

Intangible Assets and the Organization of Global Supply Chains

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Incomplete Contracts

Modern supply chains becoming more and more “global” in nature (suppliers located across different countries).

▶ **outsourcing** vs. **integration** decision

Central issue: **incomplete contracts** and **contract enforcement** (Antràs 2003, 2005; Antràs & Helpman 2004, 2008; Grossman & Helpman 2002, 2003, 2005).

Transaction cost theory → ***Better** contracting institutions increase incidences of **outsourcing** over integration.*

▶ Williamson (1971, 1975, 1985): better institutions reduce the cost associated with outsourcing.

Property right theory → ***Better** contracting institutions increase incidences of **integration** over outsourcing.*

▶ Grossman & Hart (1986); Hart & Moore (1990): better institutions reduce the need to create investment incentives through outsourcing.

Evidence → Property right theory

▶ Corcos et al. (2013), Eppinger & Kukharsky (2017), among others.

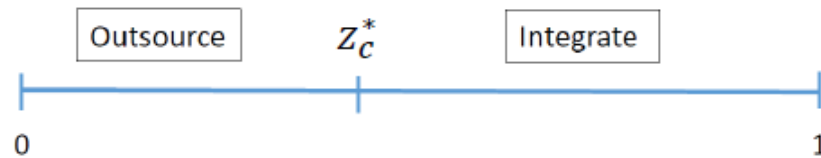
▶ Defever and Toubal (2013) provide some support for transaction cost results. A possible explanation?

Sequential Production

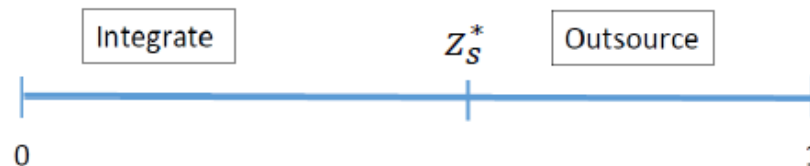
Position of and **inter-relation** between **stages** can affect organization of firms through **supplier incentive structure**.

Antràs and Chor (2013): sequential dimension of production under property rights approach

- ▶ **Sequential Complements** → *prior upstream investment increases marginal return of investment in subsequent stages*



- ▶ **Sequential Substitutes** → *reduce marginal revenue of further investment in subsequent stages*



Alfaro et al. (2015): **improved contractibility reduces reliance on outsourcing** to overcome distortions associated with inefficient investment upstream.

Motivations

- ▶ The focus of all existing works on contract enforcement and the “tangible” perception of property rights.
- ▶ Atalay et al. (2014): **vertical integration** used to promote efficient **intra-firm transfers of intangible inputs** (as opposed to smooth flow of physical inputs).
- ▶ This paper introduces the concept of **intangible assets** and the importance of their **appropriability** into the incomplete contract literature.
- ▶ Focus shifts from property rights to **Intellectual Property Rights (IPR)**, which on top of hold up problem between supplier and final producer entails additional **imitation risk** from competing firms in the market.
- ▶ Study how **IPR protection** may affect the optimal allocation of ownership rights along the value chain.
- ▶ Reaction to observable **IPRs** infers the presence of (dark matter) intangible assets.

Objectives

We build on **Antràs & Chor (2013)**, a property-right model of the supply chain with **sequential** production. Introduce **risk of imitation** that depends on the level of IPR protection enforced in the location of production.

Our mechanisms work in parallel to Antràs & Chor (2013) and Alfaro et al. (2015)

⇒ the firm's decision to integrate or to outsource a given stage in production depends on:

- ✓ the relative **position of that stage** within the production line;
- ✓ the **degree of sequential substitutability/complementarity** of supplier investments along the value chain.
- + possibility of **imitation** by competitors affects firm organization by **distorting the sequential supplier investment incentive structure under both integration and outsourcing**

Theoretical predictions are tested on firm-level data, using **trade, FDI**, and financial data on Slovenian **firms** and their **subsidiaries** to measure the propensity to integrate based on upstreamness and complementarity of inputs and the IPR regime in the host country.

The baseline model: suppliers behavior

Each supplier decides how much to invest in the compatible input by solving the following problem:

$$\max_{x(z)} (1 - \beta(z)) \cdot r'(x(z)) - c \cdot x(z)$$

Hence, integration allows the firm to extract more surplus, but...

...integrated suppliers will underinvest relatively more (due to the lower return to their investments).

Dynamic effect: Underinvestment by an integrated supplier affects the incentives for all suppliers performing more downstream stages in a way which depends on whether inputs are:

- ▶ **seq. complements** ($\rho > \alpha$) $\Rightarrow r'(z)$ is increasing in the amount of prior investments.
- ▶ **seq. substitutes** ($\rho < \alpha$) $\Rightarrow r'(z)$ is decreasing in the amount of prior investments.
- ▶ **import demand elasticity** determines ρ

Intangible assets and the risk of imitation

- ▶ Blueprint shared between the firm and a supplier can leak to competitors at given stage z under weak IPRs
- ▶ Imitation driven by Poisson process with arrival rate $\mu \in (0,1)$ (inverse of IPR) which is constant across stages

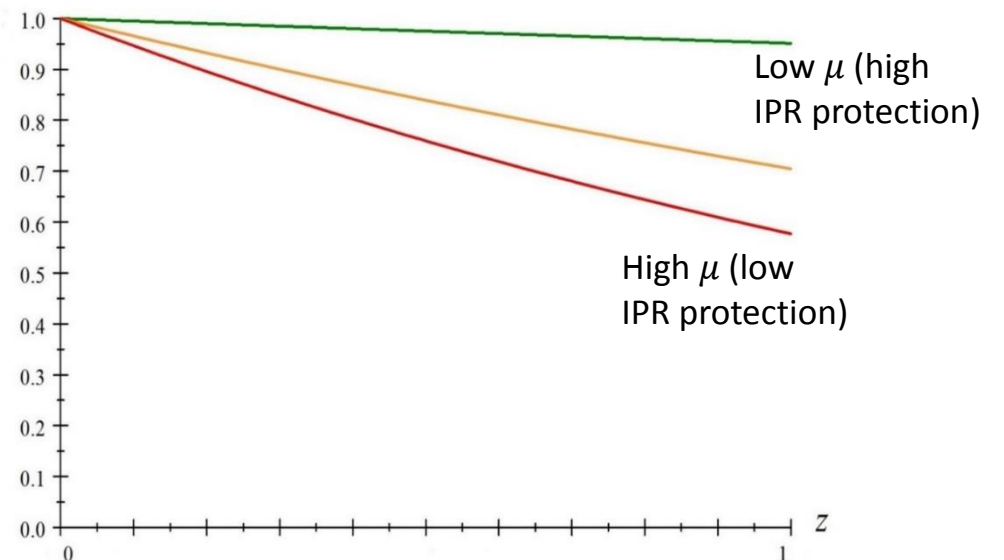
Supplier z delivers

- ✓ 0 if imitation has occurred at any stage $z' < z$ (this event has probability $1 - e^{-\mu z}$)
- ✓ $x(z)$ if imitation has not occurred at any stage $z' < z$ (this event has probability $e^{-\mu z}$)

At time 0 (when the firm has to decide on the optimal allocation of property rights along the supply chain), the expected value of production is

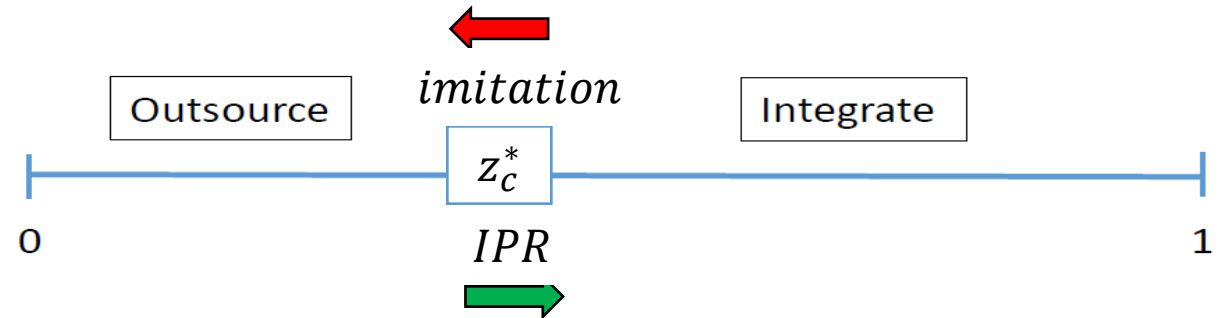
$$q = \theta \left(\int_0^1 [e^{-\mu z} x(z)]^\alpha dz \right)^{1/\alpha}$$

«Survival rate» at different stages of production



Model's predictions on the role of IPR (i)

In the **seq. complements** case ($\rho > \alpha$):



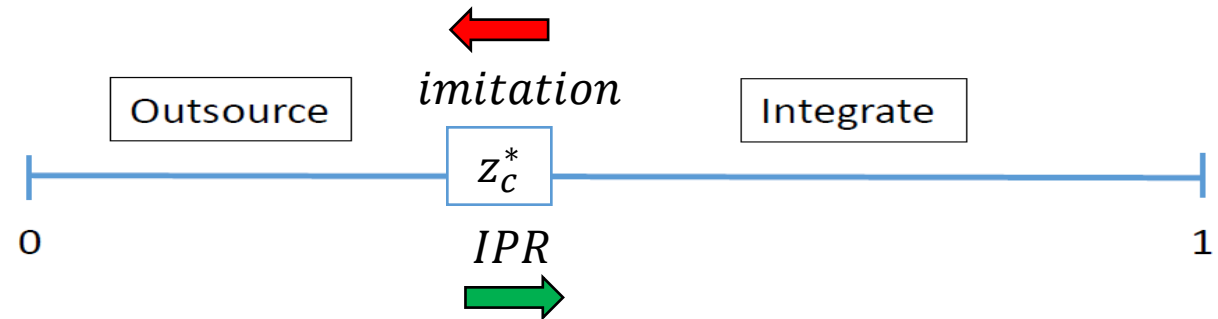
Lack of IPR shifts the cut-off stage z_c^* towards left

- ▶ Imitation reduces the attractiveness of outsourcing because it can no longer be used to create incentives for subsequent suppliers to make the adequate investment.
- ▶ As a result, final producers holds on to larger share and integrates at an earlier stage

Enforcing IPR restores the original cut-off, as it extends the range of stages that are outsourced.

Model's predictions on the role of IPR (i)

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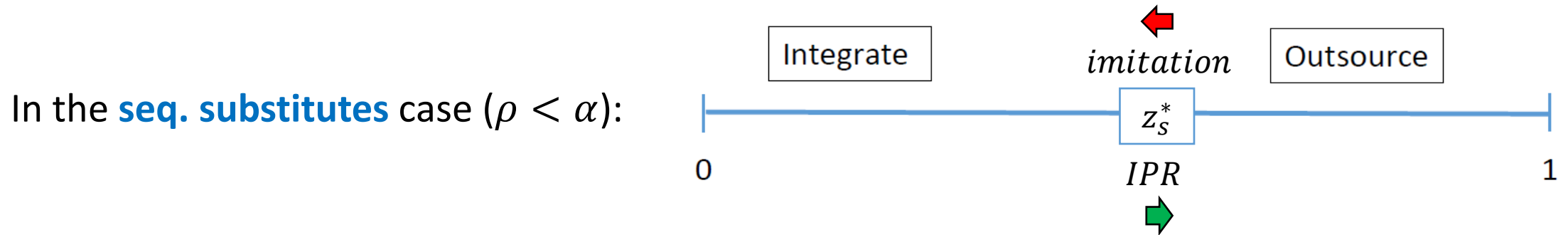


Testable prediction

Imitation risk increases likelihood of integration of the firm;
within a firm, this occurs for the more downstream stages not yet integrated.

- ▶ it is in those relatively downstream stages, where we expect to observe reduced incentives to integrate as a result of stronger IPR protection.

Model's predictions on the role of IPR (ii)



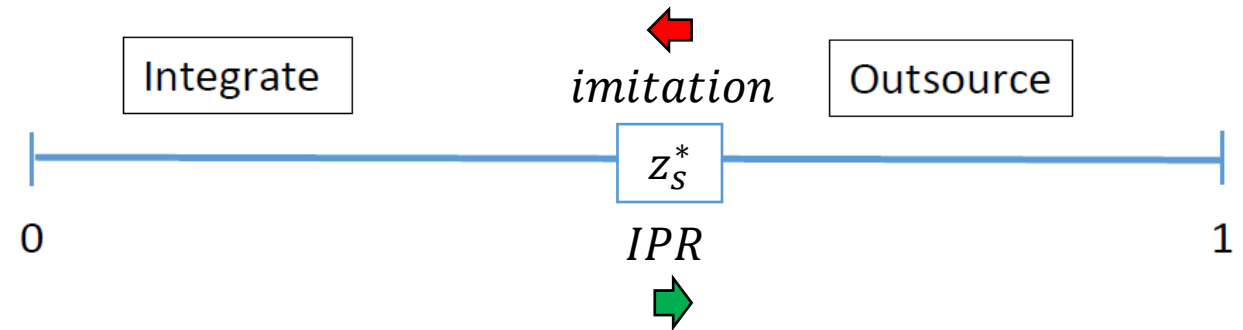
Lack of IPR shifts the cut-off stage z_S^* towards left:

- ▶ Imitation reduces the negative effect of outsourcing on follow-up investments (less likely to reach next stages), making firms anticipate the end of the chain and outsource at an earlier stage.
- ▶ The higher the input substitutability (α), the weaker the effect compared to complements.

Enforcing IPR restores the original cut-off, as it extends the range of stages that are integrated.

Model's predictions on the role of IPR (ii)

In the **seq. substitutes** case ($\rho < \alpha$):



Testable predictions

imitation risk increases likelihood of outsourcing of the firm;
 within a firm, this occurs for the more downstream stages not yet outsourced;
 however, the effect is less relevant compared to complements.

- ▶ Imitation reduces negative dynamic effect of outsourcing balancing it out with the static positive one, making the firm more indifferent between the organizational modes (less sensitive to IPRs)

Empirical strategy and data (i)

We test our results using **transaction-level trade data on Slovenian manufacturing firms** (2002-2009), matched with detailed information of origin/direction of inward/outward **FDI** and firm balance sheets:

- ✓ 6010 firms, imports from 171 countries, outward FDI with 37 partner countries

Slovenia:

2004 EU member, 2007 adopted the euro; **increasing** involvement in **GVC** (**WTO index: 58.7** in 2011), mostly strong **backward** participation (WTO, 2016)

- ✓ Exploit info on core activity of firm's affiliate (2007-2009)
- ✓ Inputs imported that are classified under core activity of affiliate at 4-digit industry level regarded as integrated (as in Alfaro et al., 2015)
- ✓ Accounts for firms being able to engage in both integration and outsourcing in a host country

Empirical strategy and data (ii)

Complementarity. Antràs & Chor (2013) approach → **Complements** ($d_{compl}=1$): above-median import demand elasticity for a firm's core export product; **Substitutes** ($d_{compl}=0$) otherwise.

Also a **(firm-level) proxy for α** the importance of which is derived from the theory.

Input classified within same industry → higher technological substitutability

Herfindahl index, how (6-digit) inputs are spread across different (3-digit) industries, above/below median

Upstreamness. Identify position of imported input in GVC w.r.t the firm's output (core export-product at 6-digit HS): average distance of each input h from the final demand of product k (as in Alfaro et al. 2015)

IPR Protection. the log of Park (2008) index of IPR enforcement in each host country

Baseline model regression

Baseline model specification:

$$\Pr(\text{dInteg}_{ijt} = 1) = \beta_0 + \beta_1 \text{Upstr}_{ijt-1} + \beta_2 d_IPR_{jt-1} + \beta_3 \text{Upstr}_{ijt-1} \times d_IPR_{jt-1} + \\ + \mathbf{X}'_{it} \boldsymbol{\beta}_4 + \sum \beta_{5.j} d\text{industry}_j + \sum \beta_{6.t} d\text{country}_t + \sum \beta_{7.t} d\text{year}_t + u_{it}$$

where subscripts i, j and t refer to firms, countries and years, respectively.

- ✓ Firm-specific controls (\mathbf{X}_{it}): age, size, capital intensity of production, labor productivity, export orientation and financial leverage (debt-to-assets ratio).
- ✓ Annual dummy variables to control for macroeconomic shocks.
- ✓ Partner-country dummies to account for country-specific time-invariant effects.
- ✓ Industry fixed effects (industry: core export product at 1-digit HS level).

Product level evidence

	Rho	Rho	Alpha	Alpha
	(1)	(2)	(3)	(4)
	<i>het probit</i>	<i>het probit</i>	<i>het probit</i>	<i>het probit</i>
	comp	subst	comp	subst
Upstr(-1)	-0.924*** (0.349)	-0.050 (0.214)	-0.665* (0.402)	-0.064 (0.773)
lnIPR	-2.298*** (0.521)	-0.303 (0.815)	-2.059*** (0.697)	-0.100 (1.335)
<i>lnIPRXUpstr(-1)</i>	0.606*** (0.233)	0.036 (0.145)	0.444* (0.233)	0.040 (0.509)
Observations	195029	272773	503183	45569

- ▶ Disaggregated at firm-year-product-country level
- ▶ Integration of a particular input from a country in a given year by a firm

Product level evidence

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Seq. complements:

outsource upstream, integrate downstream

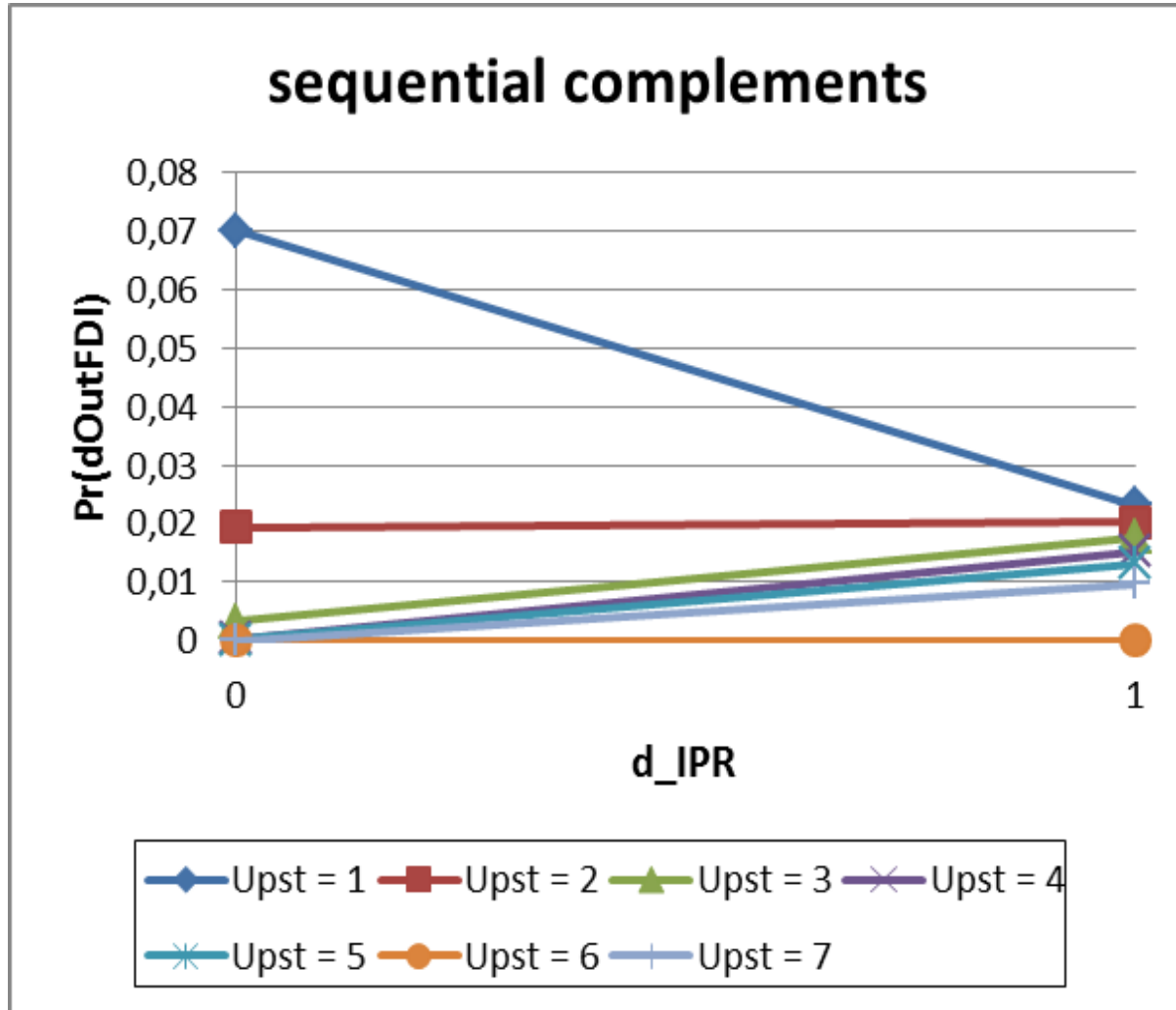
IPR protection decreases integration (**+outsource**)

not in upstream stages (**+downstream**)

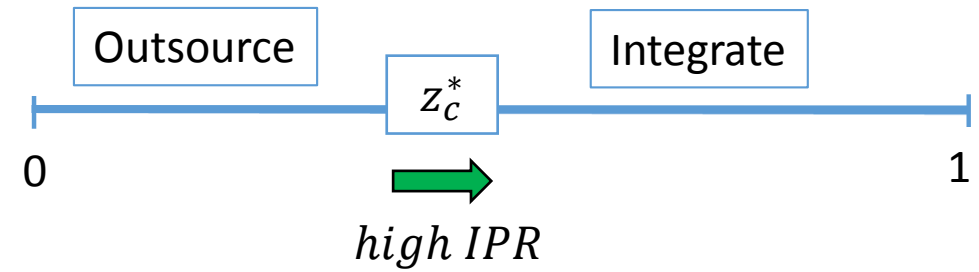
Share of integrated input imports (aggregated by country)

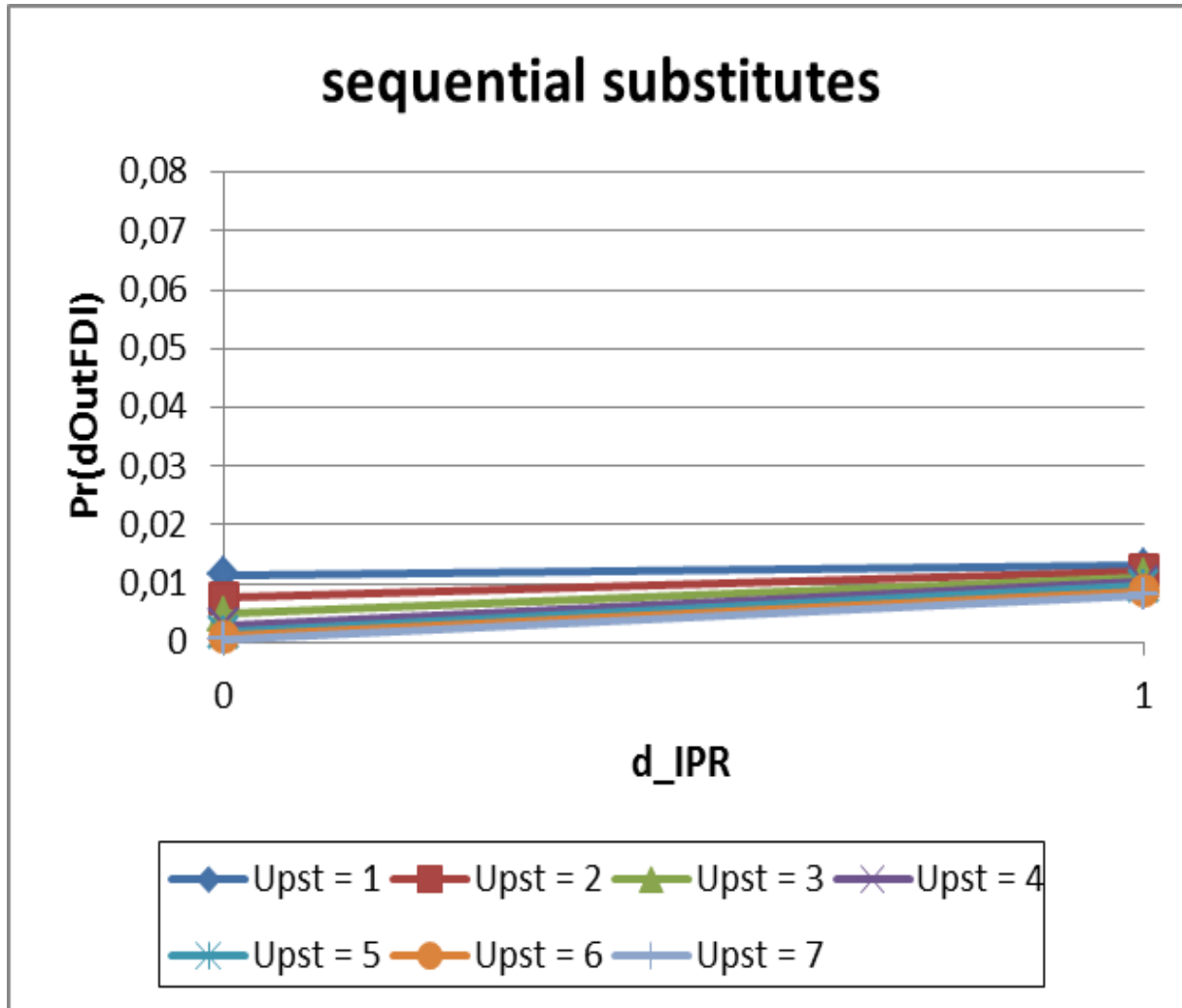
- ▶ share of firm's imports from partner country that are integrated

	Rho	Rho	Alpha	Alpha
	(1)	(2)	(3)	(4)
	<i>fractional</i>	<i>fractional</i>	<i>fractional</i>	<i>fractional</i>
	<i>logit</i>	<i>logit</i>	<i>logit</i>	<i>logit</i>
	complements	substitutes	complements	substitutes
Upstr(-1)	-6.179*	-3.636	-5.297**	-8.804
	(3.264)	(3.269)	(2.227)	(6.656)
IPR	-6.999	1.323	-4.487	-4.185
	(4.640)	(4.088)	(3.635)	(5.071)
<i>lnIPRXUpstr(-1)</i>	3.956*	2.265	3.387**	5.832
	(2.210)	(2.209)	(1.505)	(4.287)
Observations	16709	22973	37815	8156

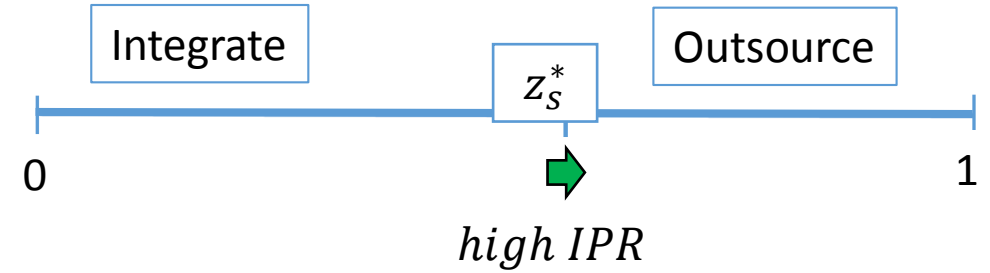


Predictive margins





Predictive margins



Robustness

- ▶ Final producer subsample
- ▶ Pure value chains
- ▶ Longer timespan (2002-2009)
- ▶ Exclusion of horizontal FDI(2002-2009)
- ▶ Controlling for unobserved heterogeneity: random-effects probit model, unit of observation firm-country pair

Concluding remarks

- The provides **novel results in the case of non-appropriability of intangible assets**:
 - Better institutions (in form of higher IPR protection) can **encourage** outsourcing, **as opposed to the contract enforcement** → **imitation** a relevant feature in the property rights theory
 - ▶ **Lack of IPR protection** induces firms to opt for **integration**
 - ▶ **Sound IPR regime** allows firms to use **outsourcing** to create supplier incentives.
 - IPRs relevant for sequential **complements** and relatively **downstream** stages.
- Not a not a model of prevention of dissipation, but of mitigation of its effect on profits
- The empirical findings reinforce the crucial role of IPRs for the organizational mode
→ **intangible assets are important in global supply chains!**