

AN AGENT BASED MODEL OF FIRMS SELLING AND SOURCING INTERNATIONAL DECISIONS WITH FLEXIBILITY TO DEMAND AND SUPPLY SHOCKS

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ABSTRACT

The increasingly global fragmentation of production is a central topic of the international trade economics research agenda. The agent based model presented in this paper tries to combine in a unique coherent schema two usually distinct fields of internationalization analysis: from one side firms' selling decisions (i.e., the choice to export or to invest directly abroad) and from the other side firms' sourcing decisions (i.e., the choice to outsource or to produce directly intermediate goods). Therefore, assuming the presence of fixed and variable costs to export and to import, the model is able to reproduce both the exporters and importers firm better performance empirical evidence. Moreover, assuming that production flexibility to shocks is higher with lower capital intensity and it increases when firms outsource their intermediate goods, the model replicates the positive empirical relationship between sectoral capital intensity and imports of intermediate goods from foreign affiliates. The simultaneous study of selling and sourcing decisions might offer useful tools to understand economic processes and gives the opportunity to test the effects of different combinations of trade and industrial policy measures on international division of labor and welfare.

INTRODUCTION

International fragmentation of production is a central aspect of globalization processes, reshaping national and regional sectoral specializations with a strong impact on employment and welfare. From both an empirical and a theoretical approach international trade economics is trying to understand and analyze the reasons and the conditions that, from one side, determine firms' selling decisions, leading firms to export or to integrate horizontally (i.e., conceiving horizontal integration as the firm's choice to not export in a foreign country but producing directly in this country the products the firm want to sell) and, from the other side, delineate sourcing strategies: outsourcing the intermediate goods or vertical integrate their production in the home country or abroad (i.e., assuming firms need intermediate goods, vertical integration is the choice to not buy intermediate goods from an other firm but producing the intermediate good directly

in the same plant or in an affiliate factory at home or abroad).

In the US there is a consistent empirical evidence according to which vertical integration abroad is stronger in sectors where capital intensity is higher: in these sectors firms prefer to import intermediate goods from affiliate companies abroad than buy them from not affiliate firms (intra-firm import) (Antràs, 2003). The Antràs 2003 model is able to replicate this stylized fact assuming the presence of transaction costs, modeling property right effects on appropriability of final goods and hold-on problems. In fact, conceiving capital intensity as a proxy for the relevance of headquarter services in the final good production, in the Antràs 2003 model firms with higher capital intensity have stronger incentives to produce by themselves intermediate goods. Moreover, the Antràs and Helpman model (Antràs et al., 2004) considers also firm heterogeneity in productivity as a determinant of sourcing decisions.

At the same time, firm heterogeneity (in the form of a given distribution of productivity) and the presence of fixed and variable costs to export are crucial elements of the Melitz model (Melitz, 2003), that is aimed to explain the reasons why exporters have a better performance than firms that do not export, besides this model has also been enlarged to deal with horizontal integration (Helpman et al., 2004).

However, in standard economic analysis is not easy to model at the same time firms' selling decisions and sourcing choices, moreover endogenizing technological change with firms heterogeneity is not so immediate. Thanks to the opportunities offered by agent based simulation to design a simple structure of firms decision processes and firms interactions, the model described in this paper aims to integrate the analysis of internationalization choices in serving markets and in sourcing. Moreover, the model assumes bounded rationality of agents : firms' decisions are the result of a basic reinforcement learning process based on the Tesfatsion 2005 model, which determines the dynamic of the simulation and permits to endogenize in a stylized way technological change as the effect of the choice to invest in innovation.

The model reproduces as emergent results the exporter and importer premia. In fact, exporters better performance (and in first instance the higher productivity of exporters) is the result of a stronger innovative effort, that

allow firms to overcome the obstacles represented by the fixed costs to enter foreign markets. After a firm enters foreign markets, it gains more resources that could be used to foster the same good competitive decisions that allowed the firm to become an exporter or to produce directly abroad. At the same time considering sourcing choices, the model is able to replicate the importer premia empirical evidence, according to which also importer firms present a better performance than not importers.

The model reproduces also the capital intensive firms preference for vertical integration abroad, assuming the presence of both demand and supply shocks. The sourcing choice relies on a simple configuration of transaction cost that permit to focus the analysis on the reactions to demand and supply negative shocks. As in standard economics, production is made using a fixed factor (capital), that can not be modified in the short run, combined with a variable factor (labor) that can react faster to shocks, therefore capital intensity is conceived as a proxy for the intensity of the short run invariable factor. The nature of the shocks considered is twofold: demand negative shocks when firm's demand is lower than its productive capacity and supply shocks when, in reason of imperfect information and contract incompleteness, outsourcers do not provide the requested quantity of intermediate goods. The first shock is endogenous because it is the result of firms' and consumers' decisions, the second one is exogenous, in fact according to model's hypothesis there is an exogenous fixed probability that an intermediate good is not supplied.

The model is based on basic assumptions on negative shocks flexibility: in first instance firms with lower capital intensity are more reactive to negative shocks, because they can shift a larger part of the lost to the variable input (reducing the expenditure for the variable input), moreover firms can shift the burden of demand shocks to outsourcing firms (buying a minor quantity of the intermediate good). However outsourcing the intermediate good production lead to supply shocks.

The structure of the paper is divided in four parts. The first part illustrates the model, the second describes the simulation result regarding outsourcing and vertical integration, the third is focused on the exporter and importer premia, the fourth concludes.

THE MODEL

The model is made using the Python-SLAPP protocol (Terna, 2011), it can be synthetically described focusing on five interconnected parts of its structure: the interaction structure, agents' properties, the selling choice, the sourcing decision and the simulation data analysis.

Interaction Structure

In the model there are two typology of agents: firms and consumers, initially in the same number in two countries (A,B). Firms' interactions are indirect through competition, in fact firms produce different varieties of the same

good and compete through price decisions, besides firms that have a negative Net-Worth exit from the market (the Net-Worth is given by the sum of firm's liquidity reserves and the value of firm's capital)

Firms have three separate selling choices: they could choose to serve just the home market, to sell also in the other country (export) or to create another firm abroad to produce and sell directly in the foreign country their product (horizontal integration).

On the other side, firms need intermediate goods to produce the final ones, they have four separate options to obtain intermediate goods: they could buy the intermediate goods at home (home outsourcing) at a constant price, they could buy them abroad (abroad outsourcing), firms can produce directly the intermediate goods at home (vertical integration at home) or they could produce them abroad (vertical integration abroad), there are costs differences among these forms and, moreover, because of market imperfections outsourcing leads to the possibility that part of the quantity of the intermediate good needed will not be provided. When a firm outsources abroad or vertically integrate abroad this firm imports intermediate goods, consequently the model partially deals with the import side of firm activity.

It is assumed that in one country (B) the unit cost to produce or to outsource the intermediate good is cheaper in order to give a reason for importing it from the other country (A), for simplicity simulation data analysis is restricted to country A where is convenient to import the intermediate good.

Agents

Consumers have different variety preferences and they weight in a different way the importance of price and variety. Every consumer has a first choice variety of the final good: the far the goods offered are from the first choice the lower is the utility the consumer will extract from them, besides if goods offered are too different from the preferred variety consumers do not buy it. Every run in a random order consumers choose the good they buy, determining firms' individual supply.

Firms are profit oriented and at the beginning they have the same characteristics, they use two factor of production one fixed in the short run (K) and the other variable (L), the proportion between the two factor is constant ($0 < \nu < 1$). where y is the output:

$$\begin{cases} K = (1 - \nu)y \\ L = \nu y \end{cases} \quad (1)$$

Every firm produces a different variety of the same final good and for every unit of the final good they produce they need a unit of the intermediate good. In order to increase their productive capacity they have to buy units of the fixed factor (K). Firms make basic choices: the offering price of the final good they produce, increasing or reducing the production capacity, selling and out-

sourcing options and they choose whether to invest in research permitting them to reduce the unit cost (equal to the marginal cost) at which they produce. All the decisions are taken using a simple reinforcement learning algorithm based on the Tesfatsion 2005 model, that derives from Roth and Erev experimental analysis (Roth et al., 1993), in this way firms learn to react to external stimuli and they could change their behavior adapting it to the modification of the environment, of course reactions are not immediate, we could think that firms follow routines that suffer for a certain degree of inertia. Moreover, selling and outsourcing choices last for a short period of time, which is needed to recuperate the starting fixed cost that might be implied by the different selling and sourcing options. In fact, it is possible to conceive selling and sourcing choices as not short time ones.

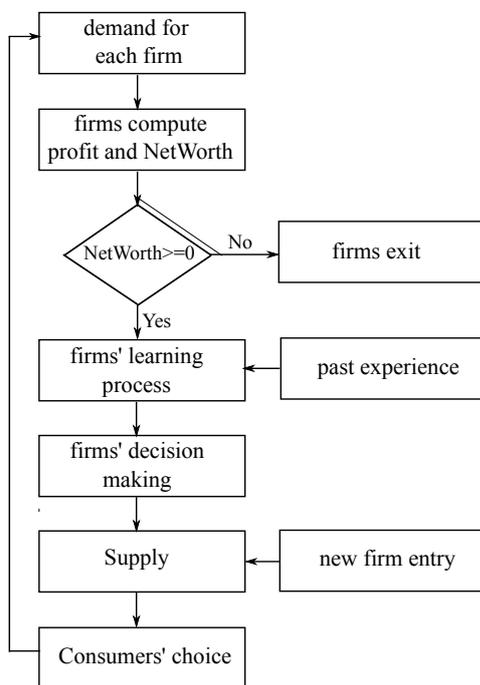


Figure 1: Simulation's Schema

Export/Horizontal Integration Choice

Selling in the foreign market increases firms' market opportunities, however if a firm chooses to export it incurs in an initial fixed cost (costs to build a commercial network abroad, to modify the good produced to match foreign standard and tastes etc..) and in higher variable costs (due to transport costs, export and import taxes, assurances etc..). On the other side, if a firm chooses to sell directly abroad building an affiliate firm in the foreign market (horizontal integration) it has to pay a fixed cost (start-up expenditure) but does not pay higher variable costs, because it has not to ship its products. The new firm created has the same characteristics of the mother

firm as a clone: the same productivity capacity, unit cost level and final good variety. However, the foreign affiliate starts a semi-autonomous life, making its-own decision on sourcing, innovative effort and price setting, until the mother firm exits the market or chooses to disinvest. When the mother firm disinvests the value of capital and the liquidity of the affiliate is added to its liquidity. Finally, firms in order to export or to horizontally integrate need to have enough liquidity to pay the fixed costs to export or to invest abroad.

Outsourcing/Horizontal Integration Choice

Firms can buy the quantity of intermediate goods they need in the home market (home outsourcing) at a constant unit cost. If they buy it from abroad (outsourcing abroad) they pay a starting fixed cost and higher marginal costs (import costs). Similarly firms can make by themselves the intermediate goods they need, but if they want to integrate the production domestically (home vertical integration) they have to pay a fixed cost (start up cost) and they have to buy the needed capital to produce it, while the marginal cost is the same as in outsourcing. If a firm vertical integrates abroad both the starting fixed cost and the unit cost are higher (vertical outsourcing abroad). When a firm outsources for every unit of the intermediate good needed there is a constant probability ($p = 0.1$) that the good will not be provided to the firm. Intermediate goods could not be provided for multiple reasons, for instance because of imperfect information and incomplete contracts some intermediate goods can not have the necessary characteristics or sufficient quality to be used. Therefore producing directly is more expensive but it is less dangerous (Antràs, 2003; Antràs et al., 2004).

Flexibility to negative demand and supply shocks

Flexibility to negative shocks is a crucial assumption of the model, starting from the idea that the firm structure in part is influenced by its capacity to react to shocks. For instance, outsourcing could be a way to shift demand shocks to provider firms. Moreover, a basic hypothesis of the model is that as in standard economics capital is conceived as a factor that can not be modified in the short run, consequently firms with higher capital intensity react in a slower way to negative shocks.

There are two crucial parameters in the simulation: flexibility to shocks (δf) and the capital intensity (ν). When a firm receives a demand that is lower than its productive capacity, it suffers a demand shock that could be in part absorbed employing a minor quantity of the variable input necessary to produce the final good at full productive capacity. Moreover, if the firm produces by itself the intermediate good it can reduce also the quantity of the variable input employed to produce it, otherwise if the firm outsources the intermediate good it could reduce by a fraction equal to δf the quantity of intermediate good it has to buy. Therefore, if a firm is vertical integrated producing directly at home or abroad the intermediate good it could reduce the expenditure just on

the variable factor by a fraction equal to δf , while if the firm outsources it could reduce all the excessive expenditure by δf . Consequently, if a firm outsources it could absorb a higher amount of a demand shock. On the other side if a firm outsources there is a constant probability for every intermediate good needed that the intermediate good will not be provided by the outsourcer, reducing the effective supply of the firm. However outsourcing is less expensive than integrate the intermediate good production.

Simulation Data Analysis

In every simulation firms are initially homogeneous, their heterogeneity (in productivity, productive capacities, international openness, prices) emerges as the results of individual firms' choices regarding innovative efforts, price setting, selling and outsourcing forms. While ν and δf are constant and equal for all the firms to compare different specification of the model and to cope with the empirical analysis based on sectoral differences (markets with different capital intensity ν) and not on individual heterogeneity. Simulation data are analyzed considering just the period of time (simulation cycles) in which the number of firms and the supply concentration stabilize, conceiving it as a quasi-equilibrium in a system that is intrinsically dynamic. Firms and time are the two dimensions used to implement Panel data econometric analysis, one panel is used to study integration processes (20 cycles) and a longer one for the exporter/importer premia (100 cycles).

The period of time used to analyze the exporter and the importer premia is longer than the one used to study production fragmentation processes, because the production fragmentation empirical evidence regards aggregate economic sectors differences, while the exporter and importer premia analysis is essentially microeconomic, therefore even if more computational demanding, using a longer micro dataset allows a more intensive exploration of firm individual characteristics.

PRODUCTION FRAGMENTATION RESULTS

Given the flexibility to shocks (δf), the higher the capital intensity the lower the firm capacity to reduce the effects of demand and supply shocks. Consequently, in simulations where firms have high capital intensity (lower ν) they could tend to outsource to limit the demand shock effects, however when they outsource they are hit by offer shocks. At the same time, in simulations with low capital intensity, demand shocks have a reduced effect on production, therefore the incentives to outsource are lower, but on the other side firms are more reactive to offer shocks due to outsourcing.

Running one hundred simulations for each of the four levels of the δf considered (ZF: $\delta f = 0$, LF: $\delta f = 0.2$, MF: $\delta f = 0.5$, HF $\delta f = 0.8$) and looking at the correlation between capital intensity and different integration indicators (ICm, INm, IQm are respectively the total cost,

number and products from foreign integrate production divided by the total cost, number and intermediate products importation, while ICf, INf, IQf are respectively the total cost, number and products from integrate production divided by the total cost number and intermediate products made), it appears evident that firms with lower ν , therefore with higher capital intensity, in simulation with medium and high flexibility present an higher tendency to integrate vertically their production both domestically and abroad (table 1). Reproducing the empirical evidence of the direct relationship between capital intensity and integration abroad.

Table 1: Production Fragmentation and Capital Intensity (Capital Intensity (ν) as independent variable)

	ZF	LF	MF	HF
ICm	0.013** (0.0044)	-0.004 (0.0055)	-0.013** (0.0054)	-0.030** (0.0058)
ICf	0.008** (0.0041)	-0.008** (0.0038)	-0.016** (0.0043)	-0.036** (0.060)
INm	0.030** 0.0039	0.011** (0.0043)	-0.009** (0.0043)	-0.029** (0.0044)
INf	0.030** (0.0036)	0.008** (0.0036)	-0.007** (0.0037)	-0.033** (0.0039)
IQm	0.016** (0.0043)	-0.002 (0.0055)	-0.015** (0.0053)	-0.041** (0.0051)
IQf	0.011** (0.0039)	-0.005 (0.004)	-0.018** (0.0042)	-0.039** (0.0053)
n	-53.761** (8.2970)	-58.27** (7.0403)	-11.69* (6.6212)	38.562** (5.0830)
sim	100	100	100	100

Note: Standard error in parenthesis below the coefficients. Asterisks denote significance levels (**: $p < 5\%$; *: $p < 10\%$). All regressions include time dummies.

In figure 2 is represented the relation between ν and the percentage of intermediate goods expenditure that comes from foreign affiliate firms (vertical integration abroad) on the total of expenditure on intermediate goods from abroad (total of importations, therefore both from affiliated intermediate producers abroad and outsourcing from abroad). When ν decreases, capital intensity increases, and with high δf (MF and HF) vertical integration abroad augments. While for low level of flexibility the negative relation between ν and integration is not so relevant and it is reversed with zero flexibility.

To understand the micro processes that lead to the emergent sectoral distribution of sourcing integration, first of all it is possible to look at the macro patterns (table 1): in simulation with higher δf (MF and HF) there is a negative correlation between ν and the number of firms in the market, in fact with higher ν (less capital intensity) firms can easily increase their size because they have to buy a minor amount of the fixed factor to increase their productive capacity. When the demand is given, if firms are larger the total number of them has to decline. How-

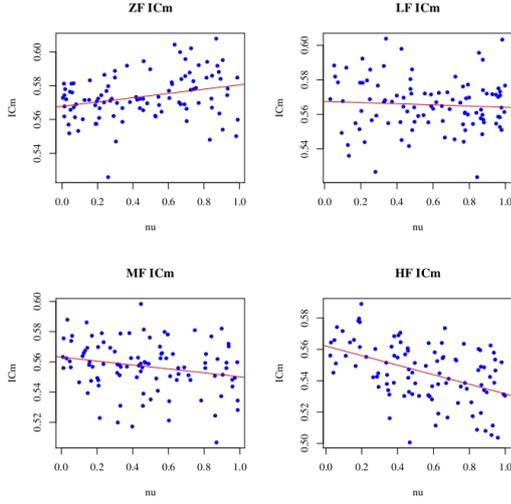


Figure 2: Intermediate Goods Imports Vertical Integration

ever, thanks to the higher flexibility in MF more firms are able to survive even if the average size increases, in fact the correlation between ν and n is less negative in MF than in LF simulations. Consequently, in MF simulations thanks to the higher possibility to compensate shocks more firms can survive, this leads to tougher competition, especially when capital intensity is lower as the stronger negative relationships between ν and p (prices) and between ν and uc (unit cost) shows in the case of medium flexibility (MF) with respect to LM simulations (table 2).

Table 2: Prices and Unit Costs (re panel regression)

	LF		MF	
	p	uc	p	uc
ν	-0.137** (0.01819)	-0.007** (0.0044)	-0.335** (0.0191)	-0.0195** (0.00439)
pC	-0.0214** (0.0017)	-0.001** (0.0001)	-0.022** (0.0002)	-0.001** (0.0001)
uc	-1.255** (0.0220)		-1.338** (0.0224)	
dexp	0.372** (0.0069)	-0.001** (0.0001)	0.369** (0.0071)	-0.001** (0.0001)
dHorI	0.298** (0.0144)	-0.001** (0.0001)	0.266** (0.0140)	-0.001** (0.0001)
firms	46,811		47,618	

Note: On the y axis independent variables. Standard error in parenthesis below the coefficients. Asterisks denote significance levels (**: $p < 5\%$; *: $p < 10\%$). All regressions include time dummies.

When capital intensity is lower (higher ν) and flexibility is higher (MF), the deriving tougher competitive environment leads to lower sales given the productive capacity, in fact looking at simulations with medium δf

and higher ν (lower capital intensity) firms have lower sales (S) controlling for the level of productive capacity (pC). The lower level of sales results in stronger demand shocks as showed by the dhq indicator (dhq is the difference between productive capacity and sales divided by the productive capacity, it is a measure of plant underproduction), consequently the cost of a higher difference between sales and productive capacity could be more efficiently compensate through outsourcing, moreover a lower capital intensity allows firms to absorb in a greater extent supply shocks. While, when δf is lower the possibility to compensate demand shock becomes lower, therefore firms do not increase too much their productive capacity. In fact, the correlation between ν and sales is lower in the simulation with low δf and consequently also the correlation between ν and dqh is weaker, in fact the necessity to outsource to reduce demand shocks is lower and at the same time the capacity to absorb supply shocks is reduced (table 3).

Table 3: Supply and Demand Shocks (re panel regressions)

	LF		MF	
	dqh	S	dqh	S
ν	0.019** (0.0012)	-0.827** (0.0578)	0.045** (0.0013)	-2.138** (0.0638)
pC	0.002** (0.0001)	0.819** (0.0016)	0.002* (0.0001)	0.804** (0.0019)
p	0.014** (0.0001)	-0.617** (0.0075)	0.016** (0.0002)	-0.650** (0.0078)
uc	0.142** (0.0019)	-3.331** (0.0561)	0.175** (0.0022)	-3.900** (0.0644)
dExp	-0.081** (0.0008)	4.031** (0.0471)	-0.084** (0.0008)	4.187** (0.0503)
dHorI	0.070** (0.0018)	-5.071** (0.1363)	0.065** (0.0018)	-4.760** (0.1391)
firms	46,811		47,618	

Note: Standard error in parenthesis below the coefficients. Asterisks denote significance levels (**: $p < 5\%$; *: $p < 10\%$). All regressions include time dummies

On the other side changing δf the impact on integration is just partially relevant with lower and medium ν (respectively LN: $\nu = 0.2$, MN: $\nu = 0.5$), while the case of high ν (HN: $\nu = 0.8$) presents a significant negative relationship between all the integration indicators and δf . Therefore with high ν , so with low capital intensity, an increase of flexibility results in higher outsourcing, in fact low capital intensive firms can reduce demand shocks recurring to outsourcing and, at the same time, offer shocks could be easily absorbed (table 4).

EXPORTER AND IMPORTER PREMIA

There is a strong empirical evidence that in the same economic sector there are huge differences in productiv-

Table 4: Production Fragmentation and Flexibility (flexibility δf as independent variable)

	LN	MN	HN
ICm	0.001 (0.0043)	-0.006 (0.0052)	-0.015** (0.0054)
ICf	-0.001 (0.0038)	-0.006 (0.0038)	-0.018** (0.0041)
INm	-0.007** (0.0038)	-0.010** (0.0043)	-0.031** (0.0032)
INf	-0.009** (0.0032)	-0.016** (0.0034)	-0.032** (0.0032)
IQm	-0.012** (0.0042)	-0.015** (0.0052)	-0.020** (0.0053)
IQf	-0.013** (0.0035)	-0.017** (0.0038)	-0.023** (0.0040)
sim	100	100	100

Note: Standard error in parenthesis below the coefficients. Asterisks denote significance levels (**: $p < 5\%$; *: $p < 10\%$). All regressions include time dummies.

ity among firms, part of these differences are the consequence of: the better performance of exporter firms (the exporter premia), to the better performance of firms that invest abroad to produce and sell final products (horizontal integration) and in a minor extent to the importer premia, in fact importers present higher productivity than not importers (Bernard et al., 2001; Castellani et al., 2009; Feenstra, 2002). The model is able to replicate these empirical results endogenizing technological change and assuming the presence of fixed and variable cost to export, invest abroad and import (importing is equivalent to outsourcing or vertical integrate from abroad, in the last case we have intra-firm import). Exporters, importers and investors abroad present a better performance because from one side they have to increase their productivity to overcome the obstacle represented by the initial fixed cost to enter foreign markets (Melitz, 2003; Helpman et al., 2004). On the other side, entering the foreign market gives higher sales opportunities generating more resources that could be used to continue to follow the virtuous competitive policy, which allowed them to overcome the initial fixed costs. Consequently these difference in productivity are the consequence of an ex-ante self selection process and of an ex-post growth of productivity (Serti et al., 2008).

Productivity differences associated with selling and sourcing decisions could be detected by simple econometric analysis that are not aimed to find causal relationships. The econometric test is based on dummies associated with the status of exporter (dExport) or with the decision of horizontally integrated (dHorInt), controlling for the level of capital intensity of the sector and time dummies, eliminating in this way sectoral time and cohort effects, using both pooled and random effect analy-

sis.

The correlations shows that unit costs are lower for exporters than for firms that do not integrate in both low and high flexibility simulation, moreover (as above) regressions underline the negative relation between unit cost and sectoral capital intensity (table 5).

Table 5: Exporter Premia, Pooled Regression (pr) and Fixed Effect Regression (fe)

	LF		MF	
	uc(pr)	uc(re)	uc(pr)	uc(re)
ν	-0.001** (0.003)	0.007** (0.0042)	-0.014** (0.0029)	-0.012** (0.0041)
dExport	-0.097** (0.0012)	-0.001** (0.0001)	-0.099** (0.0012)	-0.001** (0.0001)
dHorInt	-0.157** (0.0016)	-0.011** (0.0001)	-0.158** (0.0016)	-0.001** (0.0001)
n. obs	59,126		60,348	

Note: Standard error in parenthesis below the coefficients. Significance levels **: $p < 5\%$; *: $p < 10\%$. Regressions include time dummies.

At the same time, in regressions with dummies for the outsourcing decisions: firms vertically integrated domestically (dIntHome), firms vertically integrated in the foreign country (dIntAbroad) and firms that outsource from abroad (dOutAbroad) present a better performance than firms that outsource from home (table 6).

Table 6: Importer Premia, Pooled Regression (pr) and Fixed Effect Regression (fe)

	LF		MF	
	uc(pr)	uc(re)	uc(pr)	uc(re)
ν	-0.007** (0.0031)	-0.007** (0.0042)	-0.016** (0.0030)	-0.012** (0.0041)
dIntHome	-0.012** (0.0006)	-0.001** (0.0001)	-0.012** (0.0006)	-0.001** (0.0001)
dIntAbroad	-0.020** (0.0006)	-0.001** (0.0001)	-0.021** (0.0006)	-0.001** (0.0001)
dOutAbroad	-0.009** (0.0006)	-0.001** (0.0001)	-0.008** (0.0005)	-0.001** (0.0001)
firms	59,126		60,348	

Note: Standard error in parenthesis below the coefficients. Significance levels **: $p < 5\%$; *: $p < 10\%$. Regressions include time dummies.

More in general importers have lower unit cost (higher productivity) thanks to the combined performance of firms that integrate vertically abroad and firms that outsource from abroad (dImpA), in fact importers performance slightly overcomes that of firms that integrate or outsource at home (table 7).

Table 7: Importer Premia, Pooled Regression (pr) and Fixed Effect Regression (fe)

	LF		MF	
	uc(pr)	uc(re)	uc(pr)	uc(re)
ν	-0.0071** (0.0031)	0.0071* (0.0042)	-0.0167** (0.0030)	-0.0124** (0.0001)
dImpA	-0.0078** (0.004)	-0.0002** (0.0001)	-0.0081** (0.0004)	-0.0002** (0.0001)
firms	59,126		60,348	

Note: Standard error in parenthesis below the coefficients. Significance levels **: $p < 5\%$; *: $p < 10\%$. Regressions include time dummies.

CONCLUSIONS

This agent based simulation model is an attempt to treat jointly two usually separated fields of research in international trade economics: international selling and sourcing decisions. Assuming that flexibility to demand and supply shocks could be an important factor in determining the choice to integrate or not the production of intermediate goods, the model is able to replicate the stylized fact according to which in sectors with higher capital intensity the percentage of intermediate goods import from foreign affiliate is higher. On the other side assuming fixed cost to export and endogenizing technological change (considering innovations as consequence of firms innovative efforts), the model replicates two micro stylized fact: the exporter and importer premia.

This model treats partially and in a very stylized way the problems of innovation efforts and firms structure in an international dimension, nevertheless the simplicity of the firm decision processes allow the model to be easily modified and used for different applications and topics (for instance the analysis of the ex-ante and ex-post characteristics of importers and exporters, or it could even be used to study the effect of asymmetries among countries deriving from differences in factor endowment or technological capabilities). It might be important to validate the micro-macro relationship emerging from the simulation, in fact even if the simulation approach has to deal with the complexity of the system reproduced, it might be useful to test the dynamic effects of different combinations of policy measures (as import and export taxes or incentives, flexibility to shocks tools etc..). Finally, a better understanding of the factors influencing export and import micro decisions might offer useful means to policy makers in different area of interest (for instance balance of payment policy effects or the reactivity to exchange rate variation). At the same time the analysis of the sectoral differences in firm's organization could give important suggestion on industrial policy interventions.

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