-10***	5.046e-09***	7.017e-10***	8.525e-10***	-1.313e-06***
	(5.185e-11)	(1.080e-09)	(2.210e-10)	(2.243e-10)	(2.483e-07)
Constant	9.807e-01***	3.357e+00***	2.329e-01***	4.400e-01***	2.085e+02***
	(3.833e-03)	(7.983e-02)	(1.634e-02)	(1.658e-02)	(1.836e+01)
Observations	3847	3847	3847	3847	3847
R-squared	0.520	0.369	0.129	0.224	0.377
Number of countries	142	142	142	142	142
Turning point	21,318	19,610	18,562	19,261	18,465

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 6. Between effects regression, PPP

	(1) **Gini**	(2) **Theil**	(3) **Herfindahl**	(4) **Hirschman**	(5) **Export lines**
GDP per capita (PPP)	-8.004e-06***	-1.597e-04***	-2.094e-05***	-2.648e-05***	4.381e-02***
	(9.440e-07)	(1.906e-05)	(3.917e-06)	(4.014e-06)	(4.148e-03)
GDP per cap. (PPP) squared	1.404e-10***	3.204e-09***	4.464e-10***	5.444e-10***	-9.663e-07***
	(2.884e-11)	(5.823e-10)	(1.197e-10)	(1.226e-10)	(1.267e-07)
Constant	9.916e-01***	3.580e+00***	2.546e-01***	4.735e-01***	1.460e+02***
	(4.591e-03)	(9.268e-02)	(1.905e-02)	(1.952e-02)	(2.017e+01)
Observations	2552	2552	2552	2552	2552
Number of countries	139	139	139	139	139
R-squared	0.512	0.392	0.150	0.241	0.434
Turning point	28,504	24,922	23,454	24,320	22,669

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 7. Pooled regression

	(1) **Gini**	(2) **Theil**	(3) **Herfindahl**	(4) **Hirschman**	(5) **Export lines**
GDP per capita	-9.780e-06***	-1.537e-04***	-1.831e-05***	-2.419e-05***	3.673e-02***
	(2.413e-07)	(3.531e-06)	(6.950e-07)	(7.295e-07)	(8.797e-04)
GDP per capita squared	2.075e-10***	3.330e-09***	4.085e-10***	5.269e-10***	-8.068e-07***
	(7.901e-12)	(1.185e-10)	(2.149e-11)	(2.375e-11)	(3.016e-08)
Constant	9.783e-01***	3.237e+00***	2.105e-01***	4.152e-01***	2.301e+02***
	(6.496e-04)	(1.879e-02)	(4.744e-03)	(4.443e-03)	(3.941e+00)
Observations	3847	3847	3847	3847	3847
R-squared	0.525	0.382	0.138	0.234	0.406
Turning point	23,566	23,078	22,411	22,955	22,763

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 8. Pooled regression, PPP

	(1) **Gini**	(2) **Theil**	(3) **Herfindahl**	(4) **Hirschman**	(5) **Export lines**
GDP per capita (PPP)	-7.051e-06***	-1.160e-04***	-1.302e-05***	-1.770e-05***	3.120e-02***
	(2.173e-07)	(4.124e-06)	(8.131e-07)	(8.703e-07)	(1.038e-03)
GDP per cap. (PPP) squared	1.123e-10***	1.988e-09***	2.311e-10***	3.051e-10***	-5.864e-07***
	(6.119e-12)	(1.187e-10)	(2.212e-11)	(2.447e-11)	(3.201e-08)
Constant	9.861e-01***	3.330e+00***	2.074e-01***	4.221e-01***	2.080e+02***
	(1.000e-03)	(2.650e-02)	(6.218e-03)	(6.111e-03)	(5.934e+00)
Observations	2552	2552	2552	2552	2552
R-squared	0.515	0.404	0.158	0.251	0.458
Turning point	31,394	29,175	28,170	29,007	26,603

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 9. Quantile regression

	(1) **Gini**	(2) **Theil**	(3) **Herfindahl**	(4) **Hirschman**	(5) **Export lines**
GDP per capita (within)	-3.972e-06***	-3.052e-05***	-8.736e-07	-2.233e-06***	1.594e-02***
	(1.858e-07)	(5.463e-06)	(6.344e-07)	(8.261e-07)	(1.346e-03)
GDP per capita squared (within)	9.689e-11***	7.655e-10***	2.035e-11	6.223e-11***	-3.315e-07***
	(4.489e-12)	(1.320e-10)	(1.533e-11)	(1.995e-11)	(3.254e-08)
Constant	5.669e-04***	-3.190e-02***	-6.709e-03***	-9.197e-03***	2.381e+00*
	(1.805e-04)	(5.312e-03)	(6.168e-04)	(8.034e-04)	(1.310e+00)
Observations	3847	3847	3847	3847	3847
Turning point	20,497	19,935	21,464	17,942	24,042

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 10. Quantile regression, PPP

	(1) **Gini**	(2) **Theil**	(3) **Herfindahl**	(4) **Hirschman**	(5) **Export lines**
GDP per capita (PPP) (within)	-1.649e-06***	-1.774e-05**	5.477e-07	1.102e-06	1.401e-02***
	(2.628e-07)	(8.309e-06)	(1.001e-06)	(1.459e-06)	(1.780e-03)
GDP per cap. (PPP) squared (within)	3.837e-11***	3.795e-10**	-6.921e-12	-5.073e-12	-1.959e-07***
	(4.721e-12)	(1.493e-10)	(1.799e-11)	(2.621e-11)	(3.194e-08)
Constant	-9.706e-04***	-6.408e-02***	-9.693e-03***	-1.310e-02***	1.920e+01***
	(2.389e-04)	(7.559e-03)	(9.114e-04)	(1.327e-03)	(1.622e+00)
Observations	2552	2552	2552	2552	2552
Turning point	21,488	23,373			35,758

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

B.1.2. Relative specialization

Appendix Table 11. Random effects regression

	(1) **Gini**	(2) **Theil**	(3) **PDI**	(4) **med_balassa**
GDP per capita	-2.392e-05***	-2.403e-04***	-3.291e-05***	1.911e-05***
	(1.156e-06)	(1.162e-05)	(1.256e-06)	(1.268e-06)
GDP per capita squared	4.419e-10***	4.794e-09***	6.188e-10***	-2.942e-10***
	(3.049e-11)	(3.089e-10)	(3.285e-11)	(3.559e-11)
Constant	9.490e-01***	3.590e+00***	8.740e-01***	1.274e-02
	(7.939e-03)	(1.048e-01)	(9.081e-03)	(9.735e-03)
Observations	3862	3862	3862	3862
Number of countries	142	142	142	142
R-squared	0.485	0.411	0.543	0.382
Turning point	27,065	25,063	26,592	32,478

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 12. Random effects regression, PPP

	(1) **Gini**	(2) **Theil**	(3) **PDI**	(4) **med_balassa**
GDP per capita (PPP)	-1.606e-05***	-1.518e-04***	-2.208e-05***	1.444e-05***
	(1.304e-06)	(1.277e-05)	(1.525e-06)	(1.042e-06)
GDP per cap. (PPP) squared	2.244e-10***	2.266e-09***	3.175e-10***	-1.655e-10***
	(2.784e-11)	(2.760e-10)	(3.365e-11)	(2.033e-11)
Constant	9.573e-01***	3.559e+00***	8.856e-01***	-8.175e-03
	(1.035e-02)	(1.277e-01)	(1.184e-02)	(1.084e-02)
Observations	2556	2556	2556	2556
Number of countries	139	139	139	139
R-squared	0.463	0.455	0.538	0.383
Turning point	35,784	33,495	34,772	43,625

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 13. Fixed effects regression

	(1) **Gini**	(2) **Theil**	(3) **PDI**	(4) **med_balassa**
GDP per capita	-2.386e-05***	-2.339e-04***	-3.338e-05***	1.858e-05***
	(1.326e-06)	(1.386e-05)	(1.518e-06)	(1.348e-06)
GDP per capita squared	4.393e-10***	4.628e-09***	6.260e-10***	-2.829e-10***
	(3.464e-11)	(3.611e-10)	(3.953e-11)	(3.639e-11)
Constant	9.496e-01***	3.549e+00***	8.789e-01***	1.642e-02***
	(4.948e-03)	(5.320e-02)	(5.660e-03)	(5.148e-03)
Observations	3862	3862	3862	3862
Number of countries	142	142	142	142
R-squared	0.485	0.410	0.543	0.382
Turning point	27,157	25,270	26,661	32,838

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 14. Fixed effects regression, PPP

	(1) Gini	(2) Theil	(3) PDI	(4) med_balassa
GDP per capita (PPP)	-1.506e-05***	-1.215e-04***	-2.107e-05***	1.364e-05***
	(1.696e-06)	(1.510e-05)	(2.036e-06)	(1.166e-06)
GDP per cap. (PPP) squared	2.080e-10***	1.768e-09***	2.999e-10***	-1.534e-10***
	(3.430e-11)	(3.113e-10)	(4.277e-11)	(2.086e-11)
Constant	9.415e-01***	3.206e+00***	8.684e-01***	3.770e-03
	(1.093e-02)	(9.411e-02)	(1.262e-02)	(8.653e-03)
Observations	2556	2556	2556	2556
Number of countries	139	139	139	139
R-squared	0.463	0.453	0.537	0.383
Turning point	36,202	34,361	35,128	44,459

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 15. Between effects regression

	(1) Gini	(2) Theil	(3) PDI	(4) med_balassa
GDP per capita	-3.092e-05***	-3.525e-04***	-3.892e-05***	3.073e-05***
	(4.004e-06)	(4.378e-05)	(4.339e-06)	(5.276e-06)
GDP per capita squared	7.574e-10***	9.424e-09***	9.633e-10***	-6.759e-10***
	(1.576e-10)	(1.724e-09)	(1.708e-10)	(2.077e-10)
Constant	9.580e-01***	3.771e+00***	8.762e-01***	-1.294e-02
	(1.162e-02)	(1.271e-01)	(1.260e-02)	(1.532e-02)
Observations	3862	3862	3862	3862
R-squared	0.469	0.390	0.521	0.378
Number of countries	142	142	142	142
Turning point	20,412	18,702	20,201	22,733

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 16. Between effects regression, PPP

	(1) Gini	(2) Theil	(3) PDI	(4) med_balassa
GDP per capita (PPP)	-2.382e-05***	-2.991e-04***	-3.165e-05***	1.908e-05***
	(3.084e-06)	(3.005e-05)	(3.255e-06)	(4.061e-06)
GDP per cap. (PPP) squared	4.347e-10***	6.351e-09***	6.053e-10***	-2.484e-10**
	(9.422e-11)	(9.181e-10)	(9.944e-11)	(1.241e-10)
Constant	9.888e-01***	4.147e+00***	9.197e-01***	-3.451e-02*
	(1.500e-02)	(1.461e-01)	(1.583e-02)	(1.975e-02)
Observations	2556	2556	2556	2556
Number of countries	139	139	139	139
R-squared	0.458	0.451	0.530	0.383
Turning point	27,398	23,547	26,144	38,406

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 17. Pooled regression

	(1) Gini	(2) Theil	(3) PDI	(4) med_balassa
GDP per capita	-2.626e-05***	-2.726e-04***	-3.249e-05***	2.696e-05***
	(7.506e-07)	(5.820e-06)	(7.263e-07)	(1.308e-06)
GDP per capita squared	5.328e-10***	6.048e-09***	6.575e-10***	-4.954e-10***
	(2.692e-11)	(1.997e-10)	(2.652e-11)	(4.790e-11)
Constant	9.545e-01***	3.638e+00***	8.701e-01***	-1.262e-02***
	(1.911e-03)	(3.266e-02)	(2.438e-03)	(2.279e-03)
Observations	3862	3862	3862	3862
R-squared	0.487	0.414	0.544	0.385
Turning point	24,643	22,536	24,707	27,210

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 18. Pooled regression, PPP

	(1) Gini	(2) Theil	(3) PDI	(4) med_balassa
GDP per capita (PPP)	-2.036e-05***	-2.190e-04***	-2.615e-05***	1.858e-05***
	(7.621e-07)	(7.845e-06)	(7.554e-07)	(1.353e-06)
GDP per cap. (PPP) squared	3.199e-10***	4.025e-09***	4.289e-10***	-2.170e-10***
	(2.372e-11)	(2.340e-10)	(2.299e-11)	(4.379e-11)
Constant	9.724e-01***	3.731e+00***	8.933e-01***	-3.394e-02***
	(3.094e-03)	(4.786e-02)	(3.581e-03)	(4.657e-03)
Observations	2556	2556	2556	2556
R-squared	0.465	0.468	0.541	0.383
Turning point	31,822	27,205	30,485	42,811

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 19. Quantile regression

	(1) Gini	(2) Theil	(3) MPDI	(4) med_balassa
GDP per capita (within)	-2.094e-05***	-1.551e-04***	-3.201e-05***	1.257e-05***
	(5.715e-07)	(9.916e-06)	(1.166e-06)	(5.859e-08)
GDP per capita squared (within)	3.568e-10***	2.910e-09***	6.012e-10***	-2.012e-10***
	(1.380e-11)	(2.396e-10)	(2.815e-11)	(1.414e-12)
Constant	8.615e-04	-5.408e-02***	3.157e-04	-2.542e-04***
	(5.565e-04)	(9.640e-03)	(1.134e-03)	(5.705e-05)
Observations	3862	3862	3862	3862
Turning point	29,344	26,649	26,622	31,238

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 20. Quantile regression, PPP

	(1) Gini	(2) Theil	(3) MPDI	(4) med_balassa
GDP per capita (PPP) (within)	-1.029e-05***	-1.185e-04***	-1.875e-05***	4.136e-06***
	(8.644e-07)	(1.152e-05)	(1.483e-06)	(5.769e-08)
GDP per cap. (PPP) squared (within)	1.317e-10***	1.831e-09***	2.753e-10***	-4.873e-11***
	(1.553e-11)	(2.071e-10)	(2.663e-11)	(1.013e-12)
Constant	-1.007e-02***	-2.131e-01***	-1.940e-02***	2.348e-04***
	(7.853e-04)	(1.048e-02)	(1.347e-03)	(5.427e-05)
Observations	2556	2556	2556	2556
Turning point	39,066	32,359	34,054	42,438

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

B.2. Production and exports – additional results

B.2.1. Production of goods

Appendix Table 21. Random effects regression

ISIC Rev. 2 3-digit 28 sectors	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman
GDP per capita	-1.043e-06	-3.440e-06	-3.022e-07	-5.019e-07
	(9.434e-07)	(2.428e-06)	(6.097e-07)	(6.641e-07)
GDP per capita squared	8.778e-11***	1.911e-10***	1.397e-11	3.083e-11*
	(2.222e-11)	(5.912e-11)	(1.569e-11)	(1.642e-11)
Constant	5.887e-01***	6.888e-01***	7.898e-02***	3.246e-01***
	(1.201e-02)	(3.640e-02)	(6.579e-03)	(8.543e-03)
Observations	1637	1637	1637	1637
R-squared	0.00401	0.00564	0.0152	1.24e-05
Number of countries	82	82	82	82
Turning point				
ISIC Rev. 2 3-digit 19 sectors				
GDP per capita	9.327e-07	1.879e-06	-4.561e-07	-3.487e-07
	(8.688e-07)	(2.342e-06)	(5.913e-07)	(6.347e-07)
GDP per capita squared	5.103e-11**	1.155e-10**	3.575e-11**	4.292e-11***
	(2.093e-11)	(5.601e-11)	(1.475e-11)	(1.568e-11)
Constant	6.070e-01***	7.558e-01***	1.432e-01***	4.198e-01***
	(1.006e-02)	(3.404e-02)	(1.039e-02)	(1.027e-02)
Observations	2155	2155	2155	2155
Number of countries	98	98	98	98
R-squared	0.158	0.139	0.0256	0.0649
Turning point				

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 22. Random effects regression, PPP

ISIC Rev. 2 3-digit 28 sectors	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman
GDP per capita (PPP)	-3.088e-06	-1.612e-05**	-4.752e-06**	-4.741e-06**
	(1.912e-06)	(8.034e-06)	(2.375e-06)	(2.348e-06)
GDP per cap (PPP) squared	1.082e-10**	5.186e-10**	1.576e-10**	1.538e-10**
	(4.456e-11)	(2.340e-10)	(7.743e-11)	(7.151e-11)
Constant	5.981e-01***	7.373e-01***	9.457e-02***	3.401e-01***
	(1.644e-02)	(5.070e-02)	(1.103e-02)	(1.279e-02)
Observations	803	803	803	803
R-squared	0.164	0.247	0.206	0.209
Number of countries	74	74	74	74
Turning point		15,542	15,076	15,413
ISIC Rev. 2 3-Digit 19 sectors				
GDP per capita (PPP)	-4.979e-06***	-1.850e-05***	-6.239e-06***	-6.026e-06***
	(1.309e-06)	(4.655e-06)	(1.600e-06)	(1.451e-06)
GDP per cap (PPP) squared	1.258e-10***	4.769e-10***	1.515e-10***	1.462e-10***
	(2.833e-11)	(1.108e-10)	(3.971e-11)	(3.478e-11)
Constant	6.406e-01***	8.566e-01***	1.709e-01***	4.481e-01***
	(1.249e-02)	(4.215e-02)	(1.278e-02)	(1.264e-02)
Observations	1168	1168	1168	1168
R-squared	0.359	0.330	0.275	0.324
Number of countries	91	91	91	91
Turning point	19,789	19,396	20,591	20,609

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 23. Fixed effects regression

ISIC rev.2 3-digit 28 sectors	(1) Hirschman	(2) Theil
GDP per capita	1.054e-06*	1.995e-06
	(6.340e-07)	(2.412e-06)
GDP per capita squared	-4.201e-12	6.883e-11
	(1.390e-11)	(5.386e-11)
Constant	3.027e-01***	5.877e-01***
	(3.217e-03)	(1.185e-02)
Observations	1637	1637
R-squared	82	82
Number of countries	0.0926	0.0715
Turning point		
ISIC Rev. 2 3-digit 19 sectors		
GDP per capita	1.167e-06*	7.648e-06***
	(5.954e-07)	(2.271e-06)
GDP per capita squared	1.037e-11	-9.100e-12
	(1.336e-11)	(5.024e-11)
Constant	3.906e-01***	6.506e-01***
	(2.973e-03)	(1.117e-02)
Observations	2155	2155
Number of countries	98	98
R-squared	0.185	0.205
Turning point		

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 24. Fixed effects regression, PPP

ISIC Rev. 2 3-digit 28 sectors	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman
GDP per capita (PPP)	2.900e-06	2.681e-06	-6.616e-07	4.704e-07
	(2.151e-06)	(9.323e-06)	(3.276e-06)	(2.950e-06)
GDP per cap (PPP) squared	2.895e-12	1.785e-10	7.725e-11	5.763e-11
	(4.913e-11)	(2.747e-10)	(1.018e-10)	(8.903e-11)
Constant	5.328e-01***	5.430e-01***	5.877e-02***	2.916e-01***
	(1.483e-02)	(4.957e-02)	(1.565e-02)	(1.501e-02)
Observations	803	803	803	803
Number of countries	74	74	74	74
R-squared	0.0937	0.00944	0.0232	0.000333
Turning point				
ISIC Rev. 2 3-digit 19 sectors				
GDP per capita (PPP)	-9.886e-07	-5.329e-06	-2.459e-06	-2.065e-06
	(1.451e-06)	(4.857e-06)	(1.697e-06)	(1.496e-06)
GDP per cap (PPP) squared	5.529e-11*	2.431e-10**	8.348e-11*	7.562e-11**
	(2.933e-11)	(1.141e-10)	(4.274e-11)	(3.595e-11)
Constant	5.935e-01***	6.990e-01***	1.268e-01***	4.016e-01***
	(1.094e-02)	(3.248e-02)	(1.037e-02)	(9.725e-03)
Observations	1168	1168	1168	1168
Number of countries	0.0244	0.000139	0.0957	0.0370
R-squared	91	91	91	91
Turning point				

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 25. Between effects regression

ISIC Rev.2 3-digit 28 sectors	(1) Hirschman	(2) Theil
GDP per capita	-7.664e-06***	-3.788e-05***
	(2.208e-06)	(9.269e-06)
GDP per capita squared	1.926e-10***	9.639e-10***
	(6.624e-11)	(2.780e-10)
Constant	3.522e-01***	8.213e-01***
	(1.096e-02)	(4.603e-02)
Observations	1637	1637
R-squared	0.137	0.179
Number of countries	82	82
Turning point	19,896	19,649
ISIC Rev. 2 3-digit 19 sectors		
GDP per capita	-1.421e-05***	-5.080e-05***
	(3.124e-06)	(1.048e-05)
GDP per capita squared	3.278e-10***	1.243e-09***
	(1.124e-10)	(3.773e-10)
Constant	4.742e-01***	9.583e-01***
	(1.298e-02)	(4.356e-02)
Observations	2155	2155
Number of countries	0.268	0.285
R-squared	98	98
Turning point	21,675	20,434

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 26. Between effects regression, PPP

ISIC Rev. 2 3-digit 28 sectors	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman
GDP per capita (PPP)	-2.028e-05***	-6.080e-05***	-1.146e-05***	-1.395e-05***
	(4.081e-06)	(1.245e-05)	(2.411e-06)	(2.994e-06)
GDP per cap (PPP) squared	5.675e-10***	1.809e-09***	3.759e-10***	4.305e-10***
	(1.412e-10)	(4.307e-10)	(8.341e-11)	(1.036e-10)
Constant	6.899e-01***	9.590e-01***	1.236e-01***	3.839e-01***
	(2.068e-02)	(6.310e-02)	(1.222e-02)	(1.518e-02)
Observations	803	803	803	803
Number of countries	74	74	74	74
R-squared	0.310	0.265	0.206	0.215
Turning point	17,868	16,805	15,243	16,202
ISIC Rev. 2 3-digit 19 sectors				
GDP per capita (PPP)	-1.864e-05***	-6.029e-05***	-1.725e-05***	-1.796e-05***
	(3.336e-06)	(1.085e-05)	(3.127e-06)	(3.141e-06)
GDP per cap (PPP) squared	4.620e-10***	1.537e-09***	4.549e-10***	4.580e-10***
	(1.117e-10)	(3.634e-10)	(1.048e-10)	(1.052e-10)
Constant	7.172e-01***	1.085e+00***	2.267e-01***	5.119e-01***
	(1.734e-02)	(5.641e-02)	(1.626e-02)	(1.633e-02)
Observations	1168	1168	1168	1168
R-squared	0.363	0.332	0.271	0.319
Number of countries	91	91	91	91
Turning point	20,173	19,613	18,960	19,607

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 27. Pooled regression

ISIC Rev.2 3-digit 28 sectors	(1) Hirschman	(2) Theil
GDP per capita	-8.138e-06***	-3.888e-05***
	(5.813e-07)	(2.363e-06)
GDP per capita squared	2.238e-10***	1.117e-09***
	(2.154e-11)	(9.292e-11)
Constant	3.419e-01***	7.585e-01***
	(2.594e-03)	(1.049e-02)
Observations	1637	1637
R-squared	0.138	0.184
Turning point	18,181	17,404
Number of countries		
ISIC Rev. 2 3-digit 19 sectors		
	-1.356e-05***	-4.848e-05***
GDP per capita	(6.062e-07)	(2.071e-06)
	3.366e-10***	1.252e-09***
GDP per capita squared	(2.364e-11)	(8.288e-11)
	4.580e-01***	9.053e-01***
Constant	(3.006e-03)	(9.791e-03)
	2155	2155
Observations	0.269	0.286
Turning point	20,143	19,361

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 28. Pooled regression, PPP

ISIC Rev. 2 3-digit 28 sectors	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman
GDP per capita (PPP)	-1.898e-05***	-5.624e-05***	-1.081e-05***	-1.313e-05***
	(1.191e-06)	(4.764e-06)	(1.421e-06)	(1.431e-06)
GDP per cap (PPP) squared	5.292e-10***	1.677e-09***	3.557e-10***	4.055e-10***
	(4.043e-11)	(1.757e-10)	(5.519e-11)	(5.444e-11)
Constant	6.691e-01***	8.920e-01***	1.145e-01***	3.718e-01***
	(6.071e-03)	(2.183e-02)	(5.632e-03)	(6.120e-03)
Observations	803	803	803	803
R-squared	0.310	0.265	0.206	0.215
Turning point	17,933	16,768	15,195	16,190
ISIC Rev. 2 3-digit 19 sectors				
GDP per capita (PPP)	-1.648e-05***	-5.174e-05***	-1.381e-05***	-1.485e-05***
	(1.048e-06)	(3.757e-06)	(1.233e-06)	(1.166e-06)
GDP per cap (PPP) squared	3.865e-10***	1.255e-09***	3.448e-10***	3.577e-10***
	(3.635e-11)	(1.328e-10)	(4.430e-11)	(4.143e-11)
Constant	7.008e-01***	1.016e+00***	2.006e-01***	4.880e-01***
	(5.152e-03)	(1.851e-02)	(5.959e-03)	(5.776e-03)
Observations	1168	1168	1168	1168
R-squared	0.368	0.337	0.276	0.324
Turning point	21,320	20,614	20,026	20,758

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 29. Quantile regression

ISIC Rev. 2 3-digit 28 sectors	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman
GDP per capita	2.812e-07	2.377e-06	2.037e-07	4.212e-07
	(8.477e-07)	(1.593e-06)	(2.459e-07)	(3.796e-07)
GDP per capita squared	5.131e-11**	5.580e-11	7.101e-12	1.164e-11
	(2.065e-11)	(3.886e-11)	(6.025e-12)	(9.246e-12)
Constant	-9.305e-04	-4.613e-03***	-7.849e-04***	-1.176e-03***
	(6.990e-04)	(1.313e-03)	(2.022e-04)	(3.130e-04)
Observations	1637	1637	1637	1637
Turning point				
ISIC Rev. 2 3-digit 19 Sectors				
GDP per capita	3.599e-06***	8.066e-06***	9.100e-07***	1.317e-06***
	(7.643e-07)	(1.893e-06)	(2.535e-07)	(3.632e-07)
GDP per capita squared	-1.625e-11	-5.401e-11	-6.549e-14	5.508e-13
	(1.934e-11)	(4.798e-11)	(6.408e-12)	(9.207e-12)
Constant	-1.682e-04	-4.553e-03**	-1.262e-03***	-1.405e-03***
	(7.337e-04)	(1.810e-03)	(2.435e-04)	(3.477e-04)
Observations	2155	2155	2155	2155
Turning point				

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 30. Quantile regression, PPP

ISIC Rev. 2 3-digit 28 sectors	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman
GDP per capita (PPP)	5.716e-06***	1.969e-05***	2.371e-06***	4.310e-06***
	(1.620e-06)	(3.219e-06)	(4.685e-07)	(7.319e-07)
GDP per cap (PPP) squared	-7.216e-11**	-3.093e-10***	-3.909e-11***	-6.968e-11***
	(3.454e-11)	(6.972e-11)	(1.015e-11)	(1.587e-11)
Constant	1.415e-03	1.666e-03	-9.696e-05	-7.374e-12
	(1.084e-03)	(2.156e-03)	(3.136e-04)	(4.899e-04)
Observations	803	803	803	803
Turning point				
ISIC Rev. 2 3-digit 19 sectors				
GDP per capita (PPP)	6.390e-07	2.804e-06	5.479e-07	9.139e-07
	(1.263e-06)	(2.860e-06)	(4.896e-07)	(7.245e-07)
GDP per cap (PPP) squared	2.312e-12	-2.660e-12	-1.556e-12	-3.760e-12
	(2.518e-11)	(5.689e-11)	(9.694e-12)	(1.437e-11)
Constant	6.113e-03***	1.005e-02***	7.990e-04**	1.425e-03***
	(9.288e-04)	(2.108e-03)	(3.625e-04)	(5.396e-04)
Observations	1168	1168	1168	1168
R-squared				
Turning point				

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

B.2.2. Export of products – absolute specialization

Appendix Table 31. Random effects regression

	(1)	(2)	(3)	(4)	(5)
SITC Rev. 1 5-digit	**Gini**	**Theil**	**Herfindahl**	**Hirschman**	**Export lines**
GDP per capita	-4.943e-06***	-1.017e-04***	-6.899e-06***	-1.022e-05***	3.560e-02***
	(3.979e-07)	(1.279e-05)	(2.243e-06)	(2.300e-06)	(1.987e-03)
GDP per capita squared	1.219e-10***	2.590e-09***	2.118e-10***	2.970e-10***	-7.069e-07***
	(1.113e-11)	(3.861e-10)	(6.797e-11)	(7.069e-11)	(4.953e-08)
Constant	9.710e-01***	4.225e+00***	2.527e-01***	4.369e-01***	2.997e+02***
	(2.861e-03)	(1.086e-01)	(2.282e-02)	(2.038e-02)	(1.672e+01)
Observations	3862	3862	3862	3862	3862
R-squared	0.487	0.282	0.0540	0.131	0.411
Number of countries	142	142	142	142	142
Turning point	20,275	19,633	16,287	17,205	25,180
SITC Rev. 1 5-digit excl. outliers					
GDP per capita	-5.625e-06***	-1.126e-04***	-9.004e-06***	-1.137e-05***	3.715e-02***
	(3.777e-07)	(1.094e-05)	(1.949e-06)	(1.929e-06)	(1.974e-03)
GDP per capita squared	1.437e-10***	2.914e-09***	2.775e-10***	3.283e-10***	-7.570e-07***
	(1.070e-11)	(3.242e-10)	(5.781e-11)	(5.789e-11)	(4.989e-08)
Constant	9.728e-01***	4.255e+00***	2.583e-01***	4.405e-01***	2.957e+02***
	(2.815e-03)	(1.073e-01)	(2.271e-02)	(2.019e-02)	(1.711e+01)
Observations	3849	3853	3858	3853	3859
Number of countries	142	142	142	142	142
R-squared	0.481	0.281	0.0549	0.133	0.413
Turning point	19,572	19,321	16,223	17,316	24,538
Feenstra SITC Rev. 2 4-digit					
GDP per capita	-8.599e-06***	-1.632e-04***	-1.217e-05***	-1.945e-05***	3.093e-02***
	(3.549e-07)	(7.208e-06)	(1.187e-06)	(1.131e-06)	(1.394e-03)
GDP per capita squared	1.559e-10***	3.704e-09***	3.519e-10***	5.050e-10***	-5.852e-07***
	(8.151e-12)	(1.864e-10)	(3.316e-11)	(3.079e-11)	(4.030e-08)
Constant	9.855e-01***	4.449e+00***	2.446e-01***	4.485e-01***	2.134e+02***
	(2.937e-03)	(1.058e-01)	(1.961e-02)	(1.883e-02)	(1.367e+01)
Observations	4008	4008	4008	4008	4008
Number of countries	135	135	135	135	135
R-squared	0.510	0.370	0.125	0.229	0.563
Turning point	27,579	22,030	17,292	19,257	26,427
HS 1988/92 6-digit					
GDP per capita	-1.372e-06***	-1.705e-05	-6.041e-06***	-4.833e-06**	1.827e-01***
	(4.248e-07)	(1.484e-05)	(1.824e-06)	(1.993e-06)	(1.502e-02)
GDP per capita squared	6.058e-11***	9.979e-10***	1.283e-10***	1.336e-10***	-3.382e-06***
	(1.001e-11)	(3.123e-10)	(3.536e-11)	(4.101e-11)	(3.306e-07)
Constant	9.641e-01***	4.561e+00***	1.765e-01***	3.327e-01***	1.722e+03***
	(3.017e-03)	(1.592e-01)	(2.284e-02)	(2.419e-02)	(1.121e+02)
Observations	1612	1612	1612	1612	1612
R-squared	0.0256	0.0610	0.0757	0.126	0.462
Number of countries	134	134	134	134	134
Turning point	11,324		23,542	18,088	27,011

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 32. Random effects regression, PPP

	(1)	(2)	(3)	(4)	(5)
SITC Rev. 1 5-digit	**Gini**	**Theil**	**Herfindahl**	**Hirschman**	**Export lines**
GDP per capita (PPP)	-2.456e-06***	-4.241e-05**	-1.694e-06	-2.989e-06	2.815e-02***
	(4.589e-07)	(1.723e-05)	(3.163e-06)	(3.096e-06)	(2.178e-03)
GDP per cap (PPP) squared	4.586e-11***	7.665e-10*	3.768e-11	5.492e-11	-4.235e-07***
	(1.028e-11)	(4.007e-10)	(7.220e-11)	(7.160e-11)	(4.581e-08)
Constant	9.682e-01***	4.113e+00***	2.404e-01***	4.217e-01***	2.718e+02***
	(3.726e-03)	(1.488e-01)	(3.103e-02)	(2.818e-02)	(1.921e+01)
Observations	2556	2556	2556	2556	2556
R-squared	0.456	0.244	0.0447	0.109	0.450
Number of countries	139	139	139	139	139
Turning point	26,777	27,665			33,235

Feenstra SITC Rev. 2 4-digit					
GDP per capita (PPP)	-4.050e-06***	-9.237e-05***	-1.171e-05***	-1.290e-05***	1.729e-02***
	(3.969e-07)	(1.209e-05)	(2.079e-06)	(2.005e-06)	(2.389e-03)
GDP per cap (PPP) squared	6.086e-11***	1.769e-09***	2.826e-10***	2.749e-10***	-2.692e-07***
	(6.750e-12)	(2.137e-10)	(3.489e-11)	(3.583e-11)	(5.249e-08)
Constant	9.766e-01***	4.349e+00***	2.544e-01***	4.446e-01***	2.127e+02***
	(3.686e-03)	(1.177e-01)	(2.153e-02)	(2.133e-02)	(1.722e+01)
Observations	2423	2423	2423	2423	2423
R-squared	0.505	0.382	0.148	0.235	0.608
Number of countries	133	133	133	133	133
Turning point	33,273	26,108	20,718	23,463	32,114
HS 1988/92 6-Digit					
GDP per capita (PPP)	-1.210e-06***	-1.309e-05	-3.064e-06**	-2.412e-06	1.575e-01***
	(3.079e-07)	(1.109e-05)	(1.476e-06)	(1.607e-06)	(1.166e-02)
GDP per cap (PPP) squared	4.390e-11***	7.186e-10***	5.985e-11**	7.451e-11***	-2.511e-06***
	(6.571e-12)	(2.032e-10)	(2.521e-11)	(2.822e-11)	(2.401e-07)
Constant	9.654e-01***	4.548e+00***	1.720e-01***	3.262e-01***	1.408e+03***
	(3.009e-03)	(1.627e-01)	(2.449e-02)	(2.570e-02)	(1.068e+02)
Observations	1610	1610	1610	1610	1610
R-squared	0.0357	0.0910	0.0652	0.0147	0.538
Number of countries	133	133	133	133	133
Turning point	13,781		25,597		31,362

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 33. Fixed effects regression

	(1) Theil	(2) Hirschman	(3) Export lines
SITC Rev. 1 5-digit			
GDP per capita	-8.557e-05***	-7.161e-06***	3.404e-02***
	(1.439e-05)	(2.572e-06)	(2.366e-03)
GDP per capita squared	2.262e-09***	2.353e-10***	-6.708e-07***
	(4.170e-10)	(7.587e-11)	(5.713e-08)
Constant	4.028e+00***	4.021e-01***	3.152e+02***
	(4.928e-02)	(8.741e-03)	(9.523e+00)
Observations	3862	3862	3862
R-squared	0.276	0.0932	0.411
Number of countries	142	142	142
Turning point	18,915	15,217	25,373
SITC Rev1 5-digit excl. outliers			
GDP per capita	-9.711e-05***	-8.378e-06***	3.588e-02***
	(1.225e-05)	(2.149e-06)	(2.345e-03)
GDP per capita squared	2.585e-09***	2.651e-10***	-7.275e-07***
	(3.527e-10)	(6.278e-11)	(5.623e-08)
Constant	4.064e+00***	4.061e-01***	3.100e+02***
	(4.341e-02)	(7.628e-03)	(9.519e+00)
Observations	3853	3853	3859
Number of countries	0.276	0.109	0.413
R-squared	142	142	142
Turning point	18,783	15,802	24,660
Feenstra SITC Rev. 2 4-digit			
GDP per capita	-1.569e-04***	-1.805e-05***	2.882e-02***
	(7.863e-06)	(1.218e-06)	(1.499e-03)
GDP per capita squared	3.564e-09***	4.745e-10***	-5.396e-07***
	(2.050e-10)	(3.323e-11)	(4.222e-08)
Constant	4.420e+00***	4.390e-01***	2.384e+02***
	(2.520e-02)	(3.927e-03)	(4.462e+00)
Observations	4008	4008	4008
Number of countries	135	135	135
R-squared	0.370	0.229	0.562
Turning point	22,012	19,020	26,705

HS 1988/92 6-digit			
GDP per capita	5.592e-05***	4.428e-06**	1.551e-01***
	(1.468e-05)	(1.915e-06)	(1.559e-02)
GDP per capita squared	-2.556e-10	-2.694e-11	-2.878e-06***
	(3.012e-10)	(3.861e-11)	(3.070e-07)
Constant	3.894e+00***	2.524e-01***	2.029e+03***
	(6.619e-02)	(8.657e-03)	(7.522e+01)
Observations	1612	1612	1612
R-squared	134	134	134
Number of countries	0.243	0.130	0.462
Turning point			26,946

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 34. Fixed effects regression, PPP

SITC Rev. 1 5-digit	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman	(5) Export lines
GDP per capita (PPP)	-1.499e-06	-1.266e-05	2.209e-06	2.026e-06	2.484e-02***
	(1.213e-06)	(4.425e-05)	(7.885e-06)	(7.946e-06)	(5.848e-03)
GDP per cap (PPP) squared	3.141e-11	3.083e-10	-2.271e-11	-2.268e-11	-3.665e-07***
	(2.380e-11)	(9.417e-10)	(1.705e-10)	(1.699e-10)	(1.041e-07)
Constant	9.554e-01***	3.686e+00***	1.785e-01***	3.515e-01***	3.173e+02***
	(7.961e-03)	(2.658e-01)	(4.654e-02)	(4.732e-02)	(4.039e+01)
Observations	2556	2556	2556	2556	2556
Number of countries	139	139	139	139	139
R-squared	0.432	0.193	0.0413	0.0985	0.448
Turning point					33,888
Feenstra SITC Rev. 2 4-digit					
GDP per capita (PPP)	-3.188e-06***	-6.388e-05***	-8.217e-06***	-8.408e-06***	8.111e-03***
	(4.818e-07)	(1.465e-05)	(2.732e-06)	(2.552e-06)	(2.684e-03)
GDP per cap (PPP) squared	4.836e-11***	1.351e-09***	2.310e-10***	2.082e-10***	-1.383e-07***
	(7.419e-12)	(2.411e-10)	(4.375e-11)	(4.263e-11)	(4.911e-08)
Constant	9.710e-01***	4.170e+00***	2.314e-01***	4.164e-01***	2.798e+02***
	(2.996e-03)	(8.488e-02)	(1.588e-02)	(1.466e-02)	(1.492e+01)
Observations	2423	2423	2423	2423	2423
R-squared	0.506	0.387	0.129	0.233	0.612
Number of countries	133	133	133	133	133
Turning point	32,961	23,642	17,786	20,192	29,324
HS 1988/92 6-digit					
GDP per capita (PPP)	2.320e-07	3.129e-05***	2.991e-07	3.512e-06**	1.296e-01***
	(3.180e-07)	(1.107e-05)	(1.421e-06)	(1.580e-06)	(1.209e-02)
GDP per cap (PPP) squared	2.270e-11***	4.057e-11	7.070e-12	-1.725e-11	-2.058e-06***
	(6.240e-12)	(1.986e-10)	(2.409e-11)	(2.719e-11)	(2.408e-07)
Constant	9.476e-01***	3.898e+00***	1.186e-01***	2.451e-01***	1.784e+03***
	(2.277e-03)	(7.914e-02)	(1.032e-02)	(1.143e-02)	(8.298e+01)
Observations	1610	1610	1610	1610	1610
R-squared	133	133	133	133	133
Number of countries	0.342	0.254	0.0513	0.132	0.538
Turning point					31,487

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 35. Between effects regression

SITC Rev. 1 5-digit	(1) Theil	(2) Hirschman	(3) Export lines
GDP per capita	-2.368e-04***	-2.916e-05***	5.953e-02***
	(4.674e-05)	(8.629e-06)	(7.654e-03)
GDP per capita squared	5.914e-09***	7.232e-10**	-1.614e-06***
	(1.840e-09)	(3.397e-10)	(3.013e-07)
Constant	4.613e+00***	4.945e-01***	2.548e+02***
	(1.357e-01)	(2.505e-02)	(2.222e+01)
Observations	3862	3862	3862
Number of countries	142	142	142
R-squared	0.284	0.150	0.383
Turning point	20,020	20,160	18,442

Feenstra SITC Rev. 2 4-digit			
GDP per capita	-2.958e-04***	-3.973e-05***	5.823e-02***
	(4.804e-05)	(8.565e-06)	(6.206e-03)
GDP per capita squared	8.458e-09***	1.187e-09***	-1.490e-06***
	(2.022e-09)	(3.606e-10)	(2.612e-07)
Constant	4.714e+00***	4.922e-01***	1.537e+02***
	(1.333e-01)	(2.377e-02)	(1.722e+01)
Observations	4008	4008	4008
R-squared	0.356	0.218	0.561
Number of countries	135	135	135
Turning point	17,486	16,735	19,540
HS 1988/92 6-digit			
GDP per capita	-2.215e-04***	-2.198e-05***	2.634e-01***
	(4.988e-05)	(7.155e-06)	(3.946e-02)
GDP per capita squared	4.735e-09***	4.852e-10**	-5.637e-06***
	(1.703e-09)	(2.442e-10)	(1.347e-06)
Constant	5.356e+00***	3.953e-01***	1.496e+03***
	(1.771e-01)	(2.540e-02)	(1.401e+02)
Observations	1612	1612	1612
R-squared	0.288	0.154	0.466
Number of countries	134	134	134
Turning point	23,390	22,650	23,363

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 36. Between effects regression, PPP

SITC Rev. 1 5-digit	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman	(5) Export lines
GDP per capita (PPP)	-7.462e-06***	-2.014e-04***	-1.973e-05**	-2.634e-05***	5.273e-02***
	(9.699e-07)	(3.566e-05)	(7.564e-06)	(6.823e-06)	(5.059e-03)
GDP per cap (PPP) squared	1.373e-10***	4.225e-09***	4.415e-10*	5.779e-10***	-1.153e-06***
	(2.963e-11)	(1.089e-09)	(2.311e-10)	(2.085e-10)	(1.546e-07)
Constant	9.963e-01***	4.911e+00***	3.293e-01***	5.364e-01***	1.822e+02***
	(4.717e-03)	(1.734e-01)	(3.679e-02)	(3.318e-02)	(2.460e+01)
Observations	2556	2556	2556	2556	2556
Number of countries	139	139	139	139	139
R-squared	0.458	0.236	0.0445	0.104	0.441
Turning point	27,174	23,834	22,344	22,789	22,866
Feenstra SITC Rev. 2 4-digit					
GDP per capita (PPP)	-9.716e-06***	-2.697e-04***	-2.844e-05***	-3.700e-05***	4.730e-02***
	(1.168e-06)	(3.548e-05)	(6.496e-06)	(6.341e-06)	(4.837e-03)
GDP per cap (PPP) squared	2.005e-10***	6.383e-09***	7.324e-10***	9.303e-10***	-9.153e-07***
	(3.821e-11)	(1.161e-09)	(2.126e-10)	(2.075e-10)	(1.583e-07)
Constant	1.001e+00***	5.086e+00***	3.218e-01***	5.405e-01***	6.736e+01***
	(5.286e-03)	(1.606e-01)	(2.941e-02)	(2.871e-02)	(2.190e+01)
Observations	2423	2423	2423	2423	2423
R-squared	0.506	0.377	0.145	0.231	0.610
Number of countries	133	133	133	133	133
Turning point	24,229	21,126	19,416	19,886	25,839
HS 1988/92 6-digit					
GDP per capita (PPP)	-5.422e-06***	-2.343e-04***	-1.404e-05**	-2.318e-05***	2.717e-01***
	(9.680e-07)	(4.321e-05)	(5.957e-06)	(6.350e-06)	(3.175e-02)
GDP per cap (PPP) squared	8.418e-11***	4.763e-09***	2.967e-10*	4.926e-10***	-5.276e-06***
	(2.825e-11)	(1.261e-09)	(1.739e-10)	(1.853e-10)	(9.268e-07)
Constant	9.982e-01***	5.865e+00***	2.302e-01***	4.421e-01***	8.664e+02***
	(4.934e-03)	(2.203e-01)	(3.037e-02)	(3.237e-02)	(1.619e+02)
Observations	1610	1610	1610	1610	1610
R-squared	0.438	0.303	0.0621	0.149	0.530
Number of countries	133	133	133	133	133
Turning point	32,205	24,596	23,660	23,528	25,749

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 37. Pooled regression

SITC Rev. 1 5-digit	(1) Theil	(2) Hirschman	(3) Export lines
GDP per capita	-2.062e-04***	-2.636e-05***	4.502e-02***
	(6.874e-06)	(1.289e-06)	(1.060e-03)
GDP per capita squared	4.593e-09***	5.957e-10***	-9.855e-07***
	(2.525e-10)	(4.843e-11)	(3.626e-08)
Constant	4.523e+00***	4.819e-01***	2.809e+02***
	(2.686e-02)	(5.312e-03)	(4.752e+00)
Observations	3862	3862	3862
R-squared	0.289	0.152	0.414
Turning point	22,447	22,125	22,841
Feenstra SITC Rev. 2 4-digit			
GDP per capita	-2.521e-04***	-3.387e-05***	4.924e-02***
	(6.759e-06)	(1.174e-06)	(9.629e-04)
GDP per capita squared	6.136e-09***	8.711e-10***	-1.105e-06***
	(2.724e-10)	(4.737e-11)	(3.998e-08)
Constant	4.689e+00***	4.861e-01***	1.817e+02***
	(2.261e-02)	(4.325e-03)	(3.449e+00)
Observations	4008	4008	4008
R-squared	0.372	0.229	0.570
Turning point	20,543	19,441	22,281
HS 1988/92 6-digit			
GDP per capita	-2.145e-04***	-2.065e-05***	2.557e-01***
	(1.152e-05)	(1.577e-06)	(8.304e-03)
GDP per capita squared	4.481e-09***	4.404e-10***	-5.312e-06***
	(3.783e-10)	(5.209e-11)	(2.482e-07)
Constant	5.156e+00***	3.654e-01***	1.657e+03***
	(4.982e-02)	(7.113e-03)	(4.367e+01)
Observations	1612	1612	1612
R-squared	0.288	0.155	0.467
Turning point	23,934	23,445	24,068

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 38. Pooled regression, PPP

SITC Rev. 1 5-digit	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman	(5) Export lines
GDP per capita (PPP)	-6.577e-06***	-1.509e-04***	-1.276e-05***	-1.839e-05***	3.797e-02***
	(2.429e-07)	(8.854e-06)	(1.672e-06)	(1.668e-06)	(1.208e-03)
GDP per cap (PPP) squared	1.100e-10***	2.755e-09***	2.452e-10***	3.488e-10***	-7.079e-07***
	(7.452e-12)	(2.801e-10)	(5.227e-11)	(5.296e-11)	(3.696e-08)
Constant	9.916e-01***	4.601e+00***	2.765e-01***	4.837e-01***	2.548e+02***
	(9.880e-04)	(4.277e-02)	(9.032e-03)	(8.379e-03)	(7.073e+00)
Observations	2556	2556	2556	2556	2556
R-squared	0.461	0.244	0.047	0.109	0.464
Turning point	29,895	27,387	26,020	26,362	26,819
Feenstra SITC Rev. 2 4-digit					
GDP per capita (PPP)	-8.379e-06***	-2.271e-04***	-2.458e-05***	-3.082e-05***	4.287e-02***
	(2.891e-07)	(9.241e-06)	(1.271e-06)	(1.442e-06)	(1.704e-03)
GDP per cap (PPP) squared	1.534e-10***	4.835e-09***	5.895e-10***	7.053e-10***	-7.645e-07***
	(9.510e-12)	(3.114e-10)	(3.847e-11)	(4.655e-11)	(5.987e-08)
Constant	9.976e-01***	4.977e+00***	3.108e-01***	5.241e-01***	8.898e+01***
	(9.469e-04)	(3.794e-02)	(7.307e-03)	(6.997e-03)	(6.125e+00)
Observations	2423	2423	2423	2423	2423
R-squared	0.514	0.387	0.148	0.238	0.613
Turning point	27,311	23,485	20,848	21,849	28,038
HS 1988/92 6-digit					
GDP per capita (PPP)	-5.093e-06***	-1.946e-04***	-9.339e-06***	-1.817e-05***	2.294e-01***
	(3.418e-07)	(1.208e-05)	(1.583e-06)	(1.762e-06)	(8.004e-03)
GDP per cap (PPP) squared	7.221e-11***	3.491e-09***	1.570e-10***	3.345e-10***	-3.915e-06***
	(1.055e-11)	(3.421e-10)	(4.252e-11)	(4.920e-11)	(2.169e-07)
Constant	9.951e-01***	5.581e+00***	1.898e-01***	4.017e-01***	1.122e+03***
	(1.414e-03)	(6.133e-02)	(8.775e-03)	(9.227e-03)	(4.970e+01)
Observations	1610	1610	1610	1610	1610
R-squared	0.439	0.310	0.067	0.155	0.539
Turning point	35,265	27,872	29,742	27,160	29,298

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 39. Quantile regression

SITC Rev. 1 5-digit	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman	(5) Export lines
GDP per capita	-3.627e-06***	-4.692e-05***	-1.087e-06*	-2.600e-06***	1.911e-02***
	(1.413e-07)	(7.590e-06)	(6.045e-07)	(9.895e-07)	(1.291e-03)
GDP per capita squared	9.640e-11***	1.262e-09***	3.277e-11**	7.924e-11***	-3.688e-07***
	(3.412e-12)	(1.833e-10)	(1.460e-11)	(2.391e-11)	(3.118e-08)
Constant	3.505e-04**	-2.677e-02***	-5.162e-03***	-7.261e-03***	4.060e+00***
	(1.373e-04)	(7.378e-03)	(5.887e-04)	(9.619e-04)	(1.254e+00)
Observations	3862	3862	3862	3862	3862
Turning point	18,812	18,590	16,585	16,406	25,908
Feenstra SITC Rev. 2 4-digit					
GDP per capita	-7.992e-06***	-1.315e-04***	-6.978e-06***	-1.366e-05***	2.747e-02***
	(1.008e-07)	(6.898e-06)	(6.344e-07)	(1.233e-06)	(1.184e-03)
GDP per capita squared	1.276e-10***	2.731e-09***	1.896e-10***	3.388e-10***	-5.200e-07***
	(2.354e-12)	(1.617e-10)	(1.488e-11)	(2.888e-11)	(2.766e-08)
Constant	3.407e-04***	-1.632e-02***	-4.182e-03***	-4.805e-03***	-1.179e+00
	(9.230e-05)	(6.308e-03)	(5.813e-04)	(1.125e-03)	(1.081e+00)
Observations	4008	4008	4008	4008	4008
Turning point	31,317	24,075	18,402	20,159	26,413
HS 1988/92 6-digit					
GDP per capita	1.117e-06***	6.503e-05***	1.246e-06***	5.751e-06***	8.472e-02***
	(1.267e-07)	(1.293e-05)	(3.795e-07)	(1.508e-06)	(7.092e-03)
GDP per capita squared	1.231e-11***	-2.960e-10	-7.476e-12	-4.053e-11	-1.698e-06***
	(2.675e-12)	(2.734e-10)	(8.012e-12)	(3.183e-11)	(1.497e-07)
Constant	2.937e-05	-8.767e-03	-6.901e-04***	-1.949e-03***	3.107e+00
	(5.582e-05)	(5.714e-03)	(1.673e-04)	(6.644e-04)	(3.129e+00)
Observations	1612	1612	1612	1612	1612
Turning point					24,947

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 40. Quantile regression, PPP

SITC Rev. 1 5-digit	(1) Gini	(2) Theil	(3) Herfindahl	(4) Hirschman	(5) Export lines
GDP per capita (PPP)	-8.396e-07***	-1.216e-05	6.531e-07	1.957e-06*	1.721e-02***
	(2.321e-07)	(1.091e-05)	(1.150e-06)	(1.147e-06)	(2.143e-03)
GDP per cap (PPP) squared	2.164e-11***	3.564e-10*	2.819e-12	-1.088e-11	-2.397e-07***
	(4.163e-12)	(1.960e-10)	(2.067e-11)	(2.060e-11)	(3.834e-08)
Constant	-9.152e-04***	-7.467e-02***	-8.822e-03***	-1.218e-02***	2.460e+01***
	(2.113e-04)	(9.915e-03)	(1.045e-03)	(1.042e-03)	(1.957e+00)
Observations	2556	2556	2556	2556	2556
Turning point	19,399				35,899
Feenstra SITC Rev. 2 4-digit					
GDP per capita (PPP)	-2.576e-06***	-7.989e-05***	-7.004e-06***	-4.948e-06***	2.505e-02***
	(2.642e-07)	(1.104e-05)	(1.436e-06)	(1.702e-06)	(2.724e-03)
GDP per cap (PPP) squared	4.026e-11***	1.645e-09***	1.697e-10***	1.301e-10***	-4.542e-07***
	(4.514e-12)	(1.889e-10)	(2.459e-11)	(2.784e-11)	(4.674e-08)
Constant	-1.357e-03***	-1.505e-01***	-1.122e-02***	-1.668e-02***	-5.485e-01
	(2.020e-04)	(8.455e-03)	(1.099e-03)	(1.357e-03)	(2.087e+00)
Observations	2423	2423	2423	2423	2423
Turning point	31,992	24,283	20,636	19,016	27,576
HS 1988/92 6-digit					
GDP per capita (PPP)	3.208e-07***	2.821e-05***	6.572e-07***	3.736e-06***	9.274e-02***
	(9.331e-08)	(9.432e-06)	(2.536e-07)	(1.098e-06)	(5.663e-03)
GDP per cap (PPP) squared	1.643e-11***	1.715e-10	7.213e-13	-1.463e-11	-1.556e-06***
	(1.780e-12)	(1.802e-10)	(4.835e-12)	(2.092e-11)	(1.082e-07)
Constant	2.110e-05	-8.641e-03	-6.993e-04***	-2.020e-03***	2.367e+00
	(5.946e-05)	(6.031e-03)	(1.616e-04)	(7.039e-04)	(3.627e+00)
Observations	1610	1610	1610	1610	1610
Turning point					29,801

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

B.2.3. Export of products – relative specialization

Appendix Table 41. Random effects regression

	(1)	(2)	(3)	(4)
SITC Rev. 1 5-digit	**Gini**	**Theil**	**PDI**	**med_balassa**
GDP per capita	-2.395e-05***	-2.403e-04***	-3.291e-05***	1.911e-05***
	(1.159e-06)	(1.162e-05)	(1.256e-06)	(1.268e-06)
GDP per capita squared	4.430e-10***	4.794e-09***	6.188e-10***	-2.942e-10***
	(3.057e-11)	(3.089e-10)	(3.285e-11)	(3.559e-11)
Constant	9.490e-01***	3.590e+00***	8.740e-01***	1.274e-02
	(7.945e-03)	(1.048e-01)	(9.081e-03)	(9.735e-03)
Observations	3862	3862	3862	3862
R-squared	0.485	0.411	0.543	0.382
Number of countries	142	142	142	142
Turning point	27,032	25,063	26,592	32,478
SITC Rev. 1 5-digit excl. outliers				
GDP per capita	-2.423e-05***	-2.540e-04***	-3.420e-05***	4.352e-10**
	(1.191e-06)	(1.055e-05)	(1.280e-06)	(1.895e-10)
GDP per capita squared	4.488e-10***	5.265e-09***	6.588e-10***	-3.421e-14**
	(3.278e-11)	(2.630e-10)	(3.497e-11)	(1.537e-14)
Constant	9.502e-01***	3.621e+00***	8.775e-01***	-1.148e-08
	(8.105e-03)	(1.066e-01)	(9.370e-03)	(1.855e-07)
Observations	3851	3859	3852	1828
Number of countries	142	142	142	104
R-squared	0.489	0.417	0.545	0.00339
Turning point	26.994	24,122	25,956	6,361
Feenstra SITC Rev. 2 4-digit				
GDP per capita	-2.104e-05***	-1.581e-04***	-2.677e-05***	1.979e-05***
	(9.134e-07)	(7.770e-06)	(1.064e-06)	(1.360e-06)
GDP per capita squared	3.876e-10***	3.024e-09***	4.892e-10***	-3.511e-10***
	(2.236e-11)	(2.381e-10)	(2.944e-11)	(3.283e-11)
Constant	9.516e-01***	3.232e+00***	8.741e-01***	1.311e-02
	(8.185e-03)	(8.230e-02)	(9.014e-03)	(9.937e-03)
Observations	4047	4047	4047	4047
Number of countries	136	136	136	136
R-squared	0.542	0.516	0.612	0.440
Turning point	27,141	26,141	27,361	28,183
HS 1988/92 6-digit				
GDP per capita	-1.213e-05***	-1.920e-04***	-2.675e-05***	1.126e-05***
	(1.315e-06)	(1.447e-05)	(1.679e-06)	(1.602e-06)
GDP per capita squared	2.193e-10***	3.468e-09***	4.799e-10***	-2.673e-10***
	(3.143e-11)	(3.154e-10)	(4.220e-11)	(4.205e-11)
Constant	9.435e-01***	3.945e+00***	9.080e-01***	2.651e-02***
	(7.848e-03)	(1.539e-01)	(9.345e-03)	(9.033e-03)
Observations	1612	1612	1612	1612
Number of countries	134	134	134	134
R-squared	0.472	0.446	0.551	0.315
Turning point	27,656	27,682	27,870	21,062

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 42. Random effects regression, PPP

	(1)	(2)	(3)	(4)
SITC Rev. 1 5-digit	**Gini**	**Theil**	**PDI**	**med_balassa**
GDP per capita (PPP)	-1.603e-05***	-1.518e-04***	-2.208e-05***	1.444e-05***
	(1.316e-06)	(1.277e-05)	(1.525e-06)	(1.042e-06)
GDP per cap (PPP) squared	2.243e-10***	2.266e-09***	3.175e-10***	-1.655e-10***
	(2.815e-11)	(2.760e-10)	(3.365e-11)	(2.033e-11)
Constant	9.571e-01***	3.559e+00***	8.856e-01***	-8.175e-03
	(1.038e-02)	(1.277e-01)	(1.184e-02)	(1.084e-02)
Observations	2556	2556	2556	2556
Number of countries	139	139	139	139
R-squared	0.464	0.455	0.538	0.383
Turning point	35,733	33,495	34,772	43,625

Feenstra SITC Rev. 2 4-digit				
GDP per capita (PPP)	-1.515e-05***	-1.251e-04***	-1.952e-05***	2.137e-05***
	(1.007e-06)	(1.220e-05)	(1.324e-06)	(1.342e-06)
GDP per cap (PPP) squared	2.015e-10***	1.678e-09***	2.523e-10***	-2.429e-10***
	(1.582e-11)	(2.554e-10)	(2.445e-11)	(1.995e-11)
Constant	9.669e-01***	3.462e+00***	8.974e-01***	-5.048e-02***
	(9.409e-03)	(9.760e-02)	(1.034e-02)	(1.195e-02)
Observations	2444	2444	2444	2444
R-squared	0.527	0.565	0.616	0.425
Number of countries	134	134	134	134
Turning point	37,593	37,277	38,684	43,989
HS 1988/92 6-digit				
GDP per capita (PPP)	-9.168e-06***	-1.683e-04***	-2.045e-05***	8.255e-06***
	(8.694e-07)	(1.044e-05)	(1.066e-06)	(1.062e-06)
GDP per cap (PPP) squared	1.394e-10***	2.598e-09***	3.007e-10***	-1.655e-10***
	(1.841e-11)	(2.031e-10)	(2.318e-11)	(2.766e-11)
Constant	9.562e-01***	4.309e+00***	9.401e-01***	1.746e-02**
	(7.907e-03)	(1.549e-01)	(9.557e-03)	(7.855e-03)
Observations	1610	1610	1610	1610
Number of countries	133	133	133	133
R-squared	0.467	0.554	0.576	0.241
Turning point	32,884	32,390	34,004	24,940

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 43. Fixed effects regression

	(1) **Theil**	(2) **PDI**
SITC Rev. 1 5-digit		
GDP per capita	-2.339e-04***	-3.338e-05***
	(1.386e-05)	(1.518e-06)
GDP per capita squared	4.628e-09***	6.260e-10***
	(3.611e-10)	(3.953e-11)
Constant	3.549e+00***	8.789e-01***
	(5.320e-02)	(5.660e-03)
Observations	3862	3862
R-squared	142	142
Number of countries	0.410	0.543
Turning point	25,270	26,661
SITC Rev. 1 5-digit excl. outliers		
GDP per capita	-2.501e-04***	-3.502e-05***
	(4.381e-05)	(5.775e-06)
GDP per capita squared	5.155e-09***	6.751e-10***
	(1.017e-09)	(1.515e-10)
Constant	3.592e+00***	8.833e-01***
	(1.656e-01)	(2.074e-02)
Observations	3859	3852
Number of countries	142	142
R-squared	0.416	0.545
Turning point	24,258	25,937
Feenstra SITC Rev. 2 4-digit		
GDP per capita	-1.422e-04***	-2.616e-05***
	(8.363e-06)	(1.219e-06)
GDP per capita squared	2.671e-09***	4.748e-10***
	(2.414e-10)	(3.339e-11)
Constant	3.181e+00***	8.716e-01***
	(2.493e-02)	(3.720e-03)
Observations	4047	4047
Number of countries	0.515	0.611
R-squared	136	136
Turning point	26,619	27,548

HS 1988/92 6-digit		
GDP per capita	-1.646e-04***	-2.751e-05***
	(1.365e-05)	(2.018e-06)
GDP per capita squared	2.956e-09***	4.920e-10***
	(2.979e-10)	(4.594e-11)
Constant	3.624e+00***	9.004e-01***
	(6.118e-02)	(9.053e-03)
Observations	1612	1612
Number of countries	0.446	0.551
R-squared	134	134
Turning point	27,842	27,957

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 44. Fixed effects regression, PPP

SITC Rev. 1 5-digit	**(1) Gini**	**(2) Theil**	**(3) PDI**	**(4) med_balassa**
GDP per capita (PPP)	-1.501e-05***	-1.215e-04***	-2.107e-05***	1.364e-05***
	(1.711e-06)	(1.510e-05)	(2.036e-06)	(1.166e-06)
GDP per cap (PPP) squared	2.077e-10***	1.768e-09***	2.999e-10***	-1.534e-10***
	(3.464e-11)	(3.113e-10)	(4.277e-11)	(2.086e-11)
Constant	9.410e-01***	3.206e+00***	8.684e-01***	3.770e-03
	(1.100e-02)	(9.411e-02)	(1.262e-02)	(8.653e-03)
Observations	2556	2556	2556	2556
R-squared	0.463	0.453	0.537	0.383
Number of countries	139	139	139	139
Turning point	36,134	34,361	35,128	44,459
Feenstra SITC Rev. 2 4-Digit				
GDP per capita (PPP)	-1.515e-05***	-1.251e-04***	-1.952e-05***	2.137e-05***
	(1.007e-06)	(1.220e-05)	(1.324e-06)	(1.342e-06)
GDP per cap (PPP) squared	2.015e-10***	1.678e-09***	2.523e-10***	-2.429e-10***
	(1.582e-11)	(2.554e-10)	(2.445e-11)	(1.995e-11)
Constant	9.669e-01***	3.462e+00***	8.974e-01***	-5.048e-02***
	(9.409e-03)	(9.760e-02)	(1.034e-02)	(1.195e-02)
Observations	2444	2444	2444	2444
Number of countries	134	134	134	134
R-squared	0.527	0.565	0.616	0.425
Turning point	37,593	37,277	38,684	43,989
HS 1988/92 6-digit				
GDP per capita (PPP)	-9.538e-06***	-1.646e-04***	-2.751e-05***	5.555e-06**
	(1.627e-06)	(1.365e-05)	(2.018e-06)	(2.237e-06)
GDP per cap (PPP) squared	1.747e-10***	2.956e-09***	4.920e-10***	-1.731e-10***
	(3.403e-11)	(2.979e-10)	(4.594e-11)	(4.149e-11)
Constant	9.196e-01***	3.624e+00***	9.004e-01***	6.430e-02***
	(7.593e-03)	(6.118e-02)	(9.053e-03)	(1.143e-02)
Observations	1612	1612	1612	1612
R-squared	0.472	0.446	0.551	0.106
Number of countries	134	134	134	134
Turning point	27,298	27,842	27,957	16,046

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 45. Between effects regression

SITC Rev. 1 5-digit	**(2) Theil**	**(3) PDI**
GDP per capita	-3.525e-04***	-3.892e-05***
	(4.378e-05)	(4.339e-06)
GDP per capita squared	9.424e-09***	9.633e-10***
	(1.724e-09)	(1.708e-10)
Constant	3.771e+00***	8.762e-01***
	(1.271e-01)	(1.260e-02)
Observations	3862	3862
R-squared	0.390	0.521
Number of countries	142	142
Turning point	18,702	20,201

Feenstra SITC Rev. 2 4-digit		
GDP per capita	-3.351e-04***	-4.186e-05***
	(3.501e-05)	(4.158e-06)
GDP per capita squared	9.198e-09***	1.093e-09***
	(1.481e-09)	(1.760e-10)
Constant	3.603e+00***	9.006e-01***
	(9.807e-02)	(1.165e-02)
Observations	4047	4047
Number of countries	136	136
R-squared	0.510	0.600
Turning point	18,216	19,149
HS 1988/92 6-digit		
GDP per capita	-3.040e-04***	-2.661e-05***
	(4.581e-05)	(3.666e-06)
GDP per capita squared	6.785e-09***	5.035e-10***
	(1.564e-09)	(1.251e-10)
Constant	4.236e+00***	9.046e-01***
	(1.626e-01)	(1.301e-02)
Observations	1612	1612
R-squared	0.452	0.552
Number of countries	134	134
Turning point	22,402	26,425

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 46. Between effects regression, PPP

SITC Rev. 1 5-digit	(1) Gini	(2) Theil	(3) PDI	(4) med_balassa
GDP per capita (PPP)	-2.384e-05***	-2.991e-04***	-3.165e-05***	1.908e-05***
	(3.083e-06)	(3.005e-05)	(3.255e-06)	(4.061e-06)
GDP per cap (PPP) squared	4.353e-10***	6.351e-09***	6.053e-10***	-2.484e-10**
	(9.420e-11)	(9.181e-10)	(9.944e-11)	(1.241e-10)
Constant	9.889e-01***	4.147e+00***	9.197e-01***	-3.451e-02*
	(1.499e-02)	(1.461e-01)	(1.583e-02)	(1.975e-02)
Observations	2556	2556	2556	2556
R-squared	0.458	0.451	0.530	0.383
Number of countries	139	139	139	139
Turning point	27,383	23,547	26,144	38,406
Feenstra SITC Rev. 2 4-digit				
GDP per capita (PPP)	-2.609e-05***	-2.864e-04***	-3.401e-05***	2.286e-05***
	(3.133e-06)	(2.613e-05)	(3.241e-06)	(4.353e-06)
GDP per cap (PPP) squared	5.226e-10***	6.139e-09***	6.866e-10***	-3.600e-10**
	(1.027e-10)	(8.568e-10)	(1.062e-10)	(1.427e-10)
Constant	1.007e+00***	4.097e+00***	9.492e-01***	-4.461e-02**
	(1.420e-02)	(1.184e-01)	(1.469e-02)	(1.973e-02)
Observations	2444	2444	2444	2444
R-squared	0.532	0.576	0.625	0.425
Number of countries	134	134	134	134
Turning point	24,962	23,326	24,767	31,750
HS 1988/92 6-digit				
GDP per capita (PPP)	-1.466e-05***	-3.199e-04***	-2.366e-05***	7.912e-06**
	(2.695e-06)	(3.642e-05)	(3.175e-06)	(3.488e-06)
GDP per cap (PPP) squared	2.103e-10***	6.371e-09***	3.858e-10***	5.577e-13
	(7.864e-11)	(1.063e-09)	(9.268e-11)	(1.018e-10)
Constant	9.951e-01***	5.005e+00***	9.538e-01***	-1.402e-02
	(1.374e-02)	(1.856e-01)	(1.619e-02)	(1.778e-02)
Observations	1610	1610	1610	1610
Number of countries	133	133	133	133
R-squared	0.469	0.558	0.572	0.331
Turning point	34,855	25,106	30,664	

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Appendix Table 47. Pooled regression

SITC Rev. 1 5-digit	(1) Theil	(2) PDI
GDP per capita	-2.726e-04***	-3.249e-05***
	(5.820e-06)	(7.263e-07)
GDP per capita squared	6.048e-09***	6.575e-10***
	(1.997e-10)	(2.652e-11)
Constant	3.638e+00***	8.701e-01***
	(3.266e-02)	(2.438e-03)
Observations	3862	3862
R-squared	0.414	0.544
Turning point	22,536	24,707
Feenstra SITC Rev. 2 4-digit		
GDP per capita	-2.742e-04***	-3.530e-05***
	(6.554e-06)	(7.684e-07)
GDP per capita squared	6.416e-09***	7.691e-10***
	(2.861e-10)	(3.103e-11)
Constant	3.548e+00***	8.942e-01***
	(2.285e-02)	(1.856e-03)
Observations	4047	4047
R-squared	0.526	0.619
Turning point	21,368	22,949
HS 1988/92 6-digit		
GDP per capita	-2.691e-04***	-2.678e-05***
	(9.061e-06)	(1.105e-06)
GDP per capita squared	5.688e-09***	5.013e-10***
	(2.771e-10)	(3.735e-11)
Constant	3.981e+00***	8.938e-01***
	(4.972e-02)	(3.463e-03)
Observations	1612	1612
R-squared	0.454	0.552
Turning point	23,655	26,711

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 48. Pooled regression, PPP

SITC Rev. 1 5-digit	(1) Gini	(2) Theil	(3) PDI	(4) med_balassa
GDP per capita (PPP)	-2.038e-05***	-2.190e-04***	-2.615e-05***	1.858e-05***
	(7.639e-07)	(7.845e-06)	(7.554e-07)	(1.353e-06)
GDP per cap (PPP) squared	3.204e-10***	4.025e-09***	4.289e-10***	-2.170e-10***
	(2.379e-11)	(2.340e-10)	(2.299e-11)	(4.379e-11)
Constant	9.724e-01***	3.731e+00***	8.933e-01***	-3.394e-02***
	(3.099e-03)	(4.786e-02)	(3.581e-03)	(4.657e-03)
Observations	2556	2556	2556	2556
R-squared	0.466	0.468	0.541	0.383
Turning point	31,804	27,205	30,485	42,811
Feenstra SITC Rev. 2 4-digit				
GDP per capita (PPP)	-2.263e-05***	-2.423e-04***	-2.958e-05***	2.100e-05***
	(7.510e-07)	(1.232e-05)	(9.857e-07)	(1.224e-06)
GDP per cap (PPP) squared	3.971e-10***	4.546e-09***	5.242e-10***	-2.892e-10***
	(2.496e-11)	(4.371e-10)	(3.385e-11)	(4.152e-11)
Constant	9.978e-01***	3.996e+00***	9.368e-01***	-3.915e-02***
	(2.434e-03)	(4.455e-02)	(3.291e-03)	(3.278e-03)
Observations	2444	2444	2444	2444
R-squared	0.539	0.589	0.634	0.427
Turning point	28,494	26,650	28,214	36,307
HS 1988/92 6-digit				
GDP per capita (PPP)	-1.355e-05***	-2.643e-04***	-2.160e-05***	8.418e-06***
	(1.001e-06)	(9.006e-06)	(1.026e-06)	(1.515e-06)
GDP per cap (PPP) squared	1.663e-10***	4.821e-09***	3.086e-10***	-5.565e-12
	(3.197e-11)	(2.439e-10)	(3.144e-11)	(4.904e-11)
Constant	9.871e-01***	4.644e+00***	9.395e-01***	-1.359e-02**
	(3.840e-03)	(5.889e-02)	(4.231e-03)	(5.589e-03)
Observations	1610	1610	1610	1610
R-squared	0.471	0.564	0.576	0.331
Turning point	40,740	27,411	34,997	756,334

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Appendix Table 49. Quantile regression

SITC Rev. 1 5-digit	(1) Gini	(2) Theil	(3) PDI	(4) med_balassa
GDP per capita	-2.086e-05***	-1.551e-04***	-3.201e-05***	1.257e-05***
	(5.881e-07)	(9.916e-06)	(1.166e-06)	(5.859e-08)
GDP per capita squared	3.544e-10***	2.910e-09***	6.012e-10***	-2.012e-10***
	(1.420e-11)	(2.396e-10)	(2.815e-11)	(1.414e-12)
Constant	6.093e-04	-5.408e-02***	3.157e-04	-2.542e-04***
	(5.733e-04)	(9.640e-03)	(1.134e-03)	(5.705e-05)
Observations	3862	3862	3862	3862
Turning point	29,430	26,649	26,622	31,238
Feenstra SITC Rev. 2 4-digit				
GDP per capita	-1.911e-05***	-1.206e-04***	-2.547e-05***	8.796e-06***
	(2.765e-07)	(5.912e-06)	(5.586e-07)	(3.060e-08)
GDP per capita squared	3.226e-10***	2.314e-09***	4.699e-10***	-1.314e-10***
	(6.512e-12)	(1.390e-10)	(1.313e-11)	(7.198e-13)
Constant	1.238e-03***	8.563e-04	1.625e-03***	-1.239e-04***
	(2.555e-04)	(5.445e-03)	(5.144e-04)	(2.825e-05)
Observations	4047	4047	4047	4047
Turning point	29,619	26,059	27,102	33,470
HS 1988/92 6-digit				
GDP per capita	1.117e-06***	6.503e-05***	1.246e-06***	5.751e-06***
	(1.267e-07)	(1.293e-05)	(3.795e-07)	(1.508e-06)
GDP per capita squared	1.231e-11***	-2.960e-10	-7.476e-12	-4.053e-11
	(2.675e-12)	(2.734e-10)	(8.012e-12)	(3.183e-11)
Constant	2.937e-05	-8.767e-03	-6.901e-04***	-1.949e-03***
	(5.582e-05)	(5.714e-03)	(1.673e-04)	(6.644e-04)
Observations	1612	1612	1612	1612
Turning point				

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 50. Quantile regression, PPP

SITC Rev. 1 5-digit	(1) Gini	(2) Theil	(3) PDI	(4) med_balassa
GDP per capita (PPP)	-1.020e-05***	-1.185e-04***	-1.875e-05***	4.136e-06***
	(9.570e-07)	(1.152e-05)	(1.483e-06)	(5.769e-08)
GDP per cap (PPP) squared	1.285e-10***	1.831e-09***	2.753e-10***	-4.873e-11***
	(1.719e-11)	(2.071e-10)	(2.663e-11)	(1.013e-12)
Constant	-9.985e-03***	-2.131e-01***	-1.940e-02***	2.348e-04***
	(8.691e-04)	(1.048e-02)	(1.347e-03)	(5.427e-05)
Observations	2556	2556	2556	2556
Turning point	39,689	32,359	34,054	42,438
Feenstra SITC Rev. 2 4-digit				
GDP per capita (PPP)	-1.166e-05***	-1.019e-04***	-1.688e-05***	2.141e-06***
	(6.642e-07)	(8.215e-06)	(1.322e-06)	(2.266e-08)
GDP per cap (PPP) squared	1.592e-10***	1.474e-09***	1.910e-10***	2.697e-11***
	(1.126e-11)	(1.411e-10)	(2.267e-11)	(3.884e-13)
Constant	-2.651e-03***	-6.806e-02***	-7.282e-03***	4.740e-05***
	(5.102e-04)	(6.284e-03)	(1.009e-03)	(1.726e-05)
Observations	2444	2444	2444	2444
Turning point	36,621	34,566	44,188	
HS 1988/92 6-digit				
GDP per capita (PPP)	3.208e-07***	2.821e-05***	6.572e-07***	3.736e-06***
	(9.331e-08)	(9.432e-06)	(2.536e-07)	(1.098e-06)
GDP per cap (PPP) squared	1.643e-11***	1.715e-10	7.213e-13	-1.463e-11
	(1.780e-12)	(1.802e-10)	(4.835e-12)	(2.092e-11)
Constant	2.110e-05	-8.641e-03	-6.993e-04***	-2.020e-03***
	(5.946e-05)	(6.031e-03)	(1.616e-04)	(7.039e-04)
Observations	1610	1610	1610	1610
Turning point				

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

B.3. Bayesian Model Averaging – detailed results

Appendix Table 51. SITC 5-digit, pooled regression, absolute specialization

45 models were selected
Best 5 models (cumulative posterior probability = 0.36):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	9.90E-01	1.85E-02	9.77E-01	1.01E+00	1.01E+00	9.76E-01	9.85E-01
gdppc	100	-5.64E-06	9.33E-07	-6.02E-06	-5.52E-06	-5.73E-06	-5.83E-06	-5.14E-06
gdppc_sq	100	1.15E-10	2.21E-11	1.20E-10	1.10E-10	1.14E-10	1.17E-10	1.09E-10
sophistication	100	-7.17E-06	8.22E-07	-7.23E-06	-7.06E-06	-7.10E-06	-7.20E-06	-7.45E-06
oil_share	100	6.26E-02	8.75E-03	6.34E-02	6.45E-02	6.58E-02	6.20E-02	6.24E-02
agval	100	8.97E-04	1.82E-04	9.65E-04	8.81E-04	8.65E-04	9.86E-04	8.74E-04
cen_lat	100	7.25E-04	1.39E-04	7.07E-04	7.37E-04	7.27E-04	7.15E-04	7.39E-04
island	100	1.87E-02	5.29E-03	1.66E-02	2.00E-02	2.05E-02	1.60E-02	2.02E-02
Europe and Central Asia	100	-2.71E-02	7.20E-03	-2.84E-02	-2.44E-02	-2.51E-02	-2.79E-02	-2.83E-02
Latin America and Caribbean	100	1.61E-02	4.19E-03	1.40E-02	1.91E-02	1.80E-02	1.47E-02	1.45E-02
aglandsh	98.3	-2.18E-04	7.57E-05	-2.13E-04	-2.09E-04	-2.17E-04	-2.05E-04	-2.57E-04
expgdp	97.3	2.55E-04	9.32E-05	1.99E-04	3.03E-04	2.34E-04	2.62E-04	2.35E-04
pop	78	-4.21E-11	2.33E-11	-5.70E-11	-5.23E-11	-5.33E-11	-5.64E-11	-5.23E-11
syr	75.6	5.11E-03	3.67E-03	6.02E-03	7.36E-03	7.49E-03	5.81E-03	
FDI_inflow	45.8	-4.97E-04	6.33E-04		-1.12E-03		-1.04E-03	
life_exp	39	-2.12E-04	3.06E-04		-5.63E-04	-5.28E-04		
labfor	22	-2.30E-11	4.39E-11					
opec	10.3	1.16E-03	4.09E-03					
dom_credit_priv	10	-8.65E-06	3.11E-05					
agri_rawmat_exp	6.9	9.92E-06	4.51E-05					
South Asia	1.6	8.89E-05	9.51E-04					
Middle East and North Africa	1.2	-8.62E-05	1.05E-03					
landl	1	4.70E-05	5.88E-04					
cap_stock	0.9	-8.37E-18	1.14E-16					
manval	0.7	-1.35E-06	2.61E-05					
urbpop	0.7	7.69E-07	1.37E-05					
polity2	0.7	1.71E-06	2.90E-05					
Turning point		2.45E+04						
nVar				13	15	14	14	12
r2				0.83	0.837	0.833	0.833	0.826
BIC				-3.85E+02	-3.85E+02	-3.84E+02	-3.84E+02	-3.84E+02
post prob				0.089	0.075	0.07	0.064	0.058

Appendix Table 52. SITC 5-digit, pooled regression, relative specialization

80 models were selected
Best 5 models (cumulative posterior probability = 0.20):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	1.07E+00	3.51E-02	1.07E+00	1.08E+00	1.07E+00	1.10E+00	1.11E+00
gdppc	100	-2.22E-05	3.24E-06	-2.32E-05	-2.24E-05	-2.35E-05	-2.21E-05	-2.29E-05
gdppc_sq	100	5.17E-10	8.10E-11	5.22E-10	5.11E-10	5.28E-10	5.58E-10	5.81E-10
sophistication	100	-2.48E-05	3.13E-06	-2.42E-05	-2.51E-05	-2.47E-05	-2.48E-05	-2.73E-05
manuf_exp	100	-1.57E-03	2.99E-04	-1.72E-03	-1.86E-03	-1.70E-03	-1.47E-03	-1.23E-03
South Asia	88.4	6.39E-02	3.29E-02	7.50E-02	7.45E-02	6.14E-02	5.24E-02	
syr	80.4	1.88E-02	1.21E-02	2.07E-02	2.16E-02	2.22E-02	2.79E-02	3.08E-02
expgdp	75.1	5.86E-04	4.10E-04	7.08E-04	7.33E-04	7.14E-04		
cen_lat	72.7	1.01E-03	7.70E-04	1.12E-03	1.09E-03	1.15E-03		
pop	66.2	-9.66E-11	7.24E-11	-1.55E-10	-1.48E-10		-1.44E-10	
oil_share	47.5	3.25E-02	3.97E-02	6.46E-02		6.16E-02		

labfor	33.8	-9.48E-11	1.36E-10			-2.94E-10		-2.61E-10
opec	23.6	1.40E-02	2.85E-02					
island	22.5	9.82E-03	2.03E-02					
cap_stock	22	-1.57E-15	3.21E-15				-7.24E-15	-7.69E-15
Latin America and Caribbean	19.7	9.97E-03	2.14E-02					
Sub-Saharan Africa	19.2	9.71E-03	2.13E-02					
aglandsh	18	-1.06E-04	2.51E-04					
Europe and Central Asia	11.7	-5.61E-03	1.76E-02					
FDI_inflow	10.8	-3.24E-04	1.08E-03					
mobile_phone	0.8	-4.60E-06	5.90E-05					
landl	0.5	-8.44E-05	1.50E-03					
dom_credit_priv	0.4	-1.00E-06	1.91E-05					
life_exp	0.4	-9.42E-06	1.51E-04					
Turning point		2.14E+04						
nVar				10	9	10	8	7
r2				0.835	0.83	0.834	0.827	0.823
BIC				-4.09E+02	-4.08E+02	-4.08E+02	-4.08E+02	-4.08E+02
post prob				0.062	0.039	0.037	0.032	0.031

Appendix Table 53. SITC 5-digit, fixed effects regression, absolute specialization

40 models were selected
Best 5 models (cumulative posterior probability = 0.35):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	9.11E-08	5.00E-04	6.67E-08	6.50E-08	6.39E-08	6.78E-08	6.86E-08
oil_share (within)	100	3.43E-02	7.64E-03	3.62E-02	3.36E-02	3.58E-02	3.39E-02	3.71E-02
mobile_phone (within)	100	2.69E-04	5.48E-05	2.56E-04	2.77E-04	2.79E-04	2.37E-04	2.68E-04
expgdp (within)	99.4	-3.12E-04	1.02E-04	-3.30E-04	-3.45E-04	-3.14E-04	-2.65E-04	-3.79E-04
dom_credit_priv (within)	95.4	-1.26E-04	5.00E-05	-1.28E-04	-1.37E-04	-1.28E-04	-1.14E-04	-1.23E-04
telephone (within)	94.8	-5.59E-04	2.26E-04	-6.23E-04	-5.22E-04	-5.42E-04	-7.34E-04	-6.35E-04
labfor (within)	94.7	-3.89E-10	1.06E-10	-4.17E-10	-4.06E-10	-3.99E-10	-4.23E-10	-4.28E-10
aglandsh (within)	36.2	-2.21E-04	3.34E-04	-6.34E-04			-6.85E-04	
life_exp (within)	34.7	-1.79E-04	2.84E-04		-5.36E-04			
syr (within)	25.1	-1.29E-03	2.54E-03					
manval (within)	24.3	-1.09E-04	2.24E-04				-4.80E-04	
urbpop (within)	12.7	-4.75E-05	1.39E-04			-3.90E-04		
polity2 (within)	6.1	-1.58E-05	7.41E-05					
pop (within)	5.3	-1.08E-11	4.60E-11					
manuf_exp (within)	1.5	-1.99E-06	1.92E-05					
inflation_deflator (within)	0.8	2.34E-08	3.37E-07					
sophistication (within)	0.6	-4.46E-09	7.92E-08					
nVar				7	7	7	8	6
r2				0.516	0.516	0.515	0.525	0.504
BIC				-1.45E+02	-1.45E+02	-1.45E+02	-1.44E+02	-1.44E+02
post prob				0.087	0.078	0.066	0.061	0.06

Appendix Table 54. SITC 5-digit, fixed effects regression, relative specialization

53 models were selected
Best 5 models (cumulative posterior probability = 0.27):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	4.67E-07	1.85E-03	1.88E-07	1.89E-07	-1.50E-06	1.88E-06	-1.33E-06
expgdp (within)	100	-1.43E-03	3.72E-04	-1.53E-03	-1.40E-03	-1.44E-03	-1.44E-03	-1.56E-03
labfor (within)	100	-1.29E-09	6.58E-10	-1.10E-09	-1.11E-09	-2.47E-09	-9.49E-10	-2.31E-09
manuf_exp (within)	100	-1.33E-03	3.13E-04	-1.26E-03	-1.54E-03	-1.51E-03	-1.51E-03	-1.25E-03
telephone (within)	62.9	-1.14E-03	9.94E-04	-1.80E-03	-1.67E-03	-1.55E-03		-1.68E-03

cap_stock (within)	48.2	-6.90E-15	8.10E-15				-1.56E-14	
oil_share (within)	45.7	3.16E-02	3.98E-02	7.31E-02				6.71E-02
gdppc_sq (within)	44.6	1.56E-10	2.11E-10				4.31E-10	
gdppc (within)	34.1	-7.14E-06	1.06E-05				-2.10E-05	
pop (within)	21.7	1.46E-10	3.16E-10			7.17E-10		6.41E-10
manval (within)	14.2	-2.31E-04	6.46E-04					
urbpop (within)	13.8	-1.80E-04	5.12E-04					
polity2 (within)	7.6	-8.00E-05	3.22E-04					
dom_credit_priv (within)	3.7	-9.09E-06	5.50E-05					
mobile_phone (within)	3.5	1.31E-05	8.17E-05					
life_exp (within)	2.9	-4.59E-05	3.01E-04					
syr (within)	2.1	-3.79E-04	2.92E-03					
agri_rawmat_exp (within)	1.1	-6.31E-06	7.20E-05					
inflation_deflator (within)	0.9	1.08E-07	1.40E-06					
nVar				5	4	5	6	6
r2				0.562	0.551	0.56	0.569	0.569
BIC				-1.81E+02	-1.80E+02	-1.80E+02	-1.80E+02	-1.80E+02
post prob				0.086	0.06	0.045	0.04	0.04

Appendix Table 55. Feenstra 4-digit, pooled regression, absolute specialization

28 models were selected

Best 5 models (cumulative posterior probability = 0.48):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	1.02E+00	7.16E-03	1.02E+00	1.03E+00	1.03E+00	1.03E+00	1.02E+00
gdppc	100	-8.88E-06	9.57E-07	-8.80E-06	-8.70E-06	-8.58E-06	-8.49E-06	-9.73E-06
gdppc_sq	100	2.38E-10	3.02E-11	2.38E-10	2.42E-10	2.25E-10	2.28E-10	2.53E-10
cap_stock	100	-4.07E-15	9.80E-16	-4.01E-15	-4.37E-15	-3.78E-15	-4.09E-15	-4.06E-15
sophistication	100	-4.01E-06	9.92E-07	-3.96E-06	-4.18E-06	-3.86E-06	-4.05E-06	-3.73E-06
pop	100	-6.65E-11	2.58E-11	-6.02E-11	-5.90E-11	-5.74E-11	-5.63E-11	-6.15E-11
manuf_exp	100	-4.00E-04	7.19E-05	-3.93E-04	-4.06E-04	-3.78E-04	-3.89E-04	-4.17E-04
East Asia and Pacific	100	-2.79E-02	5.59E-03	-2.56E-02	-2.80E-02	-2.79E-02	-3.01E-02	-2.62E-02
Europe and Central Asia	100	-6.36E-02	7.55E-03	-6.36E-02	-6.42E-02	-6.24E-02	-6.29E-02	-6.34E-02
island	96.1	1.53E-02	5.82E-03	1.64E-02	1.54E-02	1.75E-02	1.66E-02	1.41E-02
oil_share	53.6	1.33E-02	1.42E-02	2.71E-02		2.35E-02		2.62E-02
opec	47.6	8.70E-03	1.05E-02		1.99E-02		1.73E-02	
aglandsh	31.3	-4.83E-05	8.41E-05			-1.51E-04	-1.54E-04	
syr	19.4	9.47E-04	2.27E-03					4.64E-03
labfor	13.1	1.59E-11	4.94E-11					
expgdp	10.9	1.68E-05	5.82E-05					
inflation_deflator	3.2	-2.06E-07	1.40E-06					
cen_lat	2.4	4.61E-06	3.85E-05					
Turning point		1.86E+04						
nVar				10	10	11	11	11
r2				0.88	0.88	0.882	0.882	0.882
BIC				-3.50E+02	-3.50E+02	-3.49E+02	-3.49E+02	-3.48E+02
post prob				0.154	0.115	0.082	0.067	0.061

Appendix Table 56. Feenstra 4-digit, pooled regression, relative specialization

28 models were selected

Best 5 models (cumulative posterior probability = 0.39):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	1.07E+00	2.13E-02	1.07E+00	1.06E+00	1.06E+00	1.07E+00	1.07E+00
gdppc	100	-2.95E-05	3.25E-06	-3.02E-05	-3.07E-05	-3.08E-05	-2.94E-05	-3.02E-05
gdppc_sq	100	7.54E-10	9.05E-11	7.61E-10	7.76E-10	7.83E-10	7.50E-10	7.64E-10

cap_stock	100	-1.39E-14	2.84E-15	-1.35E-14	-1.39E-14	-1.45E-14	-1.35E-14	-1.39E-14
sophistication	100	-1.05E-05	2.96E-06	-1.04E-05	-9.90E-06	-1.01E-05	-1.07E-05	-1.06E-05
manuf_exp	100	-1.48E-03	2.20E-04	-1.53E-03	-1.45E-03	-1.36E-03	-1.57E-03	-1.47E-03
island	100	5.45E-02	1.52E-02	5.04E-02	5.39E-02	5.61E-02	5.35E-02	5.16E-02
East Asia and Pacific	100	-8.40E-02	1.74E-02	-7.79E-02	-8.74E-02	-9.83E-02	-7.49E-02	-8.49E-02
Europe and Central Asia	100	-1.10E-01	2.24E-02	-1.11E-01	-1.13E-01	-1.16E-01	-1.07E-01	-1.13E-01
pop	98	-1.62E-10	1.24E-10	-1.00E-10	-1.01E-10	-3.35E-10	-9.40E-11	-2.84E-10
syr	79.6	1.64E-02	1.09E-02	2.12E-02	2.07E-02	1.89E-02	1.90E-02	1.99E-02
opec	33.5	1.44E-02	2.36E-02		3.90E-02	4.71E-02		
labfor	32.1	1.33E-10	2.46E-10			4.78E-10		3.75E-10
FDI_inflow	17	-7.71E-04	2.02E-03					
Middle East and North Africa	16.3	4.96E-03	1.33E-02				3.12E-02	
dom_credit_priv	9.7	2.75E-05	1.02E-04					
expgdp	5.5	2.22E-05	1.19E-04					
aglandsh	3.2	-1.04E-05	7.27E-05					
landl	2.6	-3.35E-04	2.84E-03					
mobile_phone	2.1	-2.42E-05	2.26E-04					
life_exp	1.9	2.41E-05	1.96E-04					
polity2	1.8	-1.42E-05	1.45E-04					
oil_share	0.8	-2.18E-04	3.69E-03					
urbpop	0.8	3.62E-06	4.73E-05					
Turning point		1.96E+04						
nVar				10	11	12	11	11
r2				0.876	0.878	0.881	0.878	0.878
BIC				-3.44E+02	-3.43E+02	-3.42E+02	-3.42E+02	-3.41E+02
post prob				0.133	0.081	0.067	0.065	0.044

Appendix Table 57. Feenstra 4-digit, fixed effects regression, absolute specialization

34 models were selected
Best 5 models (cumulative posterior probability = 0.40):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	-1.49E-06	4.85E-04	-1.78E-06	-1.61E-06	-1.51E-06	-1.63E-06	-3.39E-07
manuf_exp (within)	98.7	-3.21E-04	1.02E-04	-3.14E-04	-3.88E-04	-3.06E-04	-2.30E-04	-3.59E-04
oil_share (within)	98.3	3.13E-02	1.08E-02	3.03E-02	3.15E-02	3.52E-02	3.50E-02	3.44E-02
pop (within)	98.3	-1.31E-10	4.57E-11	-1.26E-10	-1.27E-10	-1.30E-10	-1.30E-10	-1.28E-10
dom_credit_priv (within)	98.3	-1.56E-04	5.24E-05	-1.65E-04	-1.36E-04	-1.24E-04	-1.43E-04	-1.71E-04
gdppc (within)	83.9	-6.16E-06	3.34E-06	-7.26E-06	-7.39E-06	-6.82E-06	-6.61E-06	
gdppc_sq (within)	83.9	1.23E-10	6.64E-11	1.54E-10	1.35E-10	1.24E-10	1.37E-10	
expgdp (within)	70.2	2.16E-04	1.72E-04	3.21E-04	2.55E-04			
syr (within)	67	-4.37E-03	3.71E-03	-6.88E-03			-5.44E-03	
cap_stock (within)	11.8	4.59E-16	1.50E-15					
mobile_phone (within)	7	2.35E-05	1.05E-04					
telephone (within)	6.1	-1.02E-05	9.98E-05					
labfor (within)	5.4	4.95E-12	6.34E-11					
urbpop (within)	4.3	-1.10E-05	6.79E-05					
FDI_inflow (within)	4	2.39E-05	1.56E-04					
aglandsh (within)	3.9	-1.43E-05	9.56E-05					
polity2 (within)	2.1	-2.63E-06	2.96E-05					
agval (within)	1.9	2.48E-06	3.61E-05					
nVar				8	7	6	7	4
r2				0.597	0.579	0.567	0.579	0.541
BIC				-1.26E+02	-1.23E+02	-1.23E+02	-1.23E+02	-1.22E+02
post prob				0.216	0.05	0.048	0.047	0.043

Appendix Table 58. Feenstra 4-digit, fixed effects regression, relative specialization

46 models were selected
Best 5 models (cumulative posterior probability = 0.32):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	-5.95E-06	1.24E-03	-6.00E-06	-6.10E-06	-6.47E-06	-6.08E-06	-6.13E-06
gdppc (within)	100	-2.93E-05	5.71E-06	-3.09E-05	-2.70E-05	-3.11E-05	-3.12E-05	-3.18E-05
gdppc_sq (within)	100	5.88E-10	1.05E-10	5.86E-10	5.97E-10	6.30E-10	5.85E-10	6.01E-10
cap_stock (within)	100	-2.25E-14	6.10E-15	-2.39E-14	-2.37E-14	-2.66E-14	-2.02E-14	-2.33E-14
manuf_exp (within)	100	-1.36E-03	2.17E-04	-1.47E-03	-1.45E-03	-1.30E-03	-1.37E-03	-1.47E-03
labfor (within)	36.6	-2.88E-10	5.74E-10				-3.10E-10	
life_exp (within)	30.7	5.54E-04	9.70E-04					2.09E-03
mobile_phone (within)	28.5	-3.20E-04	5.93E-04		-1.15E-03			
dom_credit_priv (within)	23.5	-5.60E-05	1.17E-04					
syr (within)	20.4	-2.58E-03	5.87E-03			-1.20E-02		
land (within)	16.2	1.16E-04	2.91E-04					
pop (within)	13.2	6.99E-11	2.16E-10					
urbpop (within)	11.8	-1.40E-04	4.39E-04					-1.34E-03
sophistication (within)	1.5	-2.91E-08	3.39E-07					
FDI_inflow (within)	1.5	-1.76E-05	2.07E-04					
Turning point		2.49E+04						
nVar				4	5	5	5	6
r2				0.619	0.627	0.626	0.625	0.636
BIC				-1.57E+02	-1.56E+02	-1.55E+02	-1.55E+02	-1.54E+02
post prob				0.121	0.067	0.055	0.042	0.039

Appendix Table 59. HS 6-digit, pooled regression, absolute specialization

41 models were selected
Best 5 models (cumulative posterior probability = 0.34):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	1.05E+00	1.81E-02	1.06E+00	1.05E+00	1.06E+00	1.05E+00	1.05E+00
gdppc	100	-6.69E-06	1.03E-06	-6.26E-06	-7.35E-06	-6.97E-06	-6.89E-06	-6.50E-06
gdppc_sq	100	1.57E-10	2.63E-11	1.47E-10	1.77E-10	1.66E-10	1.55E-10	1.54E-10
cap_stock	100	-3.12E-15	7.10E-16	-3.07E-15	-3.31E-15	-3.19E-15	-2.72E-15	-3.19E-15
sophistication	100	-3.49E-06	9.00E-07	-3.28E-06	-3.84E-06	-3.56E-06	-3.04E-06	-3.56E-06
labfor	100	-1.36E-10	1.41E-11	-1.37E-10	-1.32E-10	-1.33E-10	-1.44E-10	-1.38E-10
syr	100	9.83E-03	2.63E-03	1.03E-02	9.77E-03	9.56E-03	9.62E-03	1.08E-02
island	100	2.76E-02	5.88E-03	2.82E-02	2.60E-02	2.88E-02	3.11E-02	2.44E-02
Europe and Central Asia	100	-3.03E-02	6.95E-03	-2.78E-02	-3.20E-02	-3.02E-02	-3.32E-02	-2.93E-02
life_exp	91.8	-8.62E-04	3.91E-04	-9.02E-04	-8.74E-04	-1.01E-03	-9.25E-04	-6.93E-04
manuf_exp	86.9	-1.86E-04	1.02E-04	-1.90E-04	-2.28E-04	-1.81E-04	-2.08E-04	-2.52E-04
Latin America and Caribbean	86.1	1.39E-02	7.67E-03	1.62E-02	9.75E-03	1.32E-02	1.71E-02	1.28E-02
oil_share	63.9	1.79E-02	1.63E-02	2.61E-02		2.18E-02	2.94E-02	
urbpop	35.7	9.34E-05	1.47E-04		2.68E-04	2.14E-04		
Middle East and North Africa	13.6	1.70E-03	4.95E-03					
agri_rawmat_exp	13.2	3.06E-05	8.99E-05					
mobile_phone	11.8	1.75E-05	5.74E-05					
cen_lat	9	2.34E-05	8.68E-05				2.53E-04	
East Asia and Pacific	7.1	-6.48E-04	2.77E-03					
opec	5.2	6.07E-04	2.96E-03					
manval	4.6	-1.84E-05	1.04E-04					
agval	3.1	1.26E-05	8.14E-05					
FDI_inflow	2.7	-1.69E-05	1.25E-04					
South Asia	1	8.38E-05	1.05E-03					
land	0.6	6.59E-12	9.81E-11					
Turning point		2.13E+04						

nVar				12	12	13	13	11
r2				0.876	0.875	0.878	0.878	0.87
BIC				-2.97E+02	-2.96E+02	-2.96E+02	-2.95E+02	-2.95E+02
post prob				0.119	0.071	0.061	0.047	0.045

Appendix Table 60. HS 6-digit, pooled regression, relative specialization

36 models were selected
Best 5 models (cumulative posterior probability = 0.44):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	1.15E+00	7.03E-02	1.20E+00	1.05E+00	1.17E+00	1.19E+00	1.15E+00
gdppc	100	-1.95E-05	3.29E-06	-1.74E-05	-2.22E-05	-1.88E-05	-1.71E-05	-1.90E-05
gdppc_sq	100	4.66E-10	7.44E-11	4.35E-10	5.00E-10	4.54E-10	4.26E-10	4.50E-10
cap_stock	100	-1.26E-14	2.08E-15	-1.32E-14	-1.19E-14	-1.26E-14	-1.29E-14	-1.24E-14
sophistication	100	-1.05E-05	2.68E-06	-1.10E-05	-8.99E-06	-1.11E-05	-9.61E-06	-1.10E-05
labfor	100	-2.43E-10	4.32E-11	-2.22E-10	-2.55E-10	-2.44E-10	-2.35E-10	-2.60E-10
syr	100	2.69E-02	7.79E-03	2.89E-02	2.44E-02	3.06E-02	2.79E-02	2.91E-02
manuf_exp	100	-9.12E-04	1.96E-04	-8.53E-04	-1.02E-03	-9.16E-04	-9.93E-04	-8.65E-04
island	100	8.88E-02	1.76E-02	9.99E-02	7.10E-02	9.05E-02	9.66E-02	8.50E-02
life_exp	74.7	-1.99E-03	1.39E-03	-3.02E-03		-2.31E-03	-2.97E-03	-1.96E-03
Latin America and Caribbean	73.1	3.39E-02	2.51E-02	5.45E-02		4.19E-02	5.46E-02	3.57E-02
Europe and Central Asia	47.2	-2.37E-02	2.87E-02		-5.79E-02			-3.32E-02
Middle East and North Africa	41.7	1.93E-02	2.58E-02	4.64E-02			4.93E-02	
East Asia and Pacific	22.8	-8.82E-03	1.78E-02		-4.10E-02			
urbpop	20.1	1.29E-04	3.02E-04					
South Asia	13.4	4.13E-03	1.24E-02				2.94E-02	
FDI_inflow	8.6	-1.45E-04	5.98E-04					
oil_share	6.4	2.67E-03	1.29E-02					
cen_lat	5.2	4.31E-05	2.09E-04					
landl	2.8	-4.39E-04	3.27E-03					
agri_rawmat_exp	2	6.65E-06	6.50E-05					
opec	1.9	3.57E-04	3.65E-03					
Sub-Saharan Africa	1.2	2.96E-04	3.26E-03					
dom_credit_priv	0.8	1.22E-06	1.77E-05					
Turning point		2.09E+04						
nVar				11	10	10	12	11
r2				0.875	0.871	0.87	0.877	0.873
BIC				-3.01E+02	-3.00E+02	-2.99E+02	-2.99E+02	-2.98E+02
post prob				0.153	0.119	0.068	0.056	0.039

Appendix Table 61. HS 6-digit, fixed effects regression, absolute specialization

67 models were selected
Best 5 models (cumulative posterior probability = 0.23):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100	6.56E-07	4.29E-04	6.63E-07	4.07E-07	6.86E-07	6.55E-07	7.12E-07
life_exp (within)	100	-2.07E-03	3.07E-04	-2.21E-03	-2.09E-03	-2.11E-03	-2.08E-03	-2.15E-03
mobile_phone (within)	100	3.32E-04	9.45E-05	1.97E-04	3.70E-04	3.73E-04	3.74E-04	3.38E-04
pop (within)	92.8	-1.22E-10	1.04E-10	-9.55E-11	-9.22E-11	-1.05E-10	-1.00E-10	-1.08E-10
gdppc (within)	77.8	-3.89E-06	3.28E-06		-6.76E-06	-3.04E-06	-2.93E-06	-2.77E-06
manval (within)	74.6	-5.31E-04	3.95E-04	-8.89E-04	-6.43E-04			-5.53E-04
FDI_inflow (within)	71.1	9.65E-04	7.43E-04		1.43E-03	1.58E-03	1.34E-03	1.39E-03
manuf_exp (within)	56.5	-1.73E-04	1.79E-04		-3.04E-04	-4.34E-04	-3.09E-04	-3.74E-04
sophistication (within)	45.5	8.81E-07	1.11E-06		2.21E-06	1.74E-06		1.90E-06
gdppc_sq (within)	43.7	3.60E-11	4.67E-11		7.89E-11			
cap_stock (within)	26.5	7.26E-16	1.38E-15			3.06E-15	3.05E-15	2.71E-15

labfor (within)	22.9	6.90E-11	2.30E-10					
urbpop (within)	16.7	-9.89E-05	2.57E-04					
polity2 (within)	1.1	-3.06E-06	3.80E-05					
dom_credit_priv (within)	0.9	-3.92E-07	5.50E-06					
telephone (within)	0.8	-1.13E-06	1.83E-05					
nVar				4	9	8	7	9
r2				0.442	0.521	0.505	0.489	0.519
BIC				-7.49E+01	-7.42E+01	-7.39E+01	-7.37E+01	-7.35E+01
post prob				0.066	0.048	0.041	0.037	0.034

Appendix Table 62. HS 6-digit, fixed effects regression, relative specialization

36 models were selected
Best 5 models (cumulative posterior probability = 0.39):

	p!=0	**EV**	**SD**	**model 1**	**model 2**	**model 3**	**model 4**	**model 5**
Intercept	100	6.98E-07	1.07E-03	7.18E-07	6.70E-07	7.29E-07	6.80E-07	6.81E-07
manval (within)	100	-3.44E-03	6.74E-04	-3.65E-03	-3.42E-03	-3.78E-03	-3.16E-03	-3.55E-03
life_exp (within)	100	-4.12E-03	7.27E-04	-4.27E-03	-4.08E-03	-4.09E-03	-4.19E-03	-3.90E-03
telephone (within)	100	-1.64E-03	4.12E-04	-1.79E-03	-1.76E-03	-1.61E-03	-1.39E-03	-1.58E-03
labfor (within)	95.2	-5.93E-10	2.47E-10	-6.31E-10	-5.89E-10	-6.41E-10	-5.98E-10	-5.99E-10
polity2 (within)	38.1	-4.44E-04	6.67E-04		-1.17E-03			-1.17E-03
gdppc (within)	30.9	-9.24E-07	2.02E-06			-2.18E-06		-2.18E-06
FDI_inflow (within)	30.1	6.46E-04	1.16E-03					
manuf_exp (within)	27.1	-1.25E-04	2.41E-04				-4.16E-04	
gdppc_sq (within)	13.1	-1.96E-13	2.80E-11					
pop (within)	7.3	-3.40E-12	9.33E-11					
mobile_phone (within)	3.7	-4.07E-06	2.72E-05					
agri_rawmat_exp (within)	3.4	-1.47E-05	1.00E-04					
urbpop (within)	2.4	-1.83E-05	1.50E-04					
nVar				4	5	5	5	6
r2				0.563	0.574	0.572	0.572	0.584
BIC				-1.15E+02	-1.14E+02	-1.13E+02	-1.13E+02	-1.12E+02
post prob				0.134	0.095	0.06	0.056	0.045