Imports, supply chains and productivity

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Motivation

- Large theoretical and empirical literature has explored how trade liberalization impacts on industry and firm productivity
- One well-explored mechanism is competition-induced reallocations of resources from the least productive to the most productive sectors (Melitz, 2003)
- Others include love of varieties (Krugman, 1979, 1980) and trade-induced innovations (Grossman and Helpman, 1991)

- Less well understood is the extent to which gains from trade filter through the supply chain
- Recent theoretical work highlights this channel as a potentially important 'missing' gain from trade (Melitz and Redding, 2014)

- Our paper explores empirically the extent to which there are productivity gains through this channel and disentangles some of the underlying mechanisms at work

What we do in this paper….

- Using firm-level panel data for Vietnam 2006-2011 we look at the impact of an expansion in imports on the productivity of domestic firms

- We add to the empirical literature in a number of ways:
  - Test whether imports lead to within-sector productivity gains
  - Test whether these productivity gains lead to forward spillovers through the supply chain for downstream domestic firms
  - Consider how the level of competition upstream might alter the effect of imports on downstream sectors
  - Examine the effect of imports on importing vs. non-importing firms
  - Explore some of the mechanisms underlying within-firm productivity gains

Preview of findings

- The most important channel through which imports impact on productivity is competition
- The main source of within-sector effects is reallocations of resources through firm exits and sector switching
- Competition induced gains from trade in upstream sectors spillover to downstream sectors through the supply chain
- These gains are not directly associated with importing intermediates

- Our results suggest that ignoring the gains from trade through the supply chain may significantly underestimate the impact of trade on the productivity of domestic firms

Description of mechanisms

Mechanism 1. Impact of expanded imports on domestic competitors – horizontal effects (Melitz, 2003; Bernard et al., 2003)

- Direct effect on domestic firms by increasing competition
- Inefficient firms must engage in efficiency improvements (reduce slack or use inputs more efficiently) in order to survive
- Firms might also engage in innovations or other investments to distinguish them from the competition (Grossman and Helpman, 1991)

- The reorganization of production will lead to the exit of the least efficient firms and may lead to some firms to switch sectors

Description of mechanisms

Mechanism 2. Love of varieties (Krugman, 1979, 1980; Helpman, 2011)

Impact on firms that import intermediates from upstream sectors:

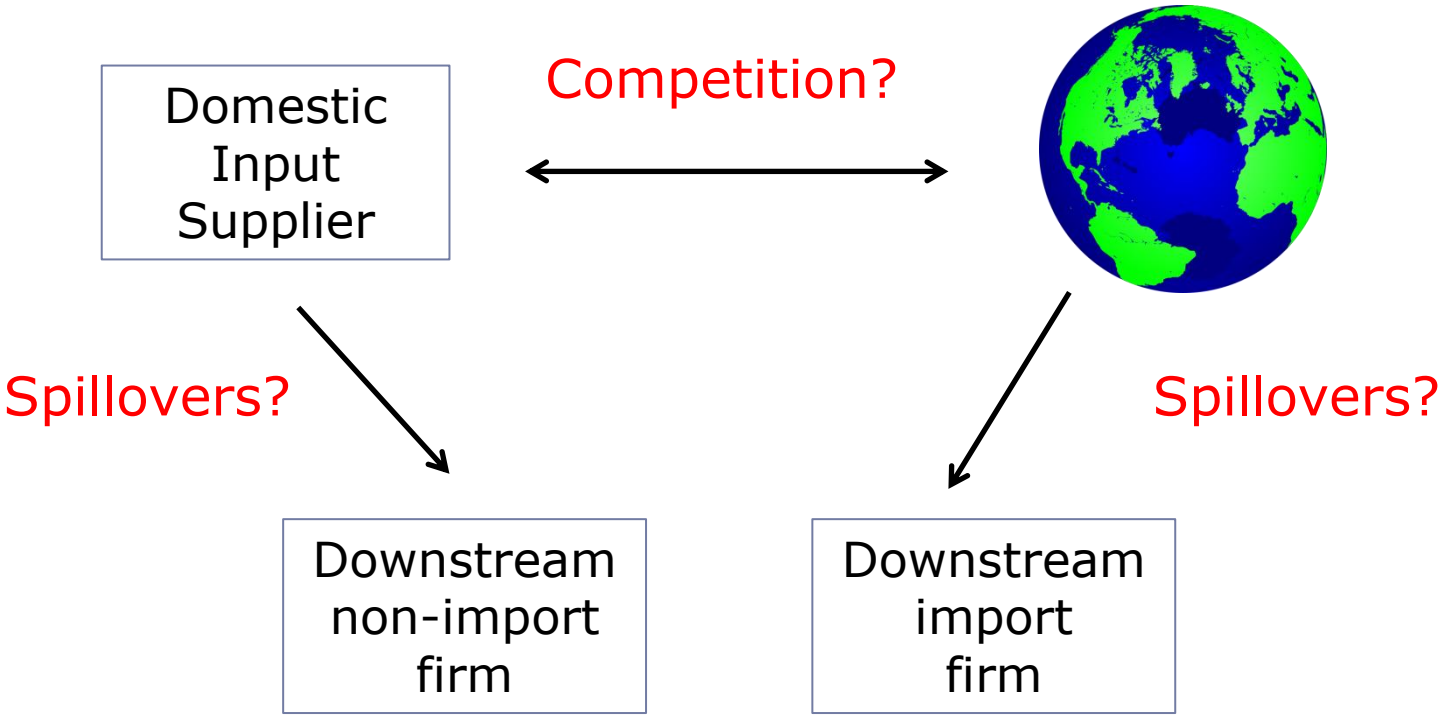
- Firms that import intermediates may experience physical productivity improvements
- More imported intermediates should lead to greater variety, better quality inputs, or inputs that embody new technologies

Description of mechanisms

Mechanism 3. Impact on firms that do not import intermediates from upstream sectors (Melitz and Redding, 2014):

- All downstream firms will benefit from a reorganization of production upstream
  - a reduction in the cost of inputs due to increased competition upstream
  - better quality or variety of domestic inputs due to innovations and investment

Description of mechanisms



Related Literature

- Large empirical literature linking trade to productivity improvements at the industry and firm level (see Melitz and Trefler, 2012, review paper)

- Strong support for reallocations driving productivity growth
  - Tybout et al. (1991) and Pavcnik (2002) for Chile; Eslava et al. (2004) and Fernandes (2007) for Columbia

- Some evidence supporting imported inputs as a channel for productivity growth
  - Kasahara and Rodrigue (2008) for Chile; Halpern et al. (2005) for Hungary; Goldberg et al. (2008) for India; Amiti and Konings (2007) for Indonesia
- Also contradicting evidence provided by:
  - Van Biesebroeck (2003) for Columbia and Muendler (2004) for Brazil.

- Limited work exploring additional supply chain effects

Empirical Approach

- One step approach to estimating productivity and capturing impact of imports on productivity.

- Model for within-sector productivity effects (Mechanism 1):

$$ln\,Y_{ijt} = \alpha_i + \beta_1\, ln\, L_{ijt} + \beta_2\, ln\, K_{ijt} + \delta_1\, ln\, imp_{jt} + \boldsymbol{\varphi}\mathbf{X}_{ijt} + \boldsymbol{\eta}\mathbf{Z}_{jt} + s_j + \tau_t + e_{ijt}$$

Fixed effects: firm i, 4-digit sector j, time (t)

Y value added, L labor inputs, K capital inputs

$lnimp$ the log level of imports into sector j

$\mathbf{X}$ firm specific time varying controls

$\mathbf{Z}$ sector specific time varying controls.

Identified through relationship between within-sector variation in imports and within-firm variation in productivity

Empirical Approach

- Endogeneity concerns:
  - Unobserved sector-specific factors that impact on both the level of imports into a sector and firm-level productivity
  - Control for firm, sector and time specific effects
  - One potential source of omitted variable bias remains – time-varying sector-specific shocks that impact on imports into a sector and firm level productivity

- Instruments for imports:
  - Three-year change in the level of imports into a sector in the SE Asian region (excluding Vietnam) over the three previous years (similar to Autor et al., 2013)
  - Weighted average of distance imports into 4-digit sector travel to get to Vietnam to proxy transport costs (CEPII GeoDist database; Mayor and Zignago, 2011)

Empirical Approach

- Model for estimating productivity effects through the supply chain (Mechanisms 2 and 3):

$$ln\,Y_{ijt} = \alpha_i + \beta_1\,ln\,L_{ijt} + \beta_2\,ln\,K_{ijt} + \delta_1\,ln\,imp_{jt} + \delta_2\,primpin_{ujt} +$$

$$+ \delta_3 impfirm_{ijt} + \delta_4\,primpin_{ujt} \times impfirm_{ijt} + \boldsymbol{\varphi}\mathbf{X}_{ijt} + \boldsymbol{\eta}\mathbf{Z}_{jt} + s_j + \tau_t + e_{ijt}$$

primpin is the proportion of inputs into sector j from upstream sectors u accounted for by imports

$$primpin_{ujt} = \sum_{u=1}^{J-1} \omega_{ut}\left(imp_{ut}/\left(out_{ut} + imp_{ut}\right)\right)$$

ω are weights which capture the proportion of total inputs into sector j that come from sector u

out is the domestically produced output in sector u and *imp* is the level of imports into sector u

Interaction term between *primpin* and *impfirm* allows differential effect of productivity impacts from imports through the supply chain for import vs. non-import firms to be determined

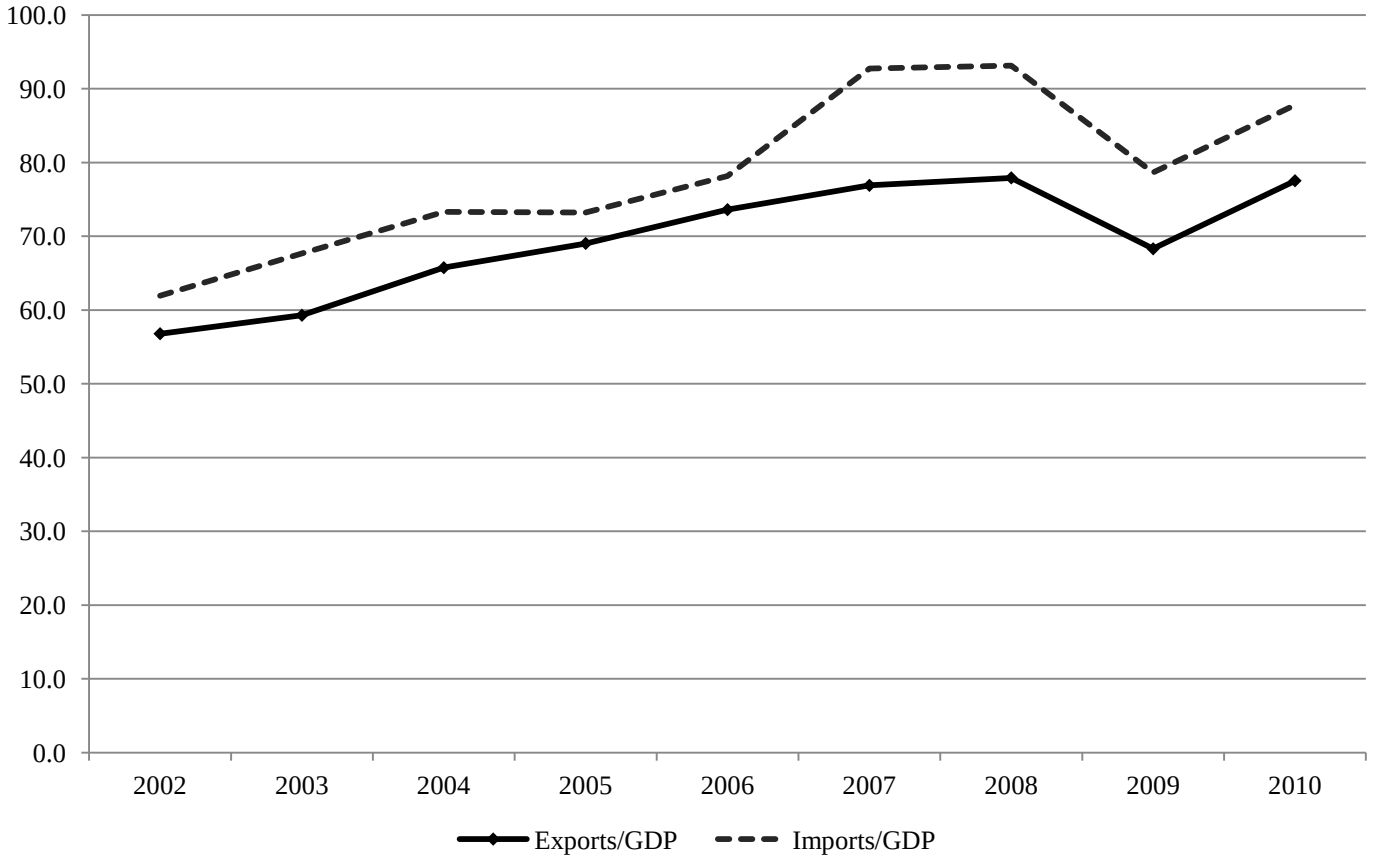
Vietnamese Context

- The opening up of the Vietnamese economy began in 1986 with the adoption of a range of policy measures under *doi moi* (renovation) in particular relating to trade liberalisation and the promotion of foreign direct investment (FDI)

- Trade liberalization took the form of the removal of export taxes and non-tariff barriers and the negotiation of various trade agreements with ASEAN, the US and the EU which ultimately lead to WTO accession in 2007

- Significant growth in exports and imports over 2000s:
  - Steady growth in both is evident throughout the 2000s but in particular post WTO accession in 2007

Trade in Vietnam



Source: General Statistics Office Vietnam, National Accounts

Data

- Vietnamese Enterprise Survey collected annually by the GSO for 2006 to 2011
- Data gathered on population of all registered enterprises in Vietnam with 30 employees or more and representative sample of smaller firms
- Unbalanced panel of 53,234 firms totaling 156,501 observations

- Export and import data at 4-digit level taken from COMTRADE

- Supply Use Tables for Vietnam in 2007 to measure input-output linkages along the supply chain

Measuring supply chain linkages

- Vietnam Supply-Use Tables (SUT) for 2007
- The SUT maps the use of 138 commodities in 112 production activities
- We link these production activities to the 4-digit ISIC codes used in the Enterprise Survey to produce 73 comparable sector codes
- The SUT data are used to construct a sets of weights that captures upstream linkages between sectors, whereby for each sector i, their link with upstream sector j is the proportional contribution of output from sector j to its total input base
- Weights used to compute a weighted average of imports from upstream sectors

Results 1: within-sector effects

Dependent variable: lnva	(1) OLS	(2) IV
Value of imports	0.020*	0.151*
	(0.011)	(0.090)
Firm fixed effects	Yes	Yes
Sector fixed effects	Yes	Yes
Time effects	Yes	Yes
Firm level controls	Yes	Yes
Sector level controls	Yes	Yes
Clustered standard errors (sector-year)	Yes	Yes
R-squared	0.366	0.364
Firms	53,234	53,234
N	156,501	156,501

Validity of instruments: Underidentification, weak identification, overidentification, endogeneity tests all point to valid instruments

Results 2: supply-chain effects

Dependent variable: lnva	(1) OLS	(2) IV	(3) IV	(4) OLS	(5) IV
Value of imports	0.021**	0.143*	0.153*	0.018*	0.139*
	(0.010)	(0.085)	(0.085)	(0.010)	(0.082)
Upstream imports	0.126	0.194*	0.194*	-0.014	0.056
	(0.086)	(0.106)	(0.106)	(0.087)	(0.105)
Upstream imports * Import Firm			0.032		
			(0.101)		
Upstream imports * HHI_up				1.594***	1.293***
				(0.384)	(0.448)
HHI_up				-0.855***	-0.737***
				(0.211)	(0.234)
R-squared	0.366	0.364	0.364	0.367	0.364
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Exploring some underlying mechanisms

- Model for identifying reallocation as a source of within-firm productivity improvements:

$$Exit\ /\ Switch_{jt+1} = s_j + \gamma\, ln\, imp_{jt} + \boldsymbol{\theta}\mathbf{Z}_{jt} + \tau_t + v_{jt}$$

Exit/Switch the proportion of firms in sector j that exit or switch sectors in the next period

Endogeneity of *lnimp* requires use of a similar IV strategy

- Model for identifying behavioral changes as a source of within-firm productivity improvements (sub-sample of firms, survivors):

$$ln\, Y_{ijt} = \alpha_i + \beta_1\, ln\, L_{ijt} + \beta_2\, ln\, K_{ijt} + \delta_1\, ln\, imp_{jt} +$$
$$\lambda_1 innov_{ijt} + \lambda_2 innov_{ijt} \times ln\, imp_{jt} + \boldsymbol{\varphi}\mathbf{X}_{ijt} + \boldsymbol{\eta}\mathbf{Z}_{jt} + s_j + \tau_t + e_{ijt}$$

innov is a firm-level indicator of innovation/technology

Results 3: reallocation effects

	(1)	(2)	(3)	(4)
	OLS	IV	OLS	IV
Dependent variable:	Exit		Switch Sector	
Value of imports	0.004	0.009*	0.019***	0.019***
	(0.003)	(0.005)	(0.004)	(0.005)
Sector fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Sector level controls	Yes	Yes	Yes	Yes
Clustered standard errors (sector-year)	Yes	Yes	Yes	Yes
R-squared	0.255	0.247	0.312	0.312
Sectors	123	123	123	123
N	457	457	457	457

Instrument: Level of imports into SE Asian region (ex-Vietnam)
Validity: Underidentification, weak identification and endogeneity tests all point to valid instruments

Results 4: within-firm behavioral effects

- Technology and Competitiveness Survey (2009-2011)
- Sample of 8,000 manufacturing firms
- Balanced panel of 3,674 private domestic firms

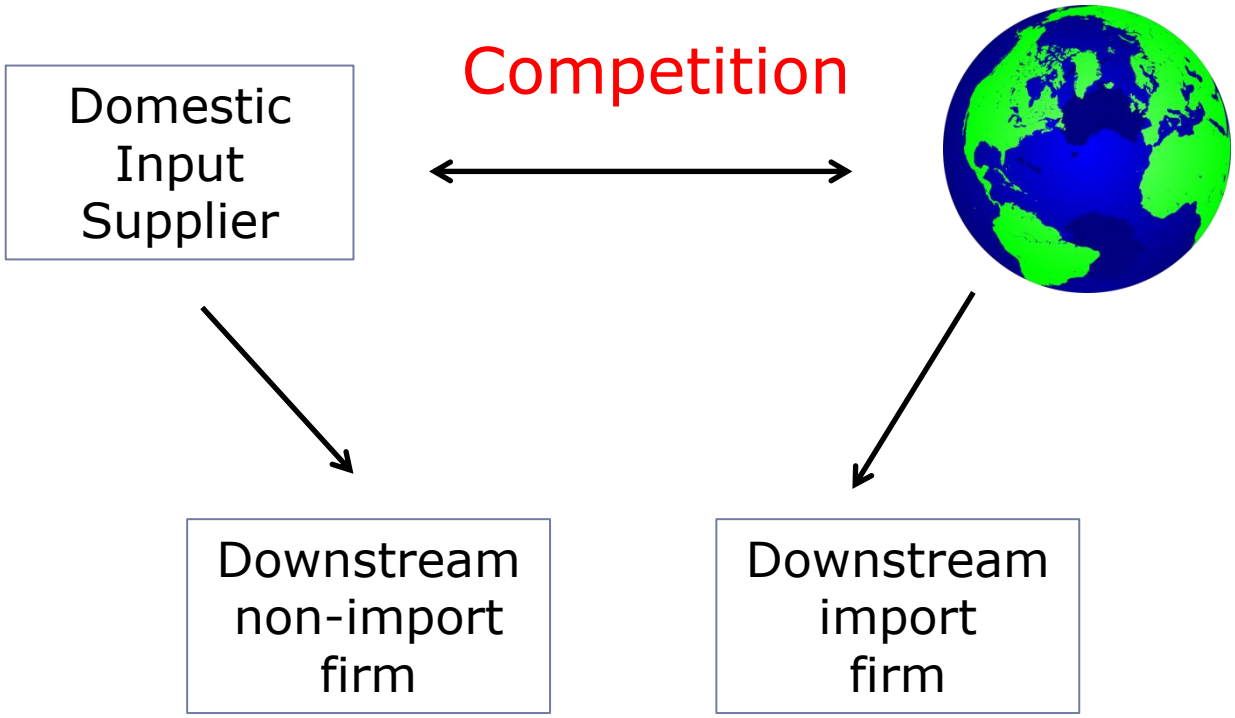
	2009		2010		2011	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
New Machinery	0.185	0.388	0.117	0.321	0.093	0.290
New ICT	0.249	0.432	0.133	0.340	0.114	0.318
Process Innovation	0.286	0.452	0.591	0.492	0.625	0.484
Quality Innovation	0.779	0.415	0.763	0.420	0.797	0.402
Expand Variety	0.479	0.500	0.416	0.493	0.427	0.495
Expand Product	0.160	0.367	0.146	0.353	0.138	0.345
Switch Sector	0.020	0.141	0.029	0.169	0.035	0.184
Tech Adaptation	0.222	0.416	0.078	0.268	0.061	0.239
R&D	0.119	0.324	0.104	0.306	0.095	0.294

Results 4: within-firm behavioral effects

Dependent variable: lnva	(1) OLS	(2) IV	(2) OLS	(3) IV
Imports	0.110***	0.232*	0.110***	0.235**
	(0.036)	(0.125)	(0.035)	(0.124)
Technology Adapt			-0.007	-0.009
			(0.011)	(0.011)
Imports *Technology Adapt			0.049**	0.047*
			(0.023)	(0.024)
R-squared	0.244	0.242	0.244	0.242
Firms	3,674	3,674	3,674	3,674
N	11,022	11,022	11,022	11,022

All controls and instrument validity testing are as before

Summary of key findings



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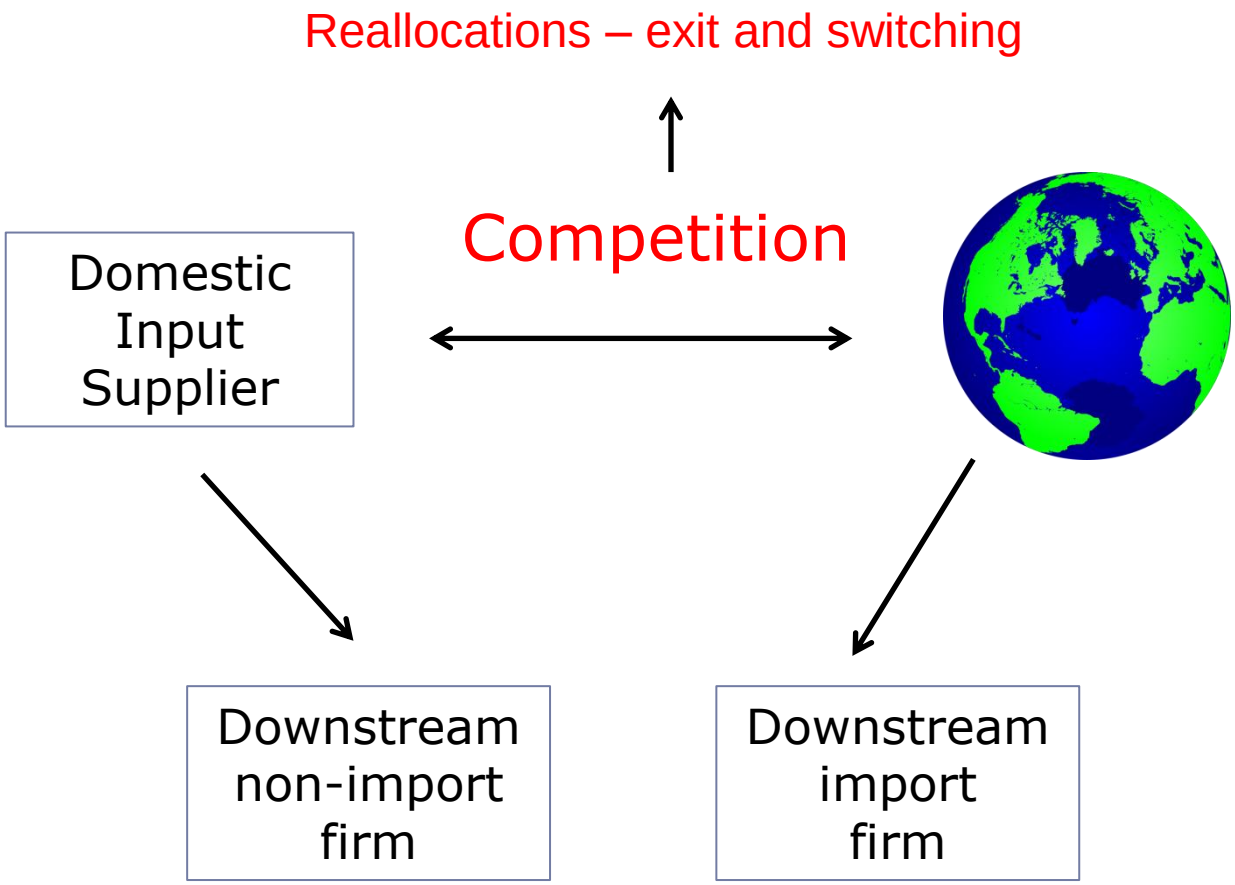

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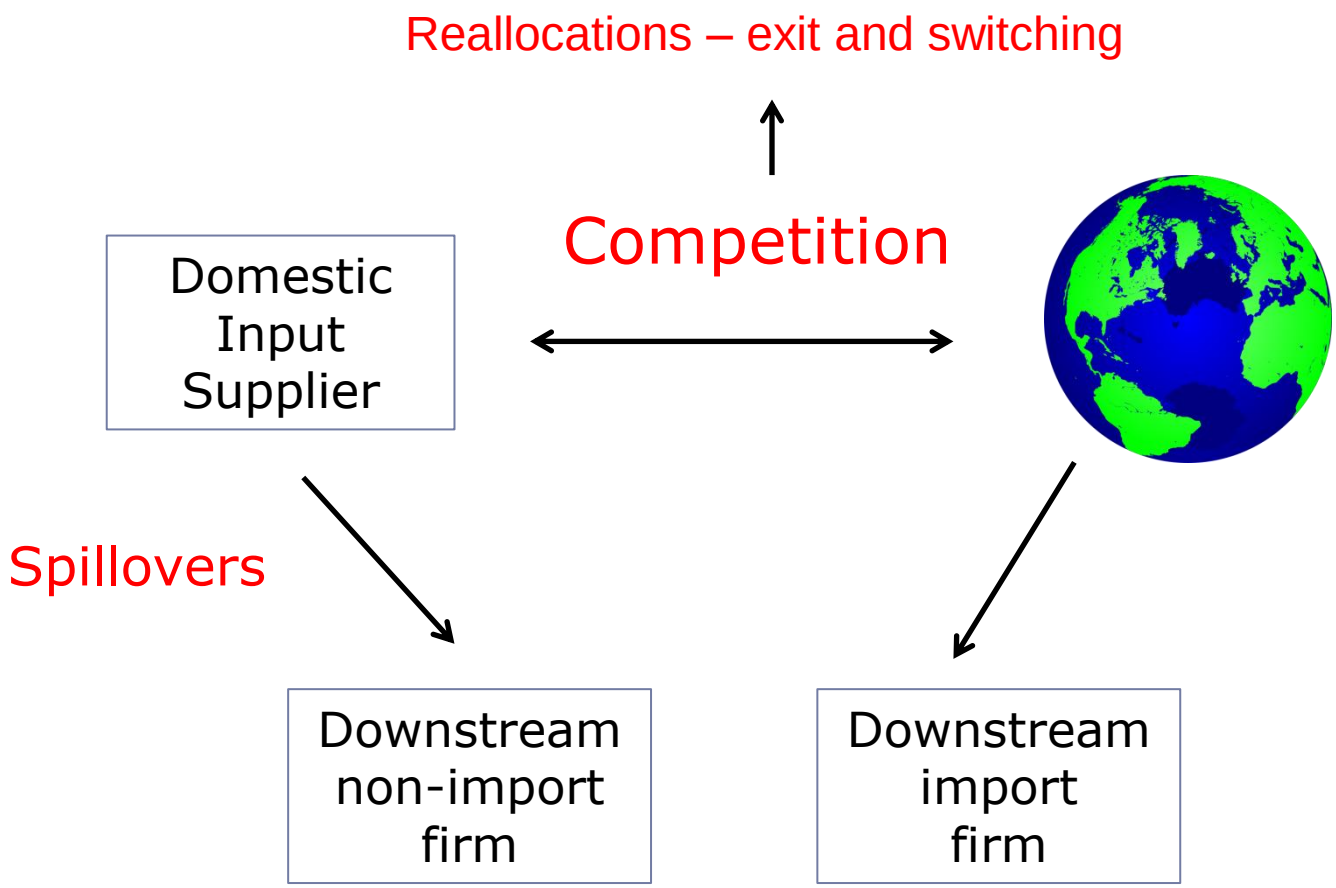

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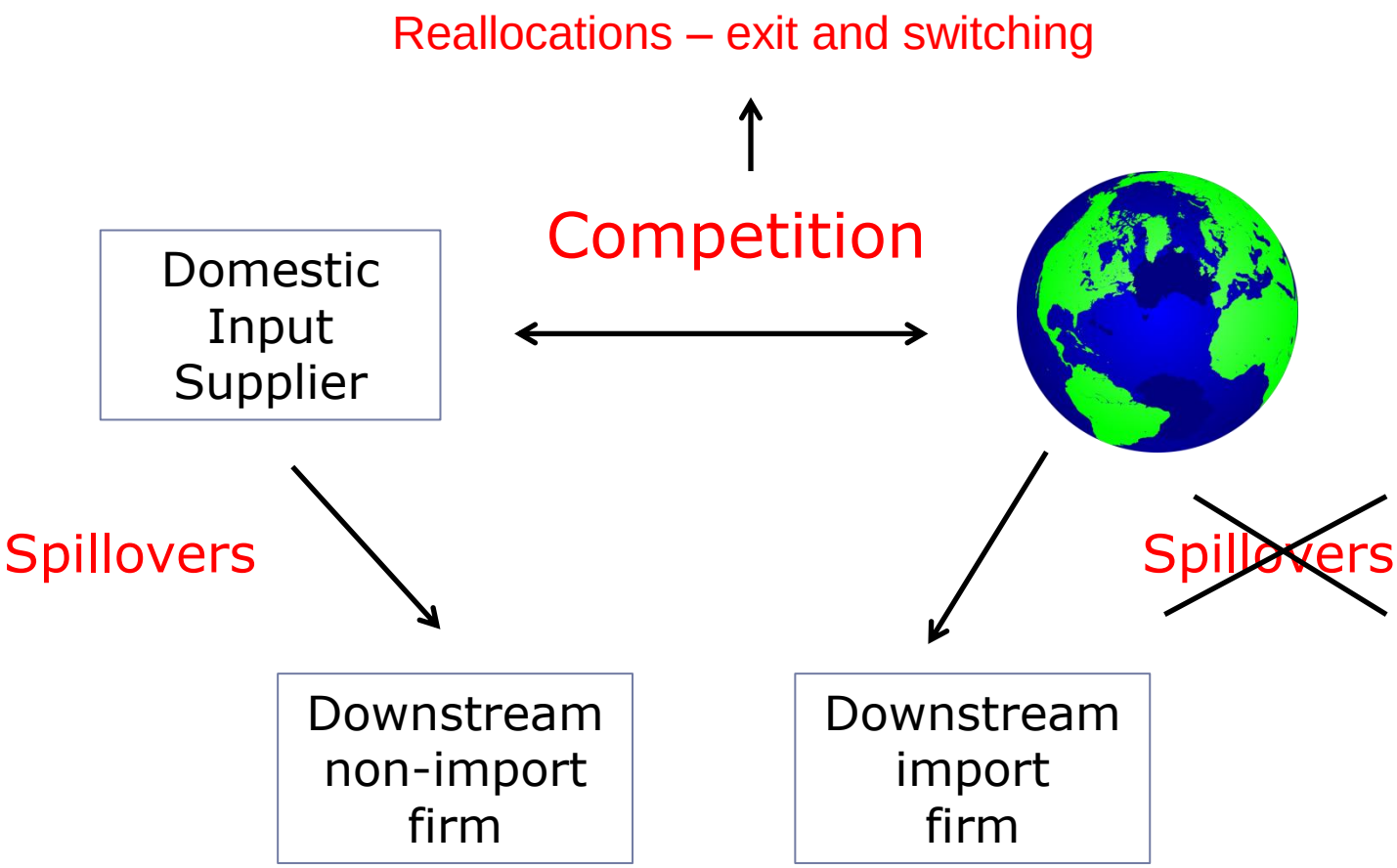

Conclusions

- Results show that imports impact on the productivity of domestic firms
- Competition from imports is the most important channel through which within-sector productivity gains are realized
- This is driven by reallocations of resources through firm's exiting production or switching sectors
- Our results show that there are spillover effects of these productivity gains for downstream firms
- These effects are not driven by importing intermediates
- Spillovers are potentially larger than the direct competition effects

- Results highlight the fact that previous empirical studies may have underestimated the productivity gains from trade

Thank you

Questions and comments most welcome