Determinants of vertical integration in export processing: Theory and evidence from China

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This paper examines the determinants of vertical integration versus outsourcing in export processing, by exploiting the coexistence of two export processing regimes in China, which designate by law who owns and controls the imported components. Based on a variant of the Antràs-Helpman (2004) model, we show theoretically control over imported components for assembly can affect firm integration decisions. Our empirical results show that when Chinese plants control the use of components, the export share of foreign-owned plants is positively correlated with the intensity of inputs provided by the headquarter (capital, skill, and R&D). These results are consistent with the property-rights theory of intra-firm trade. However, when foreign firms own and control the components, there is no evidence of a positive relationship between the intensity of headquarters’ inputs and the prevalence of vertical integration. The results are consistent with our model that considers control over imported components as an alternative to asset ownership to alleviate hold-up by export-processing plants.

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1. Introduction

Export processing, in which a final-good producer offshores the final stage of production to an assembly plant in a foreign country, has been an important part of developing nations’ economies. It employed over 63 million people in the developing world, and accounted for over half of total exports in countries such as China and Mexico in recent years (Bergin et al., 2009). Recent studies have shown how export processing and offshoring in general have important macroeconomic impacts on the host countries. In export processing, final-good producers are often confronted with the decisions of whether to source to or integrate with the foreign assembly plant, which in turn affects the macroeconomic effects of offshoring. This paper studies the prevalence of vertical integration versus outsourcing in export processing using detailed product-level trade data from China’s Customs.

We exploit the special regulatory regimes governing processing trade in China. These legal arrangements designate by law which party of a global production relationship has control rights over the imported materials, which are critical for export processing. Specifically, export processing in China has been governed under two regimes since the early 1980s, which are referred to as pure-assembly and import-assembly. The main difference between the two regimes lies in the allocation of control rights of the imported inputs. In the

“See Feenstra and Hanson (2005) for a detailed description of these two trade regimes in China.

For instance, Bergin et al. (2009, 2011) link offshoring activities to higher employment volatility in Mexico; and Sheng and Yang (2011) study how exporting processing activities contribute to increasing returns to skills in China after its accession to the WTO.
pure-assembly regime, a foreign firm supplies components to a Chines
assembly plant and retains ownership and control over the import
inputs throughout the production process. In the import-
assembly regime, a Chinese assembly plant imports components of
its own accord and retains control over their use. Based on a variant of
the Antràs-Helpman (2004) model that incorporates component-
purchase investments, we provide empirical evidence on how control
over imported inputs may serve as an alternative to asset ownership
to mitigate hold-up by foreign suppliers, which in turn shape the orga-
nizational choices of multinational production.4

While there is an extensive theoretical literature on the pattern of
intra-firm trade, empirical evidence is relatively scant and exclusive-
ly focuses on the developed world.2 This paper thus complements
the existing literature by providing evidence on the make-or-buy deci-
sions in processing trade in a developing country. In particular, our
results empirically examine existing theory on the relationship be-
tween industry characteristics and the relative prevalence of vertical
integration versus outsourcing (Antràs, 2003; Antràs and Helpman,
2004, 2008). Since this literature so far abstracted from the discuss-
ion of control rights of imported components, which are particularly
important for processing trade in developing countries, we extend
the Antràs-Helpman (2004) model to capture the policy features in
China. In the model, the final-good producer in the North invests in
headquarter services (e.g. marketing), while the assembly plant in
the South invests in assembly activities. Who invests in global com-
ponent purchase depends on the trade regime. In particular, the
final-good producer invests in component purchases under pure-
assembly, whereas the assembly plant invests in component purchas-
ues under import-assembly.

Our model, which features firm heterogeneity, predicts that ver-
tical integration and outsourcing in both import-assembly and
pure-assembly regimes can coexist in sectors where headquarter in-
vestments are important. In particular, our model predicts that the
most productive final-good producers in the North choose to inte-
grate with the assembly plant and own the imported materials
when offshoring assembly tasks to the South, whereas the least pro-
ductive final-good producers allocate both the ownership of the
plant’s asset and the control rights over imported materials to the as-
sembly plant. Based on this ranking of production modes, the model
yields a positive correlation between the export share of integrated
firms that operate under import-assembly and headquarter intensity
across sectors, consistent with the main prediction by Antràs (2003).
The cross-sector relationship between headquarter intensity and the
prevalence of integration under pure-assembly is ambiguous. The
reason for the ambiguity is that in a headquarter-intensive sector
where safeguarding the headquarter's investment incentives is
important, a foreign client can choose to either own and control
imported inputs or own the plant’s assets to alleviate hold-up. The ex-
port volume from integrated plants increases for both import-
assembly and pure-assembly when the headquarter intensity of the
sector rises. If the incremental gain from integration is sufficiently
smaller with input control than without, the export volume can
increase more for the former than the latter, resulting in a lower share
of integrated plants under pure-assembly in total processing trade.

We investigate empirically the implications of introducing controls
over input purchases on the prevalence of different global production
modes in processing trade. To this end, we use detailed firm- and
product-level trade data collected by the Customs General Administra-
tion of China for 2005. We find a positive and significant relationship
between the share of integrated plants’ exports from the import-
assembly regime and various measures of the intensity of headquarter
inputs (i.e., skill, R&D, and physical capital intensities). The results are
robust when we restrict the sample to include only Chinese exports to
the US and to different country groups based on income levels, as well
as when country fixed effects are controlled for. In sum, we find evi-
dence supporting our predictions and the property-rights theory of
intra-firm trade.

However, we find no evidence of a positive relationship between
the degree of headquarter intensity and integrated plants’ exports
from the pure-assembly regime, where the foreign firm retains own-
ership and control rights over the imported inputs. These results pro-
vide indirect support to our theoretical prediction that control over
the use of imported components serves as an alternative to asset own-
ership to mitigate hold-up by foreign assembly plants. It is worth not-
ing that this result should not be taken as a rejection of the existing
theory on intra-firm trade, but rather as a confirmation of its predic-
tions in a more complex setting.

Our paper relates to several strands of studies. First, our work is
most related to and to a large extent inspired by Feenstra and Hanson
(2005), who are the first to exploit the special regulatory ar-
rangements for processing trade in China to examine empirically the
prevalence of integration in processing trade. Similar to their work,
we also adopt the property-rights theory of the firm to rationalize
the determinants of integration. Different from theirs, we adopt the
general-equilibrium framework of Antràs (2003) and Antràs and
Helpman (2004, 2008) that pins down the relationship between indus-
yrty characteristics, productivity heterogeneity, and the prevalence
of vertical integration. By solving for the export share of each produc-
tion mode in Chinese export processing, our theoretical predictions
are largely consistent with their partial-equilibrium insights. Feenstra
and Hanson estimate their model structurally, by exploring the varia-
tion in market thickness and court efficiency across Chinese regions.6
We instead focus on the sectoral determinants of the prevalence of in-
tegration based on a more reduced-form but more general empirical
model.

Using data from assembly trade in a developing country, our paper
adds to the existing empirical literature on the determinants of arm’s-
length trade versus vertical integration in developed countries. Antràs
(2003), Yeaple (2006), Bernard et al. (2008), and Nunn and Trefler
(2011) are important precursors in this literature. They examine the
effects of headquarter inputs, productivity dispersion and contract-
ibility of inputs on intra-firm imports as a share of total imports in
the U.S. Bernard et al. (2008) use a new measure of product contract-
ibility based on the importance of intermediaries in international
trade. Nunn and Trefler (2011) explore the varying degree of relation-
ship specificity of different kinds of physical capital, and use new data
to take into account U.S. intra-firm imports that are shipped from for-

4 We take the property-rights approach to study the determinants of vertical inte-
geration. The determinants of multinational firm boundaries can be analyzed by other
theories of the firm. Existing research has applied the incentive-systems approach of
Holmstrom and Milgrom (1994), and the authority-delegation approach of Aghion
and Tirole (1997) to study the general equilibrium patterns of foreign integration
and outsourcing. For the incentive-systems approach, see Grossman and Helpman
(2004), among others. For the authority-delegation approach, see Marin and Verdier

5 Seminal work includes McLaren (2000), Antràs (2003, 2005), Grossman and Helpman
(2006) for a summary of the theoretical literature, and Hummels et al. (2001) for the
evidence of the tremendous growth of trade in intermediate inputs. More recent stud-
ies include Conconi et al. (2008) and Ornelas and Turner (2009), among others. See
Antràs (2011) for a survey of the literature.

6 There is also a literature that studies the spatial determinants of FDI, such as sup-
plier and market access. See, among others, Head and Mayer (2004) for evidence from
Europe and Amiti and Smarzynska Javorcik (2008) for evidence from China. Our anal-
ysis abstracts away from these spatial determinants.
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