Imports, Human Capital and Productivity

N.Cannarsa & J-M.Grether

Institute of Economic Research
University of Neuchâtel

January 25, 2022

Introduction

- Relevance of absorption capacity for learning by importing
  - Interaction between imports' subcomponents and human capital
- Sample
  - 2008-2014 period, 17 European countries, 39 industries
- Preliminary Results
  - Positive Evidence for the manufacturing sector and tertiary education
  - Analysis performed for other sectors and education levels
- Further Analysis

Table of Contents

Literature Review

- Trade Openness/Economic Growth
  - Dollar (1992), Sachs and Warner (1995), Edwards (1998), Rodriguez and Rodrik (1999), Wacziarg and Welch (2008)
- Imports and technology diffusion:
  - Direct: Coe and Helpman (1995)
  - Indirect: Lumenga-Neso et al. (2005)
- Imports and Productivity
  - Positive Evidence: Kasahara and Rodrigue (2008), Smeets and Warzynski (2013), Halpern et al. (2015), Bournakis et al. (2018)
  - No Evidence: Van Bisoebroeck (2008), Vogel and Wagner (2010)
- Absorption's Capacity
  - Borenzstein et al. (1998), Yassar (2013), Augier et al. (2013), Abreha (2019)

Research Questions

- Relevance of absorption capacity for different imports' types
  - Test the interaction between tertiary education and consumption, raw, intermediate and capital imports
  - Test the above interaction also with primary and secondary education
  - Perform the analysis for each sector separately
- Extend the external validity
  - CompNet, WIOT and EUROSTAT databases
  - Industry level (9 sectors, 39 industries and 17 countries)

Data: CompNet

- Unbalanced Panel of European Countries
  - 17 European Countries
  - Longest time span: 1999-2019
  - Shortest time span: 2009-2019
- Firm level based variables
  - Productivity and other firm-based variables
  - Information on variables' distribution (i.e mean, median, percentiles)
- Re-aggregated at two available levels
  - 9 sectors
  - 56 industries

Data: Timmer et al. (2015)'s WIOT

- WIOT tables
  - 43 countries and ROW
  - 2000-2014 period
  - 18 Sectors, 56 industries
  - Industry level imports
- Industries' Imports:
  - Capital Imports (constructed)
  - Intermediate Imports
  - Consumption Imports (constructed)
  - Raw Material imports

Constructed Imports

Data: Eurostat

- Panel Data
  - 2008-2021 period
  - 39 Countries/Grouped Countries, 21 sectors
- Employees by educational attainment level (in %)
  - Primary, Secondary, Tertiary
- Multiple age groups
  - Use the 15-64 years old one

Data: Final Database

- Industry database
  - 2008-2014 Time Period
  - 17 European Countries
  - 39 Industries for Imports and Productivity
  - 9 Sectors for Education

Descriptive Stat

Specification I

- Specification with total imports

$$\log Prod_{i,j,t} = \alpha_0 + \alpha_1 \log HC_{i,J,t} + \alpha_2 \log IMP_{i,j,t} + \alpha_3 \log HC_{i,J,t} * \log IMP_{i,j,t} + \mu_{i,J,j} + \gamma_t + \varepsilon_{i,j,t} \quad (1)$$

- Specification with imports subcomponents

  Same as (1) but with four different types of imports (see next slide)

Specification II

- j, J, i, t: industry, sector, country, year
- $\log Prod_{i,j,t}$: Log of labor productivity (based on real value added)
- $\log HC_{i,J,t}$: Log of percentage of school attainment level
- $\log IMP_{i,j,t}$: Log of total imports over industry output
- $\log KIMP_{i,j,t}$: Log of capital imports over industry output
- $\log IIMP_{i,j,t}$: Log of intermediate imports over industry output
- $\log CIMP_{i,j,t}$: Log of consumption imports over industry output
- $\log RIMP_{i,j,t}$: Log of raw imports over industry output

Results: All sectors included

Table 1: Fixed Effect Results (Tertiary Education)

	1	2	3	4
Log Tertiary Education	-0.048	0.053	-0.049	-0.027
	(0.043)	(0.089)	(0.045)	(0.170)
Log (Imports/Output)	0.166***	0.251***		
	(0.050)	(0.072)		
Log (Capital Imports/Output)			0.004	0.022
			(0.029)	(0.037)
Log (Intermediate Imports/Output)			0.124***	0.215***
			(0.036)	(0.065)
Log (Consumption Imports/Output)			0.013	-0.126
			(0.051)	(0.088)
Log (Raw Imports/Output)			-0.011	0.010
			(0.010)	(0.019)
Log (Imports/Output)*		0.061		
Log Tertiary Education		(0.043)		
Log (Capital Imports/Output)*				0.016
Log Tertiary Education				(0.027)
Log (Intermediate Imports/Output)*				0.066
Log Tertiary Education				(0.048)
Log (Consumption Imports/Output)*				-0.092*
Log Tertiary Education				(0.050)
Log (Raw Imports/Output)*				0.014
Log Tertiary Education				(0.015)
Constant	3.678***	3.825***	3.662***	3.660***
	(0.111)	(0.154)	(0.208)	(0.292)
Observations	4381	4381	4381	4381
Within R^2	0.017	0.018	0.017	0.021
Between R^2	0.003	0.002	0.002	0.008
Overall R^2	0.002	0.001	0.002	0.007

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

FE regressions with clustered standard errors in parenthesis. Time effects not reported.

Results: Manufacturing sector

Table 2: Fixed Effect Results for the Manufacturing Sector (Tertiary Education)

	1	2	3	4
Log Tertiary Education	0.050	0.166*	0.058	-0.157
	(0.061)	(0.093)	(0.069)	(0.201)
Log (Imports/Output)	0.116**	0.285**		
	(0.058)	(0.122)		
Log (Capital Imports/Output)			0.010	-0.055
			(0.031)	(0.066)
Log (Intermediate Imports/Output)			0.076	0.381***
			(0.053)	(0.103)
Log (Consumption Imports/Output)			0.087	-0.103
			(0.062)	(0.115)
Log (Raw Imports/Output)			-0.021	-0.047
			(0.015)	(0.035)
Log (Imports/Output)*		0.096		
Log Tertiary Education		(0.060)		
Log (Capital Imports/Output)*				-0.031
Log Tertiary Education				(0.033)
Log (Intermediate Imports/Output)*				0.178***
Log Tertiary Education				(0.055)
Log (Consumption Imports/Output)*				-0.107**
Log Tertiary Education				(0.052)
Log (Raw Imports/Output)*				-0.018
Log Tertiary Education				(0.019)
Constant	3.710***	3.916***	3.881***	3.493***
	(0.141)	(0.190)	(0.264)	(0.434)
Observations	1983	1983	1983	1983
Within R^2	0.018	0.020	0.022	0.030
Between R^2	0.008	0.018	0.003	0.046
Overall R^2	0.009	0.019	0.005	0.047

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

FE regressions with clustered standard errors in parenthesis. Time effects not reported.

Additional findings/analysis

- Analysis performed for each sector separately
  - Positive evidence for the construction sector
  - No evidence for the other sectors
- Analysis performed with other educational levels
  - Positive evidence for secondary education (construction, transportation and storage sectors)
  - No evidence for primary education

Additional results

Preliminary conclusion

- Empirically investigating for the relevance of absorption capacity for different types of imports using a set of 17 European countries, 39 industries, 9 sectors over the 2008-2014 period.
- Preliminary evidence suggests that the relevance depends on the import's type, the education level and the analyzed sector
- Further analysis needed to control for omitted variables and endogeneity biases

Further analysis

- Control for omitted variable bias
  - Include the capital labor ratio in the basic equation
  - OR replace basic equation by a production function (Cobb-Douglas with 3 inputs, human capital and import shares + interaction terms)
- Control for reverse causality bias
  - Idea for an instrument: instrument the imports of country i in the industry j at time t with the mean of the imports of all the other countries in the same sector j at the same time t.

Thank you for your attention!

Appendix

Appendix

- Variables
  - Constructed Imports
  - Descriptive Statistics
- Additional results
  - Construction Sector (Tertiary Education)
  - All sectors (Secondary Education)
  - Construction Sector (Secondary Education)
  - Transportation storage Sector (Secondary Education)

Constructed Imports

- We construct 3 coefficients to estimate industry j's capital and consumption imports:

$$\alpha_{j,Y_i} = \frac{X \text{ imports in industry } j \text{ from Y's industry } i}{X \text{ imports in all 56 industries from Y's industry } i}$$

$$\beta_j = \frac{\text{Industry j value added in X}}{\text{Value added of all 56 industries in X}}$$

$$\gamma_{j,Y_i} = \frac{1}{2}\left(\alpha_{j,Y_i} + \beta_j\right)$$

- The estimated capital/consumption imports of X in industry j coming form Y's i industry is equal to the capital/consumption imports of X coming from Y's i industry times γ_{j,Y_i}. ◂ Data: WIOT

Descriptive Statistics

Table 3: Industry Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Log Labor Productivity	4422	3.469253	.7877637	-.5150056	6.646363
Imports/Output	4411	.259051	.1587883	.044778	.9760798
Capital Imports/Output	4411	.0314894	.032901	.0033141	.3981115
Intermediate Imports/Output	4411	.1656782	.1205019	.004795	.7428831
Consumption Imports/Output	4411	.0555077	.0369104	.0141196	.3625264
Raw Imports/Output	4411	.0063757	.0162759	.0000127	.1746474
Tertiary Education	4420	.27849	.1898088	.025	.823
Secondary Education	4433	.5223016	.1857512	.083	.902
Primary Education	4069	.2159105	.1690529	.005	.873

◂ Data: Final Database

Results: Construction Sector (Tertiary Education)

◂ Data: Additional findings

Table 4: Fixed Effect Results for the F Sector (Tertiary Education)

	1	2	3	4
Log Tertiary Education	-0.187**	0.098	-0.135**	-0.615
	(0.069)	(0.204)	(0.050)	(0.458)
Log (Imports/Output)	0.565***	0.860***		
	(0.105)	(0.206)		
Log (Capital Imports/Output)			0.221**	0.092
			(0.087)	(0.198)
Log (Intermediate Imports/Output)			0.618***	1.177***
			(0.154)	(0.201)
Log (Consumption Imports/Output)			-0.249*	-0.468
			(0.124)	(0.316)
Log (Raw Imports/Output)			0.096**	-0.024
			(0.038)	(0.133)
Log (Imports/Output)*		0.156		
Log Tertiary Education		(0.093)		
Log (Capital Imports/Output)*				-0.051
Log Tertiary Education				(0.096)
Log (Intermediate Imports/Output)*				0.273***
Log Tertiary Education				(0.083)
Log (Consumption Imports/Output)*				-0.153
Log Tertiary Education				(0.140)
Log (Raw Imports/Output)*				-0.068
Log Tertiary Education				(0.060)
Constant	3.786***	4.326***	4.737***	4.085***
	(0.195)	(0.438)	(0.527)	(1.107)
Observations	111	111	111	111
Within R^2	0.331	0.354	0.440	0.492
Between R^2	0.006	0.007	0.002	0.004
Overall R^2	0.004	0.005	0.003	0.006

Standard errors in parentheses

Results: All sectors (Secondary Education)

Table 5: Fixed Effect Results (Secondary Education)

	1	2	3	4
Log Secondary Education	0.049	0.223**	0.037	0.054
	(0.050)	(0.100)	(0.051)	(0.240)
Log (Imports/Output)	0.173***	0.274***		
	(0.050)	(0.082)		
Log (Capital Imports/Output)			0.013	-0.044
			(0.028)	(0.057)
Log (Intermediate Imports/Output)			0.128***	0.218***
			(0.036)	(0.068)
Log (Consumption Imports/Output)			0.008	0.077
			(0.050)	(0.084)
Log (Raw Imports/Output)			-0.011	-0.040*
			(0.010)	(0.022)
Log (Imports/Output)*		0.114**		
Log Secondary Education		(0.055)		
Log (Capital Imports/Output)*				-0.063
Log Secondary Education				(0.043)
Log (Intermediate Imports/Output)*				0.108*
Log Secondary Education				(0.055)
Log (Consumption Imports/Output)*				0.090
Log Secondary Education				(0.071)
Log (Raw Imports/Output)*				-0.037*
Log Secondary Education				(0.021)
Constant	3.799***	3.948***	3.791***	3.785***
	(0.084)	(0.129)	(0.189)	(0.294)
Observations	4394	4394	4394	4394
Within R^2	0.017	0.018	0.018	0.021
Between R^2	0.000	0.001	0.010	0.011
Overall R^2	0.000	0.001	0.010	0.011

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

FE regressions with clustered standard errors in parenthesis. Time effects not reported.

Results: Construction Sector (Secondary Education)

Table 6: Fixed Effect Results for the F Sector (Secondary Education)

	1	2	3	4
Log Secondary Education	-0.413***	0.640	-0.312***	0.039
	(0.087)	(0.564)	(0.095)	(1.109)
Log (Imports/Output)	0.427***	0.787***		
	(0.115)	(0.154)		
Log (Capital Imports/Output)			0.150*	0.198
			(0.083)	(0.127)
Log (Intermediate Imports/Output)			0.598***	0.961***
			(0.160)	(0.174)
Log (Consumption Imports/Output)			-0.305*	-0.501**
			(0.146)	(0.213)
Log (Raw Imports/Output)			0.084*	0.099
			(0.046)	(0.113)
Log (Imports/Output)*		0.503*		
Log Secondary Education		(0.265)		
Log (Capital Imports/Output)*				0.127
Log Secondary Education				(0.195)
Log (Intermediate Imports/Output)*				0.659**
Log Secondary Education				(0.300)
Log (Consumption Imports/Output)*				-0.525
Log Secondary Education				(0.423)
Log (Raw Imports/Output)*				0.045
Log Secondary Education				(0.117)
Constant	3.707***	4.404***	4.279***	4.590***
	(0.211)	(0.309)	(0.554)	(1.029)
Observations	111	111	111	111
Within R^2	0.358	0.418	0.451	0.521
Between R^2	0.029	0.071	0.004	0.006
Overall R^2	0.022	0.055	0.006	0.003

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

FE regressions with clustered standard errors in parenthesis. Time effects not reported.

Results: Transportation and storage Sector (Secondary Education)

Table 7: Fixed Effect Results for the H Sector (Secondary Education)

	1	2	3	4
Log Secondary Education	-0.155	1.207	-0.170	-0.991
	(0.347)	(0.762)	(0.344)	(1.640)
Log (Imports/Output)	0.397*	0.872***		
	(0.214)	(0.312)		
Log (Capital Imports/Output)			-0.077	-0.361
			(0.123)	(0.249)
Log (Intermediate Imports/Output)			0.222	0.587**
			(0.148)	(0.243)
Log (Consumption Imports/Output)			-0.007	0.071
			(0.216)	(0.506)
Log (Raw Imports/Output)			0.019	-0.075
			(0.033)	(0.075)
Log (Imports/Output)*		0.655**		
Log Secondary Education		(0.305)		
Log (Capital Imports/Output)*				-0.310
Log Secondary Education				(0.206)
Log (Intermediate Imports/Output)*				0.656**
Log Secondary Education				(0.328)
Log (Consumption Imports/Output)*				-0.063
Log Secondary Education				(0.656)
Log (Raw Imports/Output)*				-0.163
Log Secondary Education				(0.105)
Constant	4.345***	5.285***	3.958***	3.419**
	(0.357)	(0.578)	(0.833)	(1.421)
Observations	565	565	565	565
Within R^2	0.056	0.069	0.051	0.086
Between R^2	0.180	0.066	0.273	0.167
Overall R^2	0.187	0.077	0.261	0.165

References I

- References

- Abreha, K.G., 2019. Importing and Firm Productivity in Ethiopian Manufacturing. The World Bank Economic Review 33 (3), 772-792.
- Augier, P., Cadot, O., and Dovis, M., 2013. Imports and TFP at the Firm Level: The Role of Absorptive Capacity. Canadian Journal of Economics 46 (3), 956–981.
- Borensztein, E., De Gregorio, J., Lee, J-W., 1998. How does foreign direct investment affect economic growth?. Journal of International Economics 45(1), 115-135
- Bournakis, I., Christopoulos, D., Mallick, S., 2018. Knowledge spillovers and output per worker: an industry level analysis for OECD countries. Economic Inquiry 56(2), 1028-1046
- Coe, D.T., Helpman, E., 1995. International R&D spillovers. European Economic Review 39(5), 859-887
- CompNet database

References II

- Dollar, D., 1992. Outward-oriented developing economies really do grow more rapidly: evidence from 95 LDCs, 1976-1985. Economic development and cultural change 40(3), 523-544
- Edwards, S., 1998. Openness, Productivity and Growth: What Do We Really Know? The Economic Journal 108, 383-398.
- Eurostat database
- Halpern, L., Koren, M., Szeidl, A., 2015. Imported Inputs and Productivity. American Economic Review 105 (12), 3660-3703.
- Kasahara, H., Rodrigue, J., 2008. Does the Use of Imported Intermediates Increase Productivity? Plant-level Evidence. Journal of Development Economics 87 (1), 106-118.
- Lumenga-Neso, O., Olerreaga, M., Schiff, M., 2005. On "indirect" trade-related R&D spillovers. European Economic Review 49(7), 1785-1798

References III

- Rodriguez, F., Rodrik, D., 1999. Trade Policy and Economic Growth: A Skeptic's guide to the Cross-national Evidence. NBER working paper 7081
- Sachs, J., Warner, A., 1995. Economic reform and the process of global integration. Brookings Papers on Economic Activity 1995(1), 1-118
- Smeets, V., Warzynski. F., 2013. Estimating Productivity with Multi-product Firms, Pricing Heterogeneity and the Role of International Trade. Journal of International Economics 90 (2), 237-244.
- Timmer, M.P., Dietzenbacher, E., Los, B., Stehrer, R., de Vries, G. J., 2015. An Illustrated User Guide to the World Input-Output Database: the Case of Global Automotive Production. Review of International Economics 23, 575-605.

References IV

- References

– Van Biesebroeck, J., 2008. The Sensitivity of Productivity Estimates: Revisiting Three Important Debates. Journal of Business & Economic Statistics 26 (3), 311-328.

– Vogel, A., Wagner, J., 2010. Higher Productivity in Importing German Manufacturing Firms: Self-selection, Learn- ing from Importing, or Both? Review of World Economics 145 (4), 641-665.

– Wacziarg, R., Welch, K.H., 2008. Trade Liberalization and Growth: New Evidence. The World Bank Economic Review 22(2), 187-231.

– M. 2013. Imported Capital Input, Absorptive Capacity, and Firm Performance: Evidence from Firm-level Data. Economic Inquiry 51 (1), 88–100.