The rise of vertical specialization trade ☆

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A B S T R A C T

Manufacturing and vertical specialization (VS) trade, trade in goods that incorporate imported inputs, have grown rapidly since the 1960s. I argue that declining trade costs are an important explanation for these facts. I present a three stage vertical specialization trade model, with raw materials, manufactured parts and final goods sectors. In the simulated model, falling trade costs explain much of the observed growth in overall and VS trade. Manufacturing trade grows twice as fast as overall trade. Raw materials trade was more important in the 1960s when trade costs were high, since their production is more strongly linked to endowments than manufacturing. Therefore, materials will be traded even when trade costs are high. Trade costs have fallen more for manufactured goods over the last 40 years, leading to a rapid expansion of manufactured parts trade relative to materials.

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1. Introduction

Trade in manufactured goods has expanded rapidly in the last fifty years (Bergoeing et al., 2004). U.S. manufacturing export share of GDP grew by 140% between 1960 and 2006. The share of manufacturing output that is exported quadrupled during that period. This fact is puzzling given that manufacturing has not grown as a nominal share of output. Early on, when manufacturing was a large part of production, there was little trade in manufactured goods. Later, when manufacturing declined in importance, trade became dominated by these goods.

At the same time, vertical specialization (VS) trade, trade in goods incorporating imported inputs, has expanded rapidly (Feenstra, 1998; Hummels et al., 1998, 2001). VS trade share of U.S. exports grew from 6% in 1972 to 12% in 1997 (Chen et al., 2005). VS trade growth is not due to a large increase in the share of intermediate goods trade.[1] Chen et al. (2005) find that share of trade accounted for by intermediate goods has been nearly constant since 1972.

I argue that the rise of manufacturing and VS trade are related: Both are driven by falling costs of trading manufactured parts. Prior to the Kennedy Round, U.S. trade was dominated by raw materials.[2] Tariffs were high on manufactured goods, including parts. Materials faced high freight costs, since they have a low value to weight ratio. However, they were still imported because the ability to produce them is strongly linked to endowments. Materials cannot reliably be replaced domestically and were essential for production. Manufactured goods are easier to replace with domestic goods since they are less dependent on endowments.

The Kennedy Round focussed on reducing manufacturing tariffs and was notable both for the size and coverage of these cuts. Since then, trade policy has gone from being biased against manufactured goods to being more neutral. Since manufactured goods are more responsive to trade barriers, manufacturing trade has grown faster than materials trade. The share of trade in intermediate goods has been roughly constant, but intermediate goods trade is now dominated by manufactured inputs.

This paper presents a tractable general equilibrium model with Ricardian trade in intermediate goods. There are two countries with three layers of production: Raw materials are inputs to intermediate goods, which in turn are inputs to final consumption goods. All three types of goods may be traded, but incur an iceberg transportation cost and may face tariffs. I calibrate the model and run simulations using data on freight costs and tariffs.

The simulated model predicts nearly all of the empirical growth in trade and the change in trade composition from 1967 to 2002.

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[1] Intermediate goods are those used as inputs to further production. In terms of input–output tables, they are goods that are shipped to production sectors rather than final demand.

[2] The composition of intermediate goods trade is documented in detail below.

Manufacturing trade grows much faster than overall trade growth. While overall share of goods output that is traded more than doubles between 1967 and 2002 in the baseline simulation, manufacturing trade share triples. VS trade also grows rapidly, more than doubling from 1972 to 1997. Beginning with the Kennedy Round, manufactured goods tariffs fell more than non-manufactured goods tariffs. Lower trade costs on manufactured parts led to VS trade growth.

While VS trade grows rapidly, intermediate goods' share of trade does not increase. Intermediate goods trade shifts from being dominated by raw materials to manufactured parts. Raw materials production tends to depend on local geographical conditions in a way that manufacturing does not. Therefore, raw materials will be traded even when trade costs are high. Combined with the fact that trade costs for raw materials fell less, most trade expansion is due to manufactured parts.

Examining the impact of tariffs and transportation costs separately, falling tariffs have a stronger effect on the growth of both manufacturing and VS trade. Specifically, falling tariffs on manufactured parts lead to their offshoring while falling freight costs alone do not.

Other papers have studied the rise of manufacturing trade. Bergoeing and Kehoe (2003) find that a monopolistic competition model of trade cannot explain increasing manufacturing trade. Dalton (2009) examines the impact of Just-in-Time (JIT) inventories on the expansion of manufactured goods trade. His model is able to generate a level shift in manufacturing trade in the early 1980s when JIT is adopted, but does not generate the empirical pattern of trade expansion over the period considered in this paper.

The paper contributes to the historical measurement of the structure of trade protection. Examples include Anderson (1972) and Irwin (2007). It presents estimates of trade costs of goods by final and intermediate uses. Supplementary tables used in the calculation of the input–output (IO) tables provide estimates of trade costs by IO commodity. These supplementary tables can be combined with the IO tables to generate estimates of the structure of protection. U.S. foreign trade statistics do not provide detailed data on freight costs before 1974, so historical data are very thin (Hummels, 2007).

There is a large literature investigating postwar trade growth, including Rose (1991), Krugman (1995), Baier and Bergstrand (2001), Bergoeing and Kehoe (2003) and Alessandria and Choi (2010). Models incorporating VS trade, such as Yi (2003) and Bridgman (2008) have been successful at resolving the puzzle that tariffs have not fallen enough to generate the observed trade growth given estimates of the Armington elasticity (Armington, 1969), the aggregate elasticity of substitution between domestic and foreign goods. However, they have not emphasized the structure of trade expansion. While Bergoeing et al. (2004) speculate that a VS model could generate that change in composition, they do not pursue the issue.

A number of papers have examined the importance of intermediates trade for a number of issues including development (Jones, 2008; Goldberg et al., 2008; Estevadeordal and Taylor, 2008), firm

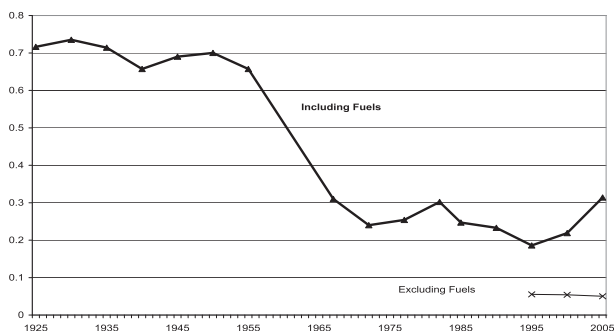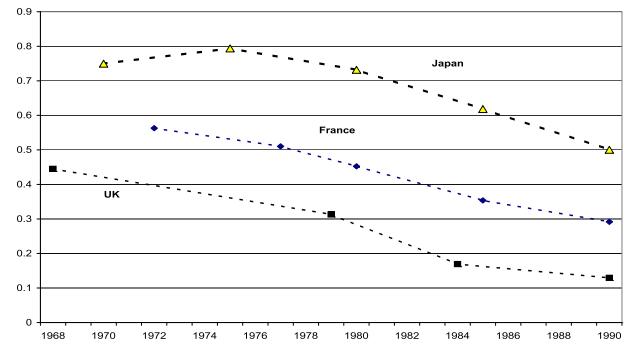Fig. 2. Materials share of intermediate goods imports.

productivity (Amiti and Konings, 2007), trade elasticities (Ramanarayanan, 2006), business cycle co-movement (Kose and Yi, 2001), and the border effect in gravity equations (Yi, 2010). Grossman and Rossi-Hansberg (2008a, 2008b) examine the growth of trade in intermediate services. A number of papers have used input–output tables to examine the factor content of trade, including Trefler and Zhu (2000) and Reimer (2006). Theoretical models of vertical specialization trade include Dixit and Grossman (1982) and Sanyal (1983). Unlike these papers, I examine the change in the composition of intermediates trade.

2. Intermediate goods trade and trade costs facts

This section documents the change in the composition of intermediates trade and the structure of trade costs for goods by use.

2.1. Composition of intermediate goods trade

Intermediate goods trade has shifted from being dominated by raw materials to manufactured parts. Fig. 1 shows the nominal share of materials (agricultural and mining products) of U.S. intermediate goods imports.[3] Imports are dominated by such raw materials early in the period. After the 1950s, the composition of imports began to shift significantly. Materials fell from over half of imported intermediate goods to less than a quarter in the 1990s.

These data likely underestimate the real decline in the importance of materials in intermediate goods trade. The data are reported in current dollars so they are vulnerable to swings in commodity prices, especially oil. The run-up in materials share in the 2000s is driven by oil prices: non-fuel materials share shows a slight decline during this period. (Data constraints do not allow removing fuels from the full time series.) The spike in 1982 is also likely driven by high oil prices.

The decline in the importance of raw materials is not restricted to the United States. Fig. 2 shows similar data for three major economies.[4] These data are reported in constant prices, so are not vulnerable to variations in commodity prices. (No such data exist for the United States.) All three show a decline in the importance of materials imports.

2.2. The structure of protection

I now turn to the structure of protection from tariffs and transportation costs for intermediate and final goods. I use input–output

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[3] Up to 1955, estimates are share of natural resource goods in non-final manufactured imports using data from Vanek (1963). From 1967 on, the estimates are the share of imported intermediate goods used by goods producing (agriculture, mining and manufacturing) industries that originate from materials (agriculture and mining) industries using IO tables. Sources and full details of the estimates are given in Appendix A.

[4] In the following Figure, the estimates are the share of imported intermediate goods used by goods producing industries that originate from materials industries using OECD constant currency input–output tables. See Appendix A for details.

Fig. 1. Materials share of U.S. intermediate goods imports, 1925–2005.