

THE EXTENSIVE MARGIN AND REVEALED FACTOR ENDOWMENTS

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Abstract

Classical trade theory along the lines of Heckscher-Ohlin states that trade between countries is explained by comparative advantage, which results from a combination of cross-country differences in factor intensity and cross-country differences in factor abundance. Guided by classical trade theory, this paper investigates whether South Africa's export growth, particularly growth along the extensive margin, provides insight into its factor abundance. In order to address the objective of this paper, an extended version of the Baldwin (1971) commodity composition approach is employed. Instead of examining whether a country's export structure can be explained by its relative factor endowments, this paper examined whether changes in a country's export structure can be explained by its relative factor endowments. The analysis benefits from the use of highly disaggregated product level trade data at the 6-digit level and corresponding revealed factor intensity data at the product level developed by Shirotori, Tumurchudur & Cadot (2010). South Africa's overall export structure reveals it to be natural resource abundant. However, its changing export structure reveals it to be capital abundant, which is consistent with typical development patterns of a country moving away from labour-intensive production, toward capital-intensive production.

1. Introduction

Recent empirical research has highlighted the relative importance of the extensive margin as a channel of export growth, especially in the case of developing countries (Evenett & Venables, 2002; Bernard, Jensen, Redding & Schott, 2009; Zahler, 2011)¹. Focussing on South Africa, the analysis in Chapter 2 further substantiates the relative importance of the extensive margin. Approximately, 38.1 percent of South Africa's export growth has resulted from entry into new export markets over the period 1995 to 2012².

In addition, recent empirical research also reveals the importance of the extensive margin in driving changing export patterns (Hummels & Klenow, 2005; Cadot et al., 2012; Klinger & Lederman, 2012). A recent paper by Cadot et al (2012), which examines export diversification patterns along the economic development path, reignites the notion that endowments have a role to play in driving changing export patterns (and by implication adjustments along the extensive margin). Firstly, they find that the initial diversification at lower levels of economic development and the re-concentration at higher levels of economic development, which form the 'hump-shaped' export diversification pattern, is driven by changes along the extensive margin³. Secondly, they find evidence indicating that this movement along the economic development path – driven primarily by adjustment along the extensive margin – is akin to countries travelling across diversification cones as per Schott (2003; 2004). For instance, they show that as the export portfolios of developed countries start to re-concentrate, the products that are dropped tend to be less capital- and skill-intensive than the products that they continue to export, and are thus at odds with the endowments of these countries. As such, their research is suggesting that endowments play a role in shaping the evolution of countries' evolving export patterns.

Motivated by this recent study by Cadot et al (2012), the analysis in this paper focuses whether South Africa's evolving export pattern, measured by growth along the extensive margin, is consistent with its factor endowments. In order to interrogate this further, the analysis in this paper turns to standard international trade theory. Standard international trade theory, specifically the Heckscher-Ohlin model, emphasises the importance of endowments in explaining trade patterns. Therefore, this paper

¹ Although cross-country decomposition studies using product level trade data typically find the intensive margin to be greater in absolute magnitude than the extensive margin, the extensive margin remains relatively important and increasingly so as one examines export growth in developing countries (Evenett & Venables, 2002; Brenton & Newfarmer, 2009; Zahler, 2011). Furthermore, decomposition studies benefitting from the increased level of detail offered by firm level trade data are able to capture and thus show an increased absolute importance of the extensive margin as a source of export growth (BJRS, 2009).

² Although it is worth noting that total extensive margin (entry into less exit out of export markets) was reduced to 29.76 percent due to exit out of markets accounting for a 8.34 percent decline in export growth.

³ Although, it must be noted that changes in the export structure can occur via growth along the intensive margin (i.e. growth in established export relationships). This occurs when a subset of products grows disproportionately faster than another subset of products, and thus the share structure of exports adjusts accordingly. Cadot et al (2012) do find evidence that the intensive margin plays a role in driving changes in the export diversification patterns, but that the role is minor when compared to adjustments along the extensive margin.

is interested in discovering what export growth, particularly growth along the extensive margin, reveals about South Africa's factor abundance.

Given that this chapter is interested in whether endowments play a role in driving the extensive margin and hence evolving export patterns, it is important to contextualise this analysis from a theoretical standpoint. The notion that endowments drive trade patterns is an old trade theory hypothesis. Old trade theory models argue that countries specialise in the production and export of products in which they have a comparative advantage. For instance, the Heckscher-Ohlin model argues for endowment-driven comparative advantage.

However, the notion that endowments fully determine trade patterns across countries is limited. The inability of old trade theory models to explain two-way trade between similarly endowed countries within similar industries resulted in the development of new trade theory models, which emphasised economies of scale and consumer love of variety (Helpman, 1981; Krugman, 1980). By dropping the assumption of the representative firm, recent heterogeneous firm trade models, such as that by Melitz (2003), emphasise selection of heterogeneous firms into export markets. The selection of firms into export markets is determined by variation in firm productivity relative to the fixed and variable costs, and hence profitability, associated with entry into export markets.

Heterogeneous firm trade models allude to the importance of the extensive margin in driving export patterns. The productivity driven entry and exit of heterogeneous firms into and out of export markets is essentially variation along the extensive margin⁴. The theoretical literature on heterogeneous firm trade theory has covered a wide range of issues. However, this author has only found one study that makes predictions on whether endowments play a role in driving firm entry and exit into and out of export markets, and hence variation along the extensive margin. The Bernard, Redding & Schott (2007) model embeds a heterogeneous firm model into a model of comparative advantage, and is thus able to examine how country, industry and firm characteristics interact in general equilibrium in response to a fall in trade costs.

The Bernard, Redding & Schott (2007) model makes a number of theoretical propositions, one of which is of relevance to the research objective of this chapter. *Proposition 9* of the Bernard, Redding & Schott (2007) model states:

'The opening of costly trade leads to a larger increase in steady-state creative destruction of firms in comparative advantage industries than in comparative disadvantage industries'

The model predicts that in each period there is a mass of existing firms that die, a mass of entrants who draw a productivity level above the zero-profit productivity cut-off and produce, and a mass of entrants who draw a productivity level below the cut-off and exit. This mass of firms exiting and

⁴ Trade decomposition studies measuring the margins of export growth include the entry and exit of firms into their measure of the extensive margin (Eekt, 2007; BJRS, 2009).

entering an industry each period is termed steady-state creative destruction. The higher the zero-profit productivity cut-off, the greater the probability of a firm drawing a productivity level below this cut-off, and thus the greater the steady-state probability of firm failure. The model predicts that an opening of costly trade leads to a larger increase in the cut-off in comparative advantage industry, and thus the steady-state rate of creative destruction rises by more in comparative advantage industries⁵.

For the purposes of this chapter, this proposition is important for two reasons: Firstly, creative destruction involves the entry and exit of firms, which is synonymous with variation along the extensive margin at the firm level⁶. Secondly, the model predicts that the extent of creative destruction varies by industry according to comparative advantage. Based on these two reasons mentioned above, one is able to relate extensive margin growth – the entry and exit of firms within an industry – to the endowment-driven comparative advantage specific to that industry. Therefore, this chapter has a theoretical basis for exploring whether endowments play a role in driving export dynamics along the extensive margin.

In addition to the theoretical motivation for this chapter's research objective that is mentioned in the preceding paragraphs, there are a number of empirical motivations for this research. Firstly, this chapter extends the Baldwin (1971) commodity composition approach, which is used to examine whether endowments are driving changes in South Africa's export pattern. The commodity composition approach is a partial test of the Heckscher-Ohlin-Vanek (HOV) theorem that regresses a measure of trade for each industry on the factor requirements specific to each industry, and yields a coefficient that is indicative of the relative factor abundance of each factor. Typically, the commodity composition approach is used to examine whether a country's export pattern can be explained by its relative factor endowments and hence the approach is a static one (for example see Alleyne & Subramanian, 2001). This chapter extends the commodity composition approach by examining whether changes in a country's export pattern can be explained by its relative factor endowments, and hence the extended approach is a dynamic one.

Secondly, this chapter benefits from the use of highly disaggregated product level trade data and matching revealed factor intensity data⁷. The revealed factor intensities for each product are

⁵ Bernard, Redding & Schott (2007) also show that as a country specialises in line with its comparative advantage, it directs and increasing share of resources to this industry. Therefore, the steady-state mass of domestic firms active in the comparative advantage industry rises relative to comparative disadvantage industry. Furthermore, because the model predicts that the flow of entrants equals the flow of exiting firms, the steady-state mass of entrants in an industry is proportional to the mass of firms in the industry. Therefore, as resources are reallocated toward the comparative advantage industry and the mass of firms rises in that industry, the mass of entrants rises in the comparative-advantage industry and declines in the comparative-disadvantage industry. The model also indicates that as the economy opens to costly trade, the exporting cut-off falls and thus the probability of a firm exporting rises, the extent to which is greater in the comparative advantage industry. Therefore, entry into exporting should also rises to a greater extent in the comparative-advantage industry.

⁶ This is if one assumes that the steady-state rate of creative destruction, which is greater in the comparative advantage industry applies to all firms within that industry – both exporters and domestic producers.

⁷ This relatively underemployed dataset is found in UNCTADs Revealed Factor Intensity Database developed by Shirotori, Tumurchudur & Cadot (2010) - <http://www.unctad.info/en/Trade-Analysis-Branch/Data-And-Statistics/Other-Databases/>.

constructed by calculating a weighted average of the factor abundance of the countries that export this good, where the weights are variants of Balassa's Revealed Comparative Advantage index.

Furthermore, in order to test the predictions of the firm-level model by Bernard, Redding & Schott (2007), this chapter also uses firm level data from the World Bank's Exporter Dynamics Database⁸. Therefore, the analysis in this chapter can be extended from the standard industry-level analysis to a more detailed product-level and firm-level analysis.

Finally, the analysis of South Africa allows for the examination of a middle income country narrative. Given South Africa's middle income country status one may expect that the manner in which endowments drive its changing export pattern to be heterogeneous and thus vary across destination.

The research in this chapter is also motivated from a policy standpoint. A key industrial policy goal in South Africa is the diversification of its export base, which implies growth of exports along the extensive margin. Therefore, the extent to which endowments drives the extensive margin and hence changes in the export pattern, may inform supply-side orientated industrial policies.

In order to address the research question on whether changes in South Africa's export pattern (arising from adjustment at the extensive margin) is driven by endowments, this chapter is guided by the Bernard, Redding & Schott (2007) heterogeneous firm trade model. As mentioned earlier, this model predicts that adjustment at the extensive margin – creative destruction evidenced by the entry and exit of firms – is higher in comparative advantage industries and hence influenced by endowment-driven comparative advantage. The empirical analysis below tests this prediction by applying a commodity composition approach similar to that in Baldwin (1971). The commodity composition approach regresses a measure of trade (in this case the extensive margin) for each product on the factor requirements specific to each product, and yields a coefficient that is indicative of the relative factor abundance of each factor.

The analysis below is divided into three parts: Firstly, the commodity composition approach is applied in a static manner, and using measures of gross and net exports, is estimated separately for the initial and final years of the analysis period. The coefficients across these two periods are compared in order to provide an indication of how endowments relate to South Africa's export structure over time. Secondly, the commodity composition approach applied in a dynamic manner, and is run using measures of the extensive margin growth as the dependent variable. Due to problems arising from the use of value measures of extensive margin growth, this chapter motivates for the use of count data when measuring extensive margin growth. Thirdly, the dynamic application of the commodity composition approach is extended to the firm-level by using measures of gross firm entry and exit into export markets as the dependent variable. These estimations are also run separately for country

⁸ The Exporter Dynamics Database is accessed at the following link: <http://data.worldbank.org/data-catalog/exporter-dynamics-database>.

groups in order to interrogate the middle income country perspective. The regressions are estimated using Ordinary Least Squares as well as the Poisson Pseudo-Maximum Likelihood estimator.

The first two parts of the regression analysis employ product level trade data at the HS 6-digit level from UN Comtrade. The final part of the regression analysis uses firm-level data from the World Bank Exporter Dynamics Database. The independent variable measures of factor intensity at the product-level are extracted from the UNCTADs Revealed Factor Intensity Indices Database.

2. Literature review

3. Methodology

This section describes the methodology applied to test whether endowments play a role in shaping South Africa's evolving export pattern. The empirical approach, the motivations, and the structure of the approach are detailed below.

3.1. The Baldwin (1971) commodity composition approach

In order to test whether endowments play a role in driving export dynamics along the extensive margin, and hence whether they play a role in shaping South Africa's evolving export pattern, this chapter applies the Baldwin (1971) commodity composition approach⁹. By applying regression analysis to the commodity composition of trade, the commodity composition approach is used to test the Heckscher-Ohlin-Vanek model. The regression equation takes the following form:

$$T_i = \alpha_i + \beta_1\theta_{1i} + \beta_2\theta_{2i} + \dots + \beta_m\theta_{mi} + \mu_i, \quad i = 1, \dots, m, \quad (1)$$

where T_i represents a measure of net trade of commodity i , the θ 's represent measures of the gross factor input requirements or factor intensities associated with the production of commodity i , the β 's are the associated coefficients, and μ_i is the stochastic error term. The estimated coefficient for each explanatory variable that measures the factor intensity embodied in the production of each traded commodity are indicative of factor abundance. For instance, a positive coefficient for an explanatory variable measuring the capital per worker embodied in the production of a commodity suggests that the country is capital abundant.

3.2. Empirical considerations

Deardorff (1984) mentions a number of issues regarding the empirical application of the commodity composition approach. It is important to consider these issues and describe how they influence the empirical analysis in this paper.

The measurement of factor intensity

The first issue to consider relates to the explanatory variables and the measurement of factor intensity. Deardorff (1984) states that, ideally, the explanatory variables controlling for the intensity of each factor employed in the production of commodity i should represent factor shares and sum to unity (provided that all factors are considered). However, Deardorff (1984) mentions that a number of studies tend to use factor ratios, which are simply the value of the factor employed relative to labour (or population).

Due to the manner in which the Revealed Factor Intensity data has been constructed, this chapter uses factor ratios. The primary motivation for using the Revealed Factor Intensity data is due to it allowing for an extension of the commodity composition analysis beyond industry-level analysis to

⁹ Also see Deardorff (1984), Feenstra (2000) Alleyne & Subramanian (2001) for more information on the commodity composition approach.

product-level analysis. The employment of industry level data that enables the use of factor shares, is aggregated into approximately 45 Standard Industrial Classification (SIC) categories. Conversely, the Revealed Factor Intensity data provides factor ratio data at the HS 6-digit level, and thus allows for the analysis of approximately 5,000 product categories. Although the analysis is disadvantaged by specification of the explanatory variables, it gains from the level of detail offered by the product-level analysis.

The selection and scaling of the dependent variable

Deardorff (1984) identifies two empirical issues specific to the dependent variable: Firstly, the choice of trade measure, and secondly, the scaling of this measure.

In a review of studies testing trade theory, Deardorff (1984) mentions that there are a variety of specifications of the dependent variable in cross-commodity regression analysis. Gross imports, gross exports and net exports have all featured as specifications of the dependent variable. Typically, the dependent variable is specified in its value form but some studies have also specified the net exports measure in its sign form. In this chapter, initial estimations of the commodity composition regression, specify the dependent variable as the value of gross and net exports by HS6 product category. These estimations are run for the initial and final years of period of analysis in order to determine whether there has been a change in export structure.

However, this chapter is interested in export growth, particularly growth along the extensive margin, and thus applies an alternative measure for the dependent variable. This alternative measure shifts away from a value measure of all new export relationships, and shifts toward a count measure of all new export relationships over the period of analysis. This specification measures a count of all new export relationships by product category. There are two specifications that use count data as a measure for the dependent variable: Firstly, a count of all new (and dying) product-destination combinations by product category. Secondly, using the Exporter Dynamics Database, a count of all entering and exiting firms by product category is employed. Both these specifications capture export growth along the extensive margin and thus allow for determining whether changes in South Africa's export pattern along the extensive margin are being driven by endowments.

The use of count data is partly motivated by empirical difficulties relating to the scaling of the dependent variable, which is the second empirical issue specific to dependent variable. Leamer & Levinsohn (1995) note that simply using the absolute level of trade is problematic since some commodity (industry or product) groups form larger shares of total output and others smaller shares. If the scale of a commodity group is not controlled for, any explanatory variable that is correlated with the size of the commodity group will pick up the scale effect (Leamer & Levinsohn, 1995). This scale effect is typically controlled for by dividing the dependent variable by a measure of world market size (Deardorff, 1984; Leamer & Levinsohn, 1995).

3.3. Modified commodity composition approach

4. Data

5. Results

6. Conclusion

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