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ORIGINAL PAPER

Pass-on trade: why do firms simultaneously engage in two-way trade in the same varieties?

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Abstract This paper documents that a large fraction of trade flows at the firm level consists of simultaneous imports and exports in identical products, narrowly defined at the 8-digit product classification, which we call *pass-on trade* (POT). We use data on imports and exports at the firm and product level for Slovenian manufacturing firms in the period 1994–2008, to show that, on average, 70 % of all exporting firms engage in POT. This corresponds to more than 50 % of all exported products. Thus, imported products that are exported again by the same firm is a statistical regularity of trade of Slovenian manufacturing firms. We document that the use of POT is increasing in firm size, product diversification, multinational status as well as firm productivity and profitability. We offer and explore empirically a number of explanations for POT. Among possible explanations, we find evidence on the importance of firms' multinational networks and demand complementarities between firms' own and POT products. The latter confirms the theoretical

The paper has benefitted from discussion with participants of the ISGEP 2011 workshop (University of Lüneburg), seminars at the University of Ljubljana and UC Louvain, as well as the EBR 2011 Conference (University of Ljubljana), EITI 2012 Conference (Keio University, Tokyo) and LETC 2012 conference (University of Ljubljana). We are grateful to the Slovenian Statistical Office for allowing us to access and analyze confidential data on international trade transactions.

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explanations for *carry-along trade* (CAT) as developed by the recent work of Bernard et al. (2012).

Keywords Pass-on trade · Multi-product firms · Two-way trade

JEL Classification R10 · R15

1 Introduction

Back in 1957, at a conference on Economic Consequences of the Size of Nations, a Dutch economist P.J. Verdoorn (published in a conference compendium in 1960) presented path-breaking empirical evidence on the *Intra-block Trade of Benelux* countries. The evidence demonstrated that the Benelux countries engage in simultaneous two-way trade in similar products. This evidence was in sharp contrast to the predictions of the standard Heckscher-Ohlin (HO) model. In particular, it predicts that countries differing in relative factor abundance will specialize in goods produced more intensively in countries' relatively abundant factor, thus leading to one-way trade specialization in homogeneous goods.

Verdoorn's findings ignited a landslide of empirical research studying the extent and determinants of intra-industry trade of differentiated goods. In 1975, the Grubel and Lloyd (1975) monograph provided the definitive evidence showing intra-industry trade as a key empirical regularity of trade between developed countries, which was shown to be as high as 70 % of bilateral trade among some country pairs. However, it lasted more than two decades after the initial work of Verdoorn to come up with theoretical foundations for this regularity, based on a monopolistic competition framework, developed initially by Krugman (1979, 1980). Although firms in the Krugman model are homogenous in terms of size and productivity, the model shows that it is optimal for them to differentiate and specialize in producing one variety. Consequently, countries with similar income per capita are shown to engage in trade of differentiated, but not identical varieties.[1] The more recent trade models additionally exploit the role of heterogeneous firms, which reduces the scope for producing and trading identical varieties even further (Melitz 2003; Bernard et al. 2011).

In contrast to this theoretical work, Damijan et al. (2012), studying the role of imported varieties on firms' productivity and expanded export scope, surprisingly find that a sizeable proportion of products added or dropped on a year-to-year basis by Slovenian manufacturing firms consists of identical varieties. Similarly, recent evidence by Bernard et al. (2010d, 2012) using linked production and export data at the firm and product level for Belgium indicates that there exist additional regularities in trade, which cannot easily be reconciled with existing multi-product models of trade. In particular, they document that three quarters of the exported products and 30 % of the export value of Belgian manufacturers are in goods that

[1] Later, it was shown that under special circumstances, such as reciprocal dumping, cross-border and seasonal trade, countries can also engage in two-way trade in identical commodities (Brander 1981; Greenaway and Milner 1983; Balassa 1986).

are not produced by the firm. This is called carry-along trade (CAT). Furthermore, they find that the shares of CAT products and CAT exports are strongly increasing in firm productivity and hence these products are concentrated in the largest and most productive firms.

This paper documents a related phenomenon. In particular, using detailed transaction-level data for Slovenian manufacturing, we document that a large fraction of firm-level exports occurs in the same 8-digit Combined Nomenclature (CN) product category that a firm has imported in the same or in the previous year. Thus manufacturing firms seem to engage in simultaneous two-way trade in the same varieties, where firms *pass-on* previously imported varieties to exports. We will call this pass-on trade (POT), which can be potentially seen as a sub-set of CAT.[2]

We document that, on average, over the 1995–2008 period, almost 70 % of all exporting firms engage to some extent in POT. Almost 40 % of all exported products of an average exporter consist of POT products, whereby the intensive margin of POT products is lower than in exports of firms' own products. Overall, by 2008 the value of POT exports is close to 13 % of the aggregate value of manufacturing exports. This indicates that POT is a prevailing regularity of trade of Slovenian manufacturing firms. We document that the extent of POT is increasing in firm size, product diversification, multinational status as well as firm productivity and profitability.

There could be various potential explanations for these new facts characterizing trade. The first is related to simple price arbitrage between different markets, with firms acting as trade intermediaries in line with Akerman (2010) and maximizing the profits from price differences within the same product category across markets. Second, a firm may serve as an intermediary within the multinational firms' networks. Bernard et al. (2012) offer additional explanations for CAT, which may be also relevant for POT. The first one relates to firm's efficiency of distribution networks allowing to sell a wider range of sourced products through an own distribution network. And the second one refers to the complementarities in the demand scope allowing a firm to offer additional sourced products that are complementary to its own products.

Confronting these possible explanations with the data points towards three plausible explanations of why do firms engage in POT: (i) firms engage in serving as an intermediary within the multinational firms' networks, (ii) firms engage in price arbitrage of ready-made products, which are sourced internationally, across a wide range of markets they serve with their own products, and (iii) firms engage in placing imported products, which are sourced as proprietary products. All of these firms' strategies of engaging in POT, however, require both high firm efficiency in placing the products (efficient distribution network) and a complementarity in firm demand scope. Our empirical work finds robust evidence on the importance of firms' multinational networks and demand complementarities between firms' own

[2] Since we have no information on domestic production, we cannot compute the extent of CAT. But it is likely that POT is closely related to CAT as documented by Bernard et al. (2010d, 2012). As shown later in this paper, CAT may account for total local and international sourcing of products, while POT entails only internationally sourced products that have been passed-on to exports.

and POT products in firms' decisions to introduce and expand the number of POT products to any market.

The remainder of the paper is outlined as follows. Section 2 describes the data set. Section 3 provides major stylized facts about POT by investigating the extensive and intensive margins of POT exporters as well as the productivity and profit premia of POT exporters. Section 4 empirically accounts for the main determinants of POT and provides a number of empirical tests of firm efficiency in placing own and sourced products and the role of complementarity in demand. Section 5 concludes.

2 Data and descriptive statistics

2.1 Data

We use data from three sources covering Slovenian manufacturing firms and their trade for the period 1994–2008. The first data set is the firm and transaction level of trade data provided by the Slovenian Customs Administration (CARS) and the Slovenian Statistical Office (SORS), which records all foreign trade transactions of firms that are engaged in international trade in products.[3] These transactions are reported at the 8-digit product level defined according to the EU Combined Nomenclature (CN), which distinguishes between 10,108 8-digit product codes in 1994, 10,404 product codes in 2003, and 9,699 codes in 2008. CN product codes have been subject to revisions over the period, with major changes of product lines in 1996, 2002 and 2007. These changes are mostly at the last 2- or 3-digits, with either one-to-one code changes (old code abandoned and a new one established), code mergers (old codes merged to a single new or existing one) or code splitting (old code split into two or more new codes). In order to eliminate spurious product churning, we account for these CN changes by applying year-to-year corrections in the code throughout the period.[4]

From the original trade data set, we extract the following information for each shipment: the value of imported and exported products in EUR currency, the physical quantity in units of output (units or kilograms), the corresponding CN code as well as codes for country of origin and country of destination. The transaction-level import and export volumes and quantities are then aggregated to create an annual trade data set on firms by products and country that is matched with annual data on firm characteristics.

The second source of data is the Agency of the Republic of Slovenia for Public Records and Related Services (AJPES), which covers the balance sheet and income statements of all Slovenian incorporated firms (all limited liability companies and joint stock companies) as well as large sole proprietors with at least 30 employees.

[3] See Online Appendix 1 for more details on the coverage of trade data.

[4] See Online Appendix 1 for a detailed description of the applied CN year-to-year corrections. As shown in Table 13 in Online Appendix 1, periodic changes in the CN code and corrections of the codes do not have a substantial impact on the average number of exported products and hence do not affect significantly the product churning rates.

This data set includes complete financial and operational information for all firms. In particular, the accounting data contains information on the total domestic and foreign sales, costs of intermediate goods, materials and services, the physical capital, the total value of assets, the number of employees, and the NACE 5-digit industry code.

The third data set is provided by the Bank of Slovenia (BS) information on inward and outward capital investments of Slovenian firms with non-residents. Specifically, this data is based on compulsory reports of capital investments between residents and non-residents. The data on capital cross-border investments are obtained from reports on credit transactions with the rest of the world and reports of short-term claims and liabilities arising from business with non-residents. This information enables us to construct variables on engagement of Slovenian firms in inward and outward foreign direct investment (FDI) using the common definition of the IMF's Balance of Payments Manual (5th edition 1993).

The data from all three sources were matched using a common firm identifier, i.e., firm registration number. We restrict our attention to manufacturing firms and exclude all firms with zero employees and zero output. Thus, our sample of firms ranges between 3,295 firms in 1994 and 4,446 firms in 2008.

2.2 Margins of trade of multi-product firms

Slovenian manufacturing firms are highly engaged in international trade. Table 1 shows that in 2008 about 75 and 83 % of manufacturing firms have been engaged in exporting or importing at least one product, respectively. In addition, about 83 % of exporting firms and 85 % of importing firms are multi-product traders, accounting for 99.4 % of total exports and 99.8 % of all imports.[5] Summary statistics also suggest that both exports and imports are highly concentrated in a few large firms. The top 12 % of exporters that export more than 50 varieties account for 74 % of total exports. Similarly, the top 20 % of all firms that import more than 50 different products account for 83 % of total imports. This suggests that there is a small 'club' of exporters and importers that account for the vast majority of total trade. This is in line, at least for the export part, with findings by Mayer et al. (2011) for French exporters. The data for Slovenia, however, show that when matching exporters with importers (not shown in the tables) both groups of traders almost perfectly overlap. In fact, 58 % of all manufacturing firms engaged in international trade are both exporters and importers. These two-way traders account for 91 and 93 % of total employment and value added, respectively, and for 98 and 99 % of total exports and imports, respectively.[6]

Recent models of multi-product firms typically predict that larger and higher productivity firms have higher volumes of exports due to higher numbers of export

[5] Note that the export numbers are somewhat higher than those reported for other countries. Bernard et al. (2010c) report for the United States that 58 % of exporters are multi-product and account for more than 99 % of exports. For Belgium, 65 % of all exporters are multi-product and account for more than 98 % of exports (Bernard et al. 2010d).

[6] At the same time, importers and exporters dominate in every respect the whole manufacturing sector as our sample consists of all manufacturing firms with non-zero employment.

Table 1 Summary statistics for importing and exporting firms by number of traded products in 2008, in EUR (mean values, 1994 prices)

No. of products traded	Exporters					Impoters				
	No. of firms	Freq. (%)	No. of empl.	Value of exports	Cum. freq. (%)	No. of firms	Freq. (%)	No. of empl.	Value of imports	Cum. freq. (%)
0	1,122	25.2	15.8	0	0.00	747	16.8	9.2	0	0.00
1	565	12.7	13.6	48,348	0.58	559	12.6	8.7	13,507	0.20
2	357	8.0	17.2	71,679	0.54	291	6.5	13.4	24,769	0.19
3	260	5.9	18.5	124,780	0.69	194	4.4	15.1	59,850	0.30
4	173	3.9	21.9	263,908	0.97	129	2.9	17.5	109,790	0.37
5	138	3.1	23.3	232,854	0.68	115	2.6	16.8	108,073	0.32
6–10	398	9.0	39.8	387,860	3.28	355	8.0	19.3	166,403	1.53
11–20	429	9.7	47.4	667,734	6.09	414	9.3	36.1	249,393	2.67
21–50	486	10.9	85.4	1,265,407	13.07	725	16.3	51.2	603,553	11.33
>50	518	11.6	279.9	6,759,066	74.10	917	20.6	201.3	3,500,629	83.10
Total	4,446	100.0	59.7	1,059,098	100.00	4,446	100.0	59.9	868,856	100.00

Source CARS, SORS, AJPES; own calculations

products and foreign markets served (e.g., Eckel and Neary 2010; Mayer et al. 2011; Bernard et al. 2010c, 2011; Di Comite et al. 2012). Table 2 shows that these predictions about extensive margins hold both for exporters and importers. The average number of export-destinations/import-source countries per firm is about 7. On the one hand, there is a large amount of heterogeneity between firms. Firms that export just one product typically export it to only one market and similarly firms that import just one product only source it from one market. On the other hand, large firms with more than 50 export products export, on average, to 37 destinations, while similarly diversified importers imported their products, on average, from 20 countries.

Table 2 also shows a similar pattern of exporters and importers in terms of the intensive margin of trade (average shipment per product and country), which appears to vary non-monotonically as the number of traded products increases. More diversified firms ship smaller values of exports and imports per product and market, whereby the intensive margin of exports exceeds the margin for imports by some 40 %. This suggests lower fixed costs of importing than exporting.[7]

2.3 Product dynamics

In Table 3, we present the statistics on the number of traded products and its dynamics. We present the data as an average over the whole period 1995–2008 and disaggregated by firm size classes. The data shows that imports are by far more diversified in terms of the total number of goods traded than exports. An average firm imports 15.6 products per year, while an exporter ships on average 5.6 products

[7] In a companion paper, Damijan et al. (2012) document these facts in more detail.

Table 2 Extensive and intensive margins for importing and exporting firms by number of traded products in 2008, in EUR (mean values, 1994 prices)

No. of products	No. of import origin countries	Value of imports per firm–product–country	Value of imports per firm–product	Value of imports per firm–country	No. of export destinat. countries	Value of exports per firm–product–country	Value of exports per firm–product	Value of exports per firm–country
1	1	21,331	21,331	21,331	1	70,168	70,168	70,168
2	1.46	13,210	18,324	26,420	1.59	39,540	57,352	79,080
3	1.82	16,901	28,031	50,702	2.06	34,948	62,910	104,843
4	2.34	18,866	42,205	75,463	2.48	34,141	70,702	136,565
5	2.71	13,917	31,171	69,586	2.96	24,484	59,629	122,422
6–10	3.73	10,641	30,191	81,680	4.03	22,874	76,779	164,533
11–20	5.23	4,999	21,094	72,725	6.42	13,657	66,420	195,080
21–50	9.20	3,066	22,148	95,098	12.53	5,657	53,643	178,295
>50	20.21	1,428	22,362	173,817	36.61	2,357	53,015	268,564
Total	6.89	7,301	19,790	75,265	7.17	20,491	47,136	114,775

Source CARS, SORS, AJPES; own calculations

Table 3 Extensive margin and product churning (adding and dropping), by size classes, per firm average over 1995–2008

Size class	Total_t	Added_t	Dropped_t	$\text{Added}_t/\text{total}_t$	$\text{Dropped}_t/\text{total}_{t-1}$
Exports					
emp < 10	1.57	0.95	0.91	0.59	0.58
9 < emp < 50	7.65	4.16	3.77	0.52	0.50
49 < emp < 250	20.50	9.76	9.32	0.47	0.48
249 < emp	64.16	28.17	26.34	0.46	0.46
Total	5.55	2.76	2.60	0.53	0.53
Imports					
emp < 10	5.20	2.84	2.84	0.61	0.64
9 < emp < 50	21.16	10.96	10.43	0.57	0.56
49 < emp < 250	56.16	26.27	26.37	0.51	0.53
249 < emp	174.20	71.20	74.09	0.44	0.46
Total	15.63	7.40	7.42	0.57	0.59

Source CARS, SORS, AJPES; own calculations

a year. Larger firms are of course more diversified, whereby a trading firm with more than 250 employees annually exports 64 products and imports 174 products.

More interesting, though, is the evidence on dynamics in the number of traded goods. Table 3 demonstrates that manufacturing firms engaged in trade seem to simultaneously add and drop both exported and imported products. Every year, an average exporter adds 2.8 new products and drops 2.6 products. That is, on average,

an exporter every year adds about 53 % of new products to its existing export set and simultaneously drops about 53 % of existing products. This is an enormous churning process that seems to be going on in exports. But apparently this holds also for imports, where these numbers are three-times higher. On average, each importer adds every year more than 7.4 new products and drops 7.4 products. Hence, in imports, each importer every year adds about 57 % of new goods to its existing imported product set and drops 57 % of existing imported products.[8] Product churning is more intense in smaller firms. Firms with less than 10 employees replace every year roughly 60 % of their exported or imported products, while largest firms (firms with more than 250 employees) every year replace about 45 % of their products traded.

3 Stylized facts on pass-on trade

Descriptive statistics presented thus far indicate that firms engage in large simultaneous adding and dropping of products in international trade. This is in stark contrast to predictions of recent models with heterogeneous firms and fixed cost of trade. This evidence on product churning in trade is, however, consistent with existing evidence. Bernard et al. (2010c) document that a majority of U.S. firms alter at least one 5-digit SIC product every 5 years. Most recently added products and the lowest-volume products are more likely to be dropped, confirming a positive correlation between product adding and dropping rates. Iacovone and Javorcik (2010) document churning in exports of Mexican firms, but relate this to trade policies, i.e., to NAFTA agreement between the United States and Mexico.

Recently, the nexus between exporting and importing has gained wider attention (see Muûls and Pisu (2009) for Belgium; Halpern and Muraközy (2011) for Hungary, etc.). Goldberg et al. (2010a, b) document for India how more imports trigger product innovation, resulting in increased exports. Bas and Strauss-Kahn (2010) confirm the close relationship between imports and exports for France. Damijan et al. (2012) also document export churning in Slovenia and relate it to globalization enabling firms to source intermediate goods abroad and using them to innovate products and to expand their export scope. However, they also show that gross churning rates of imported and exported products by Slovenian manufacturing firms are much bigger than one would normally expect and also much more intense than documented for other countries.[9] Furthermore, they indicate that simultaneous engagement of firms in extensive adding and dropping of traded goods addresses

[8] Note that Table 3 includes also products, which can be re-introduced in exports and imports. Table 14 in Online Appendix 2 shows a variant of Table 3 without including re-introduced products to the statistics of added and dropped products. Without re-introduced products the figures for added and dropped products in exports are lower by 27 %, while in imports these figures are lower by 33 %. This indicates that there is a substantial product churning going on in Slovenian exporting and importing as roughly 70 % of all added products consist of products, which are new to the firm (i.e., have never been exported/imported before). Similarly, about 70 % of all dropped products are dropped forever (i.e., will not be exported/imported again).

[9] Iacovone and Javorcik (2010) document gross churning rates of 30 % for Mexican exported products, while these figures in Slovenia are doubled.

only part of the usual firms' product dynamics aiming to optimize both their imported input mix and their exported product set towards their most valuable inputs and produced (exported) products, respectively. They hint to the point that the explanation behind the large churning figures seem to be that firms engage in simultaneous adding and dropping of traded products within the same CN-8 categories.

In this section we study this issue in more detail and provide some stylized facts about simultaneous trading and churning (adding and dropping) of traded products within the same CN-8 varieties, which we call *pass-on trade* (POT). We start with the definition and then study the extent and various dimensions of it.

3.1 Definition of pass-on trade

Firm's total exports of each product can consist of firm's in-house production, its domestic sourcing or its international sourcing. In this paper we study the extent of simultaneous two-way trade in the same products at the firm level, i.e., we account for the fraction of products within the same product code that have been passed-on from imports to exports. This means that we focus solely on potential international sourcing of products and abstract from potential domestic sourcing. The extent of potential POT is depicted in Fig. 1. Bernard et al. (2010d) find a similar pattern that Belgian firms export products, which they do not produce. However, they match firms' export data and firms' production data (at PRODCOM classification). They label the identified exports of goods not being produced by the same firms as *carry-along trade* (CAT). It is clear that CAT as defined by Bernard et al. (2010d) is a broader concept as it consists of all exports of the good that are not produced in-house, and hence involves potentially both domestic and international sourcing.

In order to account empirically for the extent of firms' simultaneous imports and exports in the same products, we match firm-level data on exported and imported products defined at the most disaggregated product level (CN-8 product code) and further disaggregated by source and destination countries. We do so for the whole period 1994–2008. This enables us to track exactly the pattern of imports and exports of goods within the same CN-8 category over time and over source and

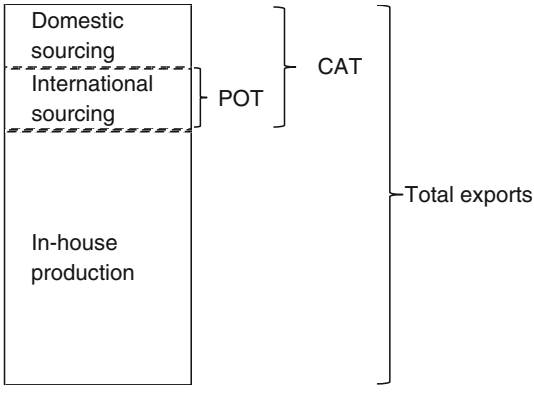

Fig. 1 Definition of POT versus CAT. *POT* firm's simultaneous two-way trade within the same product code. *CAT* exports of goods that a firm does not produce

destination countries. Out of these expanded trade data (with about 10 million observations on firms by products, countries and trade-type), we then identify products that are simultaneously imported and exported at the firm level.

The definition of POT is given in Eq. (1). A firm can import POT products either in the current or in the previous years and export them in the current year. A plausible assumption is that the *clearing period* is 2 years,[10] i.e., a POT product is defined as any currently exported CN-8 product c that a firm i has imported in the same or in the previous year (in year t or $t-1$) from any of the source countries:

$$POT_{it}^{c} = 1 \quad if \begin{cases} m_{it}^{c} > 0 \quad or \quad m_{it-1}^{c} > 0 \\ x_{it}^{c} > 0 \end{cases}, \quad c = CN-8 \tag{1}$$

Thus, POT products are firm's CN-8 category products[11] imported in year t or $t-1$ that the firm subsequently passed-on further to exports in year t.

In value terms, we put a restriction on the export value of POT products. As we focus solely on potential international sourcing of products, we constrain the maximum value of exports of each POT product to the value of its imports. In more detail, we define export value of each POT product as:

$$\begin{aligned} x_i(\text{Max}) &\leq m, \\ m &= (m_t + m_{t-1})/2 \end{aligned} \tag{2}$$

This means that value of exports of each POT product is set to its actual value. In case of export value of POT exceeding its import value, the former is then constrained to the average value of imports in periods t and $t-1$.

3.2 Patterns of pass-on trade

Table 4 presents margins of POT exports. It reveals that simultaneous trade within the same CN-8 category (POT) is a widespread and significant phenomenon in Slovenian foreign trade. Almost 70 % of exporters regularly engage in POT. Over the period 1995–2008, firms not engaged in POT exported, on average, 3.2 products, while firms engaged in POT exported 23 products. Among the latter, only half of the products consisted of their own products and half of them consisted of POT products. Thus, almost 38 % of the total number of exported products of Slovenian manufacturing firms consists of recently imported products, while POT contributes on average almost 11 % to the total value of manufacturing exports. The intensive margin of POT is lower than the intensive margin of exports of firms' own products by some 60 % (see last column of Table 4). Interestingly though, while the intensive margin of POT products is decreasing over time, the extensive margin in terms of the number of exported products is increasing. In 2008, the number of

[10] The clearing period can also be either shorter or longer. In Online Appendix 3 we provide some robustness checks using different lenghts of the clearing period, but the extent of POT does not vary significantly with the length of the clearing period.

[11] In Online Appendix 3 (see Table 15) we also provide robustness checks regarding the aggregation level of products. We find that that for reasonable variations in the level of aggregation (CN-8 vs. CN-6) POT phenomenon seems to be very robust.

Table 4 Margins of POT, measured at the CN-8 product level, per firm average over 1995–2008

Years	Share of exporters with POT	Average number of exported products			Share of POT (in %)		Shipment per product: Ratio pure POT vs. non-POT
		Exporters without POT	Exporters with POT[a]		Total number of exp. products	Total value of exports	
			Non-POT products	POT products			
1995	64.9	3.3	9.7	6.6	33.0	8.0	0.44
1996	65.6	3.7	11.5	8.6	33.1	10.1	0.76
1997	70.0	3.4	10.5	9.2	38.3	9.4	0.80
1998	70.1	3.1	9.8	9.7	40.0	10.1	0.64
1999	70.5	2.9	10.2	10.5	41.0	10.0	0.45
2000	70.9	2.9	10.9	11.5	40.2	9.8	0.61
2001	71.5	3.0	10.9	12.0	40.6	10.2	0.54
2002	72.1	3.0	11.3	12.3	40.7	9.6	0.55
2003	71.5	3.1	10.6	12.2	40.2	9.5	0.56
2004	66.9	3.2	11.2	12.8	38.2	10.3	0.45
2005	64.7	3.1	12.3	13.7	36.6	11.1	0.38
2006	60.9	3.5	13.3	14.5	33.7	12.4	0.29
2007	62.8	3.4	13.5	14.4	35.0	12.7	0.30
2008	62.8	3.1	12.3	14.0	35.7	12.6	0.33
Average	67.6	3.2	11.3	11.6	37.7	10.8	0.43

Source CARS, SORS, AJPES; own calculations

[a] Exporters with POT defined as firms exporting at least one POT product. POT is defined at CN-8 product in current or lagged period. Value of exports of POT products is set at its actual value. In case of export value of POT exceeding its import value, the former is constrained to the average value of imports in years t and $t-1$ according to: $x_t(\max) \leq (m_{t-1} + m_t)/2$; where x and m denote exports and imports of CN-8 product at the firm level

exported POT products exceeded the number of firms' own products by some 15 % and POT exports accounted already for 12.6 % of total value of Slovenian exports.[12]

This pattern of simultaneous trade is widely spread over all exporting firms. As shown in Table 5, even among firms exporting only one good there is a 27 and 23 % probability that the existing product or newly added exported product, respectively, will be passed-on from imports. Both shares of POT increase with firms' product diversification. In other words, for firms exporting more than 50 products, more than half (57 %) of their total number of exported products will, on average, consist of passed-on products. For their newly added exported products this figure is 42 % (see

[12] Note that we use a rather restrictive measure of POT referring only to simultaneous two-way trade in the same products and hence accounting only for international sourcing. We also restrict the maximum export value of each POT product to the average import value during the recent and previous year, and, hence, we do not account for potential domestic sourcing of products. Bernard et al. (2012) compare firm's own production with firm's exports of the same products and hence account also for domestic sourcing of products. They find that more than 90 % of Belgian exporters export more than they produce and that CAT accounts for more than 30 % of total export value.

Table 5 Extent of POT as a share in overall exports, measured at CN-8 product level, per firm average over 1995–2008 (in %)

Number of products exported	Number of firms	Share in no. of all exported goods	Share in no. of newly added exported goods	Share in no. of total exported goods from same country
1	6,037	27.5	23.0	14.2
2	3,887	29.2	25.8	15.3
3	2,791	30.5	28.1	14.9
4	2,034	32.1	30.1	16.5
5	1,623	35.7	32.2	18.5
6–10	5,266	38.6	34.2	19.4
10–20	4,674	44.2	36.8	21.7
20–50	4,165	50.0	38.3	23.2
>50	2,235	56.6	42.2	24.9
Total	32,712	37.7	29.9	18.5

Source CARS, SORS, AJPES; own calculations

Table 5). At the same time, a substantial part of exported products in bilateral trade with the same country consist of POT (on average, about 18.5 % of firms' total number of exported goods). This shows that firms can import products also from the country to which they export the same goods. All three figures increase in the extent of firm product diversification, indicating that a more diversified firm is also more inclined to complement its existing set of exported own products with a set of imported products.

Table 6 further shows that POT is not confined to existing multi-product exporters only, but can be observed also for new exporters. On average, in the first year of exporting, the share of POT is about one-third (32 %). In the second year after starting to export, more than one-third (38 %) of newly added products are likely to be passed-on imported products. The share of passed-on products increases then to half of total exported products up to the tenth year after starting to export. In other words, the expansion pattern of new exporters along the extensive margin is by a large margin based on their passed-on imported products.

Table 5 above also shows that POT is less frequent within the same pair of countries where source and destination countries are the same. This suggests that firms might be engaged in intermediation of products between different countries. Ruling out the option of manufacturing firms serving as wholesalers (due to the widespread pattern of POT), one possible explanation for the substantial extent of POT can be firms' engagement in production and trade networks of multinational firms. Foreign-owned firms might engage in passing-on a number of products from the affiliate in country A to the affiliate in country B. Similarly, firms having affiliates abroad might organize trade flows of the same good between affiliates in different countries for minimizing transaction and trade costs. An important reason for that may be differences in tariff rates and non-trade barriers among countries where affiliates are located. Indeed, Table 7 confirms that firms, which are part of a multinational network, engage in POT more frequently. Firms owned by multinational companies on average simultaneously

Table 6 Extent of POT among surviving new exporters[a], per firm average over 1995–2008

t[b]	No. of all exported goods	No. of POT goods	Share of POT goods (in %)	
			All	Added
0	6.4	2.4	32.4	
1	9.6	4.5	42.5	37.9
2	10.9	5.5	45.2	35.8
3	12.9	6.8	47.3	38.9
4	14.7	7.6	45.5	32.0
5	15.6	8.5	46.6	31.5
6	16.8	9.7	50.0	34.9
7	17.4	9.9	49.0	33.5
8	17.8	10.7	50.3	36.7
9	18.4	10.9	49.5	36.0
10	18.2	10.7	46.2	32.3

Source CARS, SORS, AJPES; own calculations

[a] New surviving exporters are defined as those that continue exporting for at least 5 years since start

[b] t is technical time counting years after export start($t = 0$ denotes entry year)

Table 7 Extent of POT as a share in total and newly added exported products by firm multinational status, measured at CN-8 product level, per firm average over 1995–2008

Outward FDI[a]	Inward FDI[b]	Share in no. of all exported goods	Share in no. of newly added exported goods
No	No	33.3	26.1
Yes	No	51.2	38.0
No	Yes	58.4	46.2
Yes	Yes	58.0	41.2

Source CARS, SORS, AJPES; own calculations

[a] Firms that are majority foreign owned

[b] Firms that have affiliates abroad

trade 58 % of their total number of exported products and 46 % of all newly added products. These shares are a bit lower (51 and 38 %, respectively) for firms that have their own affiliates abroad. More frequent is POT among firms which are both foreign owned and having affiliates abroad (58 and 41 %, respectively). Nevertheless, even pure domestic firms are trading substantial shares of their products simultaneously (33 and 26 %, respectively).

This indicates that POT is a widespread phenomenon among all manufacturing firms and is not restricted to multinational firms alone. As shown in Table 8, while POT accounts for 18.5 % of all exported goods among the same country pair, it is less characteristic for bilateral trade with the country where firms have located their primary owners or affiliates. With these countries total direct shares of POT in number of exported products is 2.8 (with inward FDI country) and 4.1 % (with outward FDI country) only. This further confirms the general pattern of POT among Slovenian firms.

Table 8 Extent of POT as a share in number of exported products by type of country, measured at CN-8 product level, per firm average over 1995–2008 (in %)

	All countries	Same country[a]	With inward FDI country[b]	With outward FDI country[c]
Share in no. of all exported goods	37.7	18.5	2.8	4.1
Share in no. of newly added exported goods	15.3	15.3	2.2	3.9

Source CARS, SORS, AJPES; own calculations

[a] Source and origin countries of POT are the same

[b] Firms' trade with countries of firms' major foreign owners

[c] Firms' trade with countries, where firms have their foreign affiliates

3.3 Pass-on trade premia

The evidence so far demonstrates that POT is not only a widespread phenomenon among manufacturing firms, but it is also more pronounced among larger firms with more diversified product sets and for firms with higher multinational status. This implies that POT is likely to be correlated with firm productivity. This is in line with Bernard et al. (2012) who also find that it is the most productive firms that are most heavily engaged in CAT. At same time, firms' engagement in POT should be profitable, otherwise there would be no obvious reason for firms to engage in it.

In this section, we investigate the correlation between the degree of engagement in POT and firms' productivity and profitability. In order to account for this we will estimate the premia of firms' engagement in POT in terms of productivity and profitability. POT premia are defined as the percentage difference in a particular performance indicator (total factor productivity, TFP, and return on assets, ROA) between firms that are to a certain degree engaged in POT. We compute the premia from a regression of a performance indicator on the share of POT and a set of control variables by estimating two specifications of the model:

$$\ln Y_{it} = \alpha + \beta POT_{it} + \gamma Control_{it} + \mu_i + \mu_I + \mu_t + \varepsilon_{it} \tag{3}$$

$$\ln Y_{it} = \alpha + \sum_{d=1}^{5} \beta Sh\_POT_{it}^{d} + \gamma Control_{it} + \mu_i + \mu_I + \mu_t + \varepsilon_{it} \tag{4}$$

where Y is a particular performance indicator (TFP and ROA). In the model (3), *POT* is specified as an overall firm share of POT defined as a continuous variable. In the model (4), we include five dummy variables for different degrees of engagement in POT. POT dummies are taking the value 1 if a firm's share of POT exceeds a particular threshold—0, 20, 40, 60 or 80 %. POT dummy variables are hence defined within specific intervals of shares of POT in the firm's total number of exported products. *Control* variables include log firm size (in terms of employment), log total number of products and markets served, dummy variables for inward and outward FDI, NACE 2-digit industry and year dummies.

Firm-level TFP is estimated using the Olley and Pakes (1996) approach, where the input coefficients in the production function are estimated separately for each of

the 2-digit NACE industries. In addition to TFP, we use an alternative performance measure, the rate of return of main operations on total assets (operating ROA), which measures the rate of firm profitability.

In line with the standard literature, we estimate (3) and (4) by OLS.[13] The coefficients from the OLS regressions can be interpreted as conditional differences in TFP and ROA of different degrees of engagement in POT as compared to the reference group, that is the industry-year averages of firms with no POT products.

Results for POT premia for both performance indicators are presented in Table 9. The first two specifications include the share of POT as a continuous variable both show that firms engaged in POT earn significant positive premia in all respects—they are more productive and earn higher profits per unit of assets than non-POT firms (see columns 1 and 2 of Table 9). This confirms our expectations about higher productivity and higher profits of POT firms. The next specifications include dummies for different degrees of engagement in POT show some non-linearities in the relationship between firm performance and engagement in POT (see columns 3 and 4 of Table 9). For firms that are the least engaged in POT, there is no significant POT premia. For the TFP measure, firms have to exceed the threshold of 20 % share of POT products to obtain a significant POT premia, while for the ROA measure the threshold is at 60 % share of POT. At the same time, estimated coefficients on dummy variables increase with the degree of POT, indicating that productivity and profitability of firms are monotonically increasing in the share of POT.

To summarize, the stylized facts presented in this section clearly show that POT is a widespread phenomenon among manufacturing firms. Almost 40 % of total products exported and more than half of the products exported by firms engaged in POT consist of previously imported products. POT is not confined to small and low productivity firms. On the contrary, the degree of engagement in POT is increasing in firm size, product diversification, multinational status as well as firm productivity and profitability. This implies that for firms engagement in POT is an equally possible option of serving foreign markets than exporting their own in-house-produced varieties. The next section investigates these implications in more detail.

4 Explanations and determinants of pass-on trade

Probably the most important implication of the previous section is that POT is a regularity among exporting manufacturing firms and that firms may consider serving foreign markets with their in-house-produced or POT products as an equally possible option. This section draws on these findings and investigates several

[13] Though the efficiency of OLS estimator may suffer due to unobserved firm heterogeneity, the use of fixed effects (FE) regression is not appropriate in this case. Since FE regression captures firms' deviations from their own long-term average, the interpretation of results obtained by this type of regression on dummy variables for different degrees of POT is cumbersome. The FE regressions will in fact identify only firms that changed their POT engagement over time to a lower or higher degree as measured by the POT dummy variables. Hence, FE regressions will estimate a correlation between a switch in the POT dummy and a change of the dependent variable. Switches in the POT dummy variables are rare and, hence, the results obtained by FE regressions are not very informative.

Table 9 Premia of firms engaged in POT in terms of TFP and ROA (OLS results)

	Dependent variable			
	TFP[a] (1)	ROA[b] (2)	TFP[a] (3)	ROA[b] (4)
Explanatory variables[c]				
POT	0.087***	0.006***		
	(0.01)	(0.00)		
Share POT (0–20 %)			−0.017	−0.006
			(0.02)	(0.00)
Share POT (20–40 %)			0.038***	−0.001
			(0.01)	(0.00)
Share POT (40–60 %)			0.074***	0.004
			(0.01)	(0.00)
Share POT (60–80 %)			0.110***	0.010***
			(0.01)	(0.00)
Share POT (80–100 %)			0.141***	0.013***
			(0.01)	(0.00)
Log employment	−0.043***	−0.019***	−0.045***	−0.019***
	(0.00)	(0.00)	(0.00)	(0.00)
Log products	0.032***	0.005***	0.042***	0.006***
	(0.00)	(0.00)	(0.00)	(0.00)
Log markets	0.055***	0.004***	0.054***	0.004***
	(0.01)	(0.00)	(0.01)	(0.00)
Outward FDI	0.088***	0.009**	0.077***	0.008**
	(0.02)	(0.00)	(0.02)	(0.00)
Inward FDI	0.137***	0.017***	0.117***	0.015***
	(0.01)	(0.00)	(0.01)	(0.00)
Outward and inward FDI	0.123***	0.006	0.136***	0.008
	(0.03)	(0.01)	(0.03)	(0.01)
Time dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	27,926	27,926	27,926	27,926
R^2 adjusted	0.393	0.057	0.395	0.058

Standard errors in parentheses. ***, ** and * denote statistical significance at 1, 5 and 10 % level, respectively

[a] Revenue based Olley–Pakes measure of total factor productivity

[b] Returns-to-assets (ROA)

[c] POT is a continuous share of POT. The Share POT are dummy variables with specified intervals of shares of POT in the firm's total number of exported products

dimensions related to firms' entry and expansion dynamics of POT products relative to their own produced varieties. We first outline several potential explanations for firms to engage in POT. Next we study firms' decisions to engage in POT and continue with investigating the survival and dynamics of POT products. We finish

with an analysis of complementarity between POT and own products as a potential explanation for the widespread phenomenon of POT.

4.1 Explanations of pass-on-trade

As simultaneous exports and imports within the same product category is a new phenomenon for manufacturing firms, the literature does not provide many explanations for it. There has been some theoretical work on the role of networks in promoting trade (e.g., Rauch 2001; Rauch and Watson 2004; Petropoulou 2007) and on the role of intermediaries in trade (e.g., Ahn et al. 2010; Akerman 2010; Bernard et al. 2007, 2010a, 2010b). However, empirical and theoretical work in this area is based on the assumption that intermediary firms are non-producing, which rules out the case of manufacturing firms.

The only exception is the recent work by Bernard et al. (2010d, 2012), who investigate the empirical finding of firms' exports of goods that they do not produce—carry-along trade (CAT). In their first version of paper, Bernard et al. (2010d) list some potential explanations for the existence of CAT. However, as shown above CAT does not necessarily overlap completely with the observed POT. In case of CAT, firms can—in addition to their own products—export any kind of products that they do not produce that can be sourced either in the local market or internationally. In contrast, POT is restricted only to simultaneous exports and imports within the same product category. Nevertheless, the four possible explanations for CAT as outlined by Bernard et al. (2010d) may serve as a good starting point to explain also a part of POT.

The first possible explanation for POT is that firms, once making the decision about starting to export and paying the fixed country-specific entry cost, may expand a set of exported products by passing-on part of the imported products. In this case firms behave as trade intermediaries in line with Akerman (2010) by paying the product and country fixed cost and setting price as a markup over the price of imported products. Second, one can think of firms that engage in price arbitrage between different markets by maximizing the profits from price differences within the same product category across markets. In addition, serving as an intermediary within the multinational firms' networks may as well account for a substantial part of simultaneous POT. Both seem to provide a likely explanation for large parts of observed POT.

Other explanations for CAT offered by Bernard et al. (2010d) relate to firms' re-exports of complementary products to the core exported products and to firms' exports of inputs and parts to their affiliates abroad. These explanations, however, do not necessarily apply to POT unless these exported products have been sourced internationally. More plausible is the fourth explanation referring to rebranding of imported goods. A firm that has developed its brand equity either as a firm or for its core products can use it for selling a wider range of products not produced by this firm. Importing products, rebranding and selling them with positive profits net of country and product fixed cost of exporting seem to be a viable explanation for a large part of POT.

More recently, Bernard et al. (2012) find that both the set of firms' own and a set of firms' sourced (locally or internationally) products is increasing in firm productivity. Similarly to this paper, they find that it is the most productive firms that are most heavily engaged in exporting of sourced products. In their model they derive conditions, which allow the theoretical predictions in a multi-product context to match the stylized facts found in the data. On the supply side, a necessary condition is to allow for the marginal cost of sourcing to be lower than the marginal cost of producing in-house. An alternative adjustment would be to assume that most productive producers have also the most efficient distribution network allowing them to obtain lower marginal costs of CAT. On the demand side, they show that introducing demand scope complementarity again enables to match the empirical facts that most diversified producers also introduce the most of sourced products to their exports product set.

Matching the above theoretical implications with observed facts in our data, however, does require some streamlining of potential plausible explanations of POT. The data seem to suggest that introducing new sourced (POT) products to exports is associated with similar fixed cost as introducing own in-house-produced varieties.[14] Similarly, it may also imply that overall marginal costs of a sourced product should be equal (or lower) than the overall marginal cost of placing own products.[15] The above condition may easily be obtained if a firm is engaged in simple price arbitrage across markets or as an intermediary within the multinational firms' networks. In this case, the marginal cost of sourcing and placing non-proprietary products in exports may well be lower than the marginal cost of producing the equivalent products in-house or of sourcing them in a traditional proprietary way and placing them in exports. The former, however, requires an efficient distribution network. This requirement is satisfied when firms reach a sufficiently high productivity level.

In addition, theoretical models of multi-product firms that operate in multiple markets (e.g., Bernard et al. (2010c)) typically ignore the positive relationship between the total development cost and product range and assume that firms pay a one-off cost to start producing all existing products and decide which of these they produce only upon learning how efficient they are in producing them. These models also ignore the fact that firms must decide on production capacity for each product. When explaining the expansion pattern of new exporters, Damijan et al. (2011) argue that some firms that are capacity constrained may well find it cheaper to source ready-made products abroad and after rebranding pass them on to exports together with their own core products. This again requires higher productivity of firms in production of their core products and higher efficiency in placing their own products to foreign markets.

[14] Stylized data above shows that for an average exporter the number of POT products is larger than the number of non-POT products.

[15] The overall marginal cost here refers to either total cost of development and placement of own products or to total cost of proprietary or non-proprietary sourcing and placement of sourced products. Proprietary sourcing referrs to establishing own affiliate abroad or to develop a product and outsource its production to outside firms. Non-proprietary sourcing instead referrs to simple purchasing of ready-made varieties abroad.

All of these plausible reasons for engaging in POT (or CAT)—i.e., serving as an intermediary within the multinational firms' networks, engaging in price arbitrage or sourcing proprietary or ready-made products—however, require both firm efficiency in placing the products (efficient distribution network) and a complementarity in firm demand scope. In the next subsections, we provide some empirical tests of firm efficiency in placing own and sourced products and the role of complementarity in demand.

4.2 Entry with POT and own products

The stylized facts documenting the equal number of own and POT products in the export scope of an average exporter suggest that fixed costs of entry to foreign markets may be alike for own and POT products. To empirically account for possible differences (similarities) in entry cost, we assume that a firm has a choice of entry to a foreign market with either own or sourced (POT or CAT) products. Since these decisions are not independent, we have to model them as joint decisions allowing for correlations in error terms caused by the same unobservables. A natural choice for modeling joint decisions is to use a bivariate probit estimation, which in our case assumes the following properties:

$$Pr(Y_{it}^{P} = 1 \big| Y_{it-1}^{P} = 0, Y_{it}^{O} = 1 \big| Y_{it-1}^{O} = 0) = \Phi_2\left(\mathbf{X}_{it-1}\widehat{\beta^{P}}, \mathbf{X}_{it-1}\widehat{\beta^{O}}, \widehat{\rho}\right), \qquad (5)$$

where Y_{it}^{P} and Y_{it}^{O} denote firm's i decision to enter the foreign market either with POT or own products in year t, respectively. Each of them assumes value 1 if a firm recorded a positive value of exports in year t either with a POT or own product, respectively, and 0 otherwise. The term Φ_2 denotes the bivariate cumulative distribution function of the standard normal distribution. To deal with endogeneity, the vector of control variables, $\mathbf{X}_{it-1}$, includes the lagged values of measures of firm size, performance, access to financing and multinational status. The model also includes time and 2-digit NACE industry fixed effects. The corresponding sets of coefficients are in vectors β^{P} and β^{O}. Since the probability of entry with a POT product is conditional on the probability of entry with an own product, and vice versa, the error terms of both binary variables are correlated, i.e., $Cov(\varepsilon^{P}, \varepsilon^{O}) = \rho$; where ρ indicates the strength of correlation.

We estimate model (5) using a sample of 14,170 observations for manufacturing firms with no prior experience in foreign markets and that were active in both periods $t - 1$ and t over the period 1995–2008. Results presented in Table 10 show that the estimate of parameter ρ is positive and significant, which suggests that some unobserved factors that affect the decision to export own and POT products indeed exist. As the value of ρ is fairly high ($\rho = 0.64$), this indicates that firms' decisions to enter foreign markets with either own or POT products are highly correlated.

The probability of starting to export POT products seems to be negatively correlated with TFP, but not for own products, while the return on assets has a significant (and positive) impact only on entry with own products. While access to finance (debt to assets ratio) is a significant determinant of export entry, firm size is only a strong predictor for own products. Among variables accounting for firm

Table 10 Joint entry decision to export with POT and own products, 1995–2008 (bivariate probit estimation)

	Pr[Export POT = 1] (1)	Pr[Export Own = 1] (2)	Pr[Export POT = 1] (3)	Pr[Export Own = 1] (4)
TFP ($t-1$)	−0.149***	−0.037		
	(0.06)	(0.03)		
ROA ($t-1$)			0.346	0.184**
			(0.31)	(0.09)
Equity ($t-1$)	0.278***	0.243***	0.233***	0.231***
	(0.04)	(0.02)	(0.03)	(0.02)
Debt-to-assets ratio ($t-1$)	2.076***	1.120***	2.002***	1.115***
	(0.25)	(0.09)	(0.24)	(0.09)
Employment ($t-1$)	0.091**	0.031	0.126***	0.040*
	(0.04)	(0.02)	(0.04)	(0.02)
Outward FDI ($t-1$)	−4.688***	0.0430	−4.492***	0.0852
	(0.24)	(0.40)	(0.61)	(0.40)
Inward FDI ($t-1$)	0.663***	0.305**	0.609***	0.300**
	(0.19)	(0.14)	(0.16)	(0.14)
Inw. and outw. FDI ($t-1$)	3.754***	−0.992	3.595	−1.068
	(0.82)	(0.69)	(0.82)	(0.69)
Observations	14,170		14,170	
ρ (Chi^2-test)	0.638	(188.8)	0.637	(188.2)
Log-likelihood	−3,702.6		−3,702.2	

The estimates of TFP are obtained using the Olley–Pakes estimator. ROA denotes the return on total assets. Equity, employment, TFP are included in logs. The industry fixed effects are captured with inclusion of 2-digit NACE industry dummies. The dummy variables for outward and inward FDI are 1 if foreign ownership share is at least 10 % of equity. Robust standard errors in parentheses. ***, ** and * denote statistical significance at 1, 5 and 10 % level, respectively

multinational status, inward FDI increases the likelihood of starting to export POT products more than starting to export own products. In contrast, outward FDI decreases the probability of entering foreign markets with POT products, but not for the own products. The likelihood to engage in export of POT products is quite high for firms that are both owned by the multinational company and have their own affiliates abroad. The latter confirms that firms that are multinational in scope will more likely engage in intermediation of POT products across different markets.

To summarize, the results indicate that—though the decisions to start exporting own or POT products are highly correlated—starting to export POT products requires relatively lower productivity, larger firm size, better access to finance and advanced multinational status as compared to exporting own products.

4.3 Survival and dynamics of POT products

In this subsection, we investigate the export survival and export dynamics of firms with POT products after they enter foreign markets. We follow the standard

approach in studying the survival in export markets (Görg et al. 2008; Volpe and Carballo 2009). In our case, survival refers to continued presence of POT products in the foreign markets conditional on firm own products, while growth refers to the changes in the number of exported POT products. This structure is consistent with the bivariate selection model or type-2 Tobit model proposed by Heckman (1979), which is estimated using a two step estimator. The models have the following specifications.

Export survival with POT products:

$$Pr\left[Exp_{it}^{P}=1\middle|Exp_{it-1}^{P}=1\right]=\Phi\left(\rho h_{it-1}^{P}+\chi h_{it-1}^{O}+\delta m_{it-1}+\widehat{\beta}\mathbf{X}_{it-1}\right), \quad (6)$$

Dynamics of POT products in export markets:

$$h_{it}^{P}=\rho h_{it-1}^{P}+\chi h_{it-1}^{O}+\delta m_{it-1}+\widehat{\beta}\mathbf{X}_{it-1}+\varepsilon_{itm} \quad (7)$$

In the survival Eq. (6), $Pr\left[Exp_{it}^{P}=1\middle|Exp_{it-1}^{P}=1\right]$ denotes the probability that exporter i (in period $t-1$) will continue exporting POT products also in period t, and Φ is a cumulative density of the standard normal distribution. In addition to the set of control variables introduced in the model of joint entry decision ($\mathbf{X}_{it}$), the probability of survival with POT products in foreign markets contains also the lagged number of markets (m_{it-1}) and all products (h_{it-1}), both in logs and in particular the complementarities with own products (χh_{it-1}^{O}).

In equations for the dynamics of number of POT products (products adding and dropping), we include the lagged dependent variable with corresponding autoregressive coefficient (ρ), and terms that allow to account for product and market complementarities (δm_{it-1}) and complementarities with own products (χh_{it-1}^{O}), which reflect aspects of efficiency and demand preferences of product and market that are unobserved. The other explanatory variables included in the model are the same as above. The empirical estimation uses the two-step Heckman estimator without exclusion restrictions. In the first stage, the export survival Eq. (6) is estimated and in the second stage the Mills ratio (φ/Φ) is included in the market and product dynamics Eq. (7). This allows us to obtain the corresponding parameters, λ, which reflect the correlations between the error terms in the export survival equation and the number of exported POT products.

Results presented in Table 11 (column 1) show that survival of POT products in the export markets is positively correlated with number of lagged POT products exported and number of markets served. This indicates significant complementarities of POT products with firm export diversification along both extensive margins. At the same time, survival of POT products is not significantly (but positively) related to lagged number of firm's own exported products, which implies that there are no substitution effects between POT and own products in export markets. Among other control variables, survival of POT products is positively affected by firm TFP, size and access to finance (measured with firm equity and debt to assets ratio).

As for the dynamics of POT products (see columns 2 and 3 of Table 11), both adding and dropping of POT products is positively correlated with the lagged number of exported POT and own products. This indicates a vivid process of

Table 11 Export survival and export dynamics of POT products, 1995–2008 (2-stage Heckman estimation)

	Pr[Export(t) = 1|Export($t-1$) = 1] (1)	POT products added (t) (2)	POT products dropped (t) (3)
POT products ($t-1$)	0.125***	0.189***	0.125***
	(0.02)	(0.01)	
Own products ($t-1$)	0.0215	0.417***	0.781***
	(0.02)	(0.01)	(0.00)
No. markets ($t-1$)	1.405***	0.005	−0.062***
	(0.03)	(0.01)	(0.01)
TFP ($t-1$)	0.084***	0.037***	−0.0146*
	(0.03)	(0.01)	(0.01)
Equity ($t-1$)	0.149***	0.060***	0.014***
	(0.02)	(0.01)	(0.00)
Debt-to-assets ratio ($t-1$)	0.640***	0.416***	0.165***
	(0.07)	(0.04)	(0.02)
Employment ($t-1$)	0.037**	−0.011	−0.038***
	(0.02)	(0.01)	(0.00)
Outward FDI ($t-1$)	0.071	0.057**	−0.004
	(0.12)	(0.02)	(0.01)
Inward FDI ($t-1$)	−0.134**	−0.056***	0.036***
	(0.05)	(0.02)	(0.01)
Out. and inward FDI ($t-1$)	0.340	0.131***	0.131***
	(0.24)	(0.05)	(0.03)
Observations	19,320	19,320	19,320
Chi^2		8,615.7	43,683.2
Lambda		0.331	−0.0120
s.e.(Lambda)		0.0268	0.0161

The estimates of TFP are obtained using the Olley–Pakes estimator. Number of products and markets, equity, employment and TFP are included in logs. The industry fixed effects are captured with inclusion of 2-digit NACE industry dummies. The dummy variables for outward and inward FDI are 1 if foreign ownership share is at least 10 % of equity. Robust standard errors in parentheses. ***, ** and * denote statistical significance at 1, 5 and 10 % level, respectively

churning of POT products. On the other hand, number of markets has a positive impact on adding of POT products (though not significant), and a negative impact on product dropping. The latter suggest complementarities of POT products with firm's own products in a range of export markets. In other words, firms with a larger number of export markets are less likely to withdraw their POT products benefiting from complementarities with their own products served in these markets. Results also show that higher productivity boosts expansion of POT products, while smaller exporters and exporters with lower productivity are more likely to contract the number of POT products. Interestingly, foreign-owned firms are less dynamic both

in adding and dropping of POT products, while firms with affiliates abroad are engaged more intensively in the churning of POT products.

These results suggest that the dynamics of POT products in exports is fairly similar to the dynamics of firms' own products,[16] while, on the other hand, POT products are likely to benefit from firms' diversified exports in terms of markets and own products exported. Complementarity to firms' own products thus seems to drive a substantial part of the export dynamics of POT products.

4.4 Demand scope complementarity of POT with own products

The evidence on demand scope complementarity between own and POT products is laid out in two steps. First we show that the likelihood of overlap between own and POT products increases with the relative importance of own products in exports. The complementary products may be defined at different levels. We consider complementary products as those 8-digit CN codes that correspond to the same 4-digit CN industry. The number of such industries exceeds 1,000 in all time periods. We justify our, clearly arbitrary, choice with the fact that these products are fairly similar. Based on this definition, we define an overlap between own and POT products as those 4-digit CN industries with both sets of products.

To test for complementarity we construct the following empirical model, gauging the likelihood of exporting a POT product:

$$Pr\left[Exp^{P}_{kit}=1\middle|Exp^{P}_{kit-1}=0\right]=\Phi\left(\delta Exp^{O}_{kit-1}+\widehat{\beta}\mathbf{X}_{it-1}\right), \tag{8}$$

where Exp^{P}_{kit} denotes a dummy variable that equals 1 if firm exports at least one product that corresponds to a 4-digit CN industry (denoted with index k) and 0 otherwise, Exp^{O}_{kit-1} is a measure of importance of own products in the same industry and $\mathbf{X}_{it-1}$ are control variables.

Our key interest is in the statistical significance of the coefficient δ and the economic significance of the corresponding marginal effect, which measures the likelihood of choosing POT products within the same industry in response to the changes in the importance of own products in that same industry. We interpret a positive coefficient as demand complementarity between own and POT products. Note that firms are allowed to introduce products in any 4-digit CN industry. Thus, we expand each firms' choice set to include more than 1,000 options for introducing a POT product. The number of firm-year-industry observations is hence rather large. We only look at firms that actually introduced a new POT product in any industry, which still resulted in more than 14 million observations. Since we are dealing with multiple observations within each firm-year pair, we use a probit estimator with two-way clustered standard errors.

Table 12 presents evidence consistent with the idea that own and POT products are complementary. We use three different measures to proxy for the importance of own products in the industry (Exp^{O}_{kit-1}). Column (1) shows the estimates where we

[16] See Damijan et al. (2011) for a direct comparison of export dynamics of both groups of exported products.

Table 12 Probability of introducing a POT product in 4-digit CN industry, 1995–2008

	Dependent variable: Pr[Export POT(k, t) = 1|Export(k, $t-1$) = 1]		
	(1)	(2)	(3)
Dummy for own products (k, $t-1$)	1.861***		
	(0.021)		
Number of own products (k, $t-1$)		2.81***	
		(0.029)	
Share of export value of own products (k, $t-1$)			6.150***
			(0.164)
TFP ($t-1$)	0.035***	0.029***	0.039**
	(0.011)	(0.008)	(0.014)
Equity ($t-1$)	0.036***	0.021***	0.052***
	(0.010)	(0.008)	(0.011)
Debt-to-assets ratio ($t-1$)	0.193***	0.135***	0.254***
	(0.049)	(0.042)	(0.054)
Employment ($t-1$)	0.085***	0.059***	0.096***
	(0.011)	(0.009)	(0.012)
Outward FDI ($t-1$)	0.103***	0.044***	0.135***
	(0.023)	(0.018)	(0.024)
Inward FDI ($t-1$)	0.095***	0.103***	0.072***
	(0.021)	(0.016)	(0.024)
Firm-year-industry observations	14,000,672	14,000,672	14,000,672
Chi^2	244,036.0	327,186.8	71,984.5
Log-likelihood	−611,558.2	−387,109.4	−630,731.1
Pseudo R^2	0.161	0.469	0.134

The estimates of TFP are obtained using the Olley–Pakes estimator. Number of own products within 4-digit CN industry, equity, employment and TFP are included in logs. The number of products is increased by 1 to avoid dropping industries with zero products (8-digit CN code). The dummy variables for outward and inward FDI are 1 if foreign ownership share is at least 10 % of equity. The time fixed effects are captured using time dummies. Two-way clustered standard errors for firms and time periods in parentheses. ***, ** and * denote statistical significance at 1, 5 and 10 % level, respectively

use as a proxy a dummy variable for the presence of own products. The corresponding marginal effect is 0.243, which suggests that a firm with own products within a 4-digit CN code is 24.3 % points more likely to introduce a POT product that falls within that industry. Column (2) uses the number of own products that a firm exports within a 4-digit industry as a proxy and also shows that it increases the likelihood of introducing a POT product. The marginal effect is 0.026, which implies that doubling the number of products in the industry increases the likelihood of introducing a POT product by 2.6 % points. Finally, column (3) shows the results with the export value share of own products within a 4-digit industry as a measure of importance of that industry in exporting. Again, the coefficient is positive and statistically significant, with a corresponding marginal effect suggesting that increasing the share of value of exports of own products by 10 % increases

the likelihood of choosing that industry with a POT product by 1 % point. These exploratory regressions seem to indicate that complementarity between own and POT products is likely to be a strong motive for firms to introduce POT products.

5 Conclusions

Recent evidence demonstrates that churning of products in imports and exports is bigger than suggested by recent trade models with heterogeneous firms and fixed cost of trade. This paper investigates the surprising fact that a substantial proportion of this product churning is due to simultaneous imports and exports of firms in identical varieties within the same CN-8 product code (so-called pass-on trade, POT). Using detailed data on imports and exports at the firm and product level for Slovenian manufacturing firms in the period 1994–2008, we document that, on average, almost 70 % of all exporting firms engage to some extent in POT. Almost 40 % of total products exported and more than half of the products exported by firms engaged in POT consist of previously imported products. This indicates that POT is a prevailing regularity of trade of Slovenian firms. POT is not confined to small and low productivity firms. On the contrary, the degree of engagement in POT is increasing in firm size, product diversification, multinational status as well as firm productivity and profitability. This implies that for firms engagement in POT is an equally possible option of serving foreign markets than exporting their own in-house-produced varieties.

Confronting several possible explanations for POT with the data points towards three most plausible explanations of why do firms engage in POT. The first explanation is that firms engage in serving as an intermediary within the multinational firms' networks. The second possibility is that firms engage in price arbitrage of ready-made products, which are sourced internationally, across a wide range of markets they serve with their own products. The third explanation stress the possibility that firms engage in placing imported products, which are sourced as proprietary products. All of these firms' strategies of engaging in POT, however, require both high firm efficiency in placing the products (efficient distribution network) and a complementarity in firm demand scope. Our empirical work finds robust evidence on the importance of firms' multinational networks and demand complementarities between firms' own and POT products in firms' decision to introduce and expand the number of POT products to any market they already serve.

References

Ahn, J., Khandelwal, A., & Wei, S. (2010). *The role of intermediaries in facilitating trade* (NBER Working Paper 15706). Cambridge, MA: National Bureau of Economic Research.

Akerman, A. (2010). *A theory on the role of wholesalers in international trade based on economies of scope* (Research Paper in Economics 2010:1). Department of Economics, Stockholm University.

Balassa, B. (1986). The determinants of intra-industry specialization in United States trade. *Oxford Economic Papers, 38*(2), 220–233.

Bas, M., & Strauss-Kahn, V. (2010). *Does importing more inputs raise exports? Firm level evidence from France* (MPRA Paper 27315). University Library of Munich: Munich Personal RePEc Archive.

Bernard, A., Jensen, B., Redding, S., & Schott, P. (2007). Firms in international trade. *Journal of Economic Perspectives, 21*(3), 105–130.

Bernard, A., Grazzi, M., & Tomasi, C. (2010a). *Intermediaries in international trade: Direct versus indirect modes of export* (Research Working Paper 199). Brussels: National Bank of Belgium.

Bernard, A., Jensen, B., Redding, S., & Schott, P. (2010b). *Wholesalers and retailers in U.S. Trade* (NBER Working Paper 15660). Cambridge, MA: National Bureau of Economic Research.

Bernard, A., Redding, S., & Schott, P. (2010c). Multi-product firms and product switching. *American Economic Review, 100*(March), 70–97.

Bernard, A., Van Beveren, I., & Vandenbussche, H. (2010d). *Multi-product exporters, carry-along trade and the margins of trade* (Research Working Paper 203). Brussels: National Bank of Belgium.

Bernard, A., Redding, S., & Schott, P. (2011). Multi-product firms and trade liberalization. *Quarterly Journal of Economics, 126*(3), 1271–1318.

Bernard, A., Blanchard, E., Van Beveren, I., & Vandenbusche, H. (2012). *Carry-along trade*. Hanover: Dartmouth College, Mimeo.

Brander, A. J. (1981). Intra-industry trade in identical commodities. *Journal of International Economics, 11*(1), 1–14.

Damijan, J. P., Konings, J., & Polanec, S. (2012). *Import churning and export performance of multi-product firms* (LICOS Discussion Papers 307/2012). Centre for Institutions and Economic Performance, K.U. Leuven.

Damijan, J. P., Kostevc, Č., & Polanec, S. (2011). *Export strategies of new exporters: Why is export expansion along the extensive margins so sluggish*? (LICOS Discussion Papers 277/2011). Centre for Institutions and Economic Performance, K.U. Leuven.

Di Comite, F., Vandenbussche, H., & Thisse, J. (2012). *Verti-zontal differentiation in monopolistic competition* (CEPR Discussion Paper 8752). London: Centre for Economic Policy Research.

Eckel, C., & Neary, P. J. (2010). Multi-product firms and flexible manufacturing in the global economy. *Review of Economic Studies, 77*(1), 188–217.

Goldberg, P., Khandelwal, A., Pavcnik, N., & Topolova, P. (2010a). Imported intermediate inputs and domestic product growth: Evidence from India. *Quarterly Journal of Economics, 125*(4), 1727–1767.

Goldberg, P., Khandelwal, A., Pavcnik, N., & Topolova, P. (2010b). Multi-product firms and product turnover in the developing world: Evidence from India. *Review of Economics and Statistics, 92*(4), 1042–1049.

Görg, H., Kneller, R., & Muraközy, B. (2008). *What makes a successful exporter? Evidence from firm-product level data* (CEPR Discussion Paper 6614). London: Centre for Economic Policy Research.

Greenaway, D., & Milner, C. R. (1983). On the measurement of intra-industry trade. *Economic Journal, 93*(372), 900–908.

Grubel, H. G., & Lloyd, P. J. (1975). *Intra-industry trade*. London: Macmillan.

Halpern, L., & Muraközy, B. (2011). Firm size and extensive margin: Hungarian exports. *Economic and Business Review, 13*(1–2), 27–50.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica, 47*(1), 153–161.

Iacovone, L., & Javorcik, B. S. (2010). Multi-product exporters: Product churning, uncertainty and export discoveries. *The Economic Journal, 120*(May), 481–499.

IMF (1993). *Balance of payments manual* (5th ed.). Washington, DC: International Monetary Fund.

Krugman, P. (1979). Increasing returns, monopolistic competition, and international trade. *Journal of International Economics, 9*(2), 469–479.

Krugman, P. (1980). Scale economies, product differentiation and the pattern of trade. *American Economic Review, 70*(5), 950–959.

Mayer, T., Melitz, M., & Ottaviano, G. (2011). *Market size, competition, and the product mix of exporters* (NBER Working Paper 16959). Cambridge, MA: National Bureau of Economic Research.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocation and aggregate industry productivity. *Econometrica, 64*(6), 1695–1725.

Muûls, M., & Pisu, M. (2009). Imports and exports at the level of the firm: Evidence from Belgium. *World Economy, 32*(3), 692–734.

Olley, G. S., & Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica, 64*(6), 1263–1297.

Petropoulou, D. (2007). *Information costs, networks and intermediation in international trade* (Economics Series Working Papers 370). Department of Economics, University of Oxford.

Rauch, J. E. (2001). Business and social networks in international trade. *Journal of Economic Literature, 39*(December), 1177–1203.

Rauch, J. E., & Watson, J. (2004). Network intermediaries in international trade. *Journal of Economics & Management Strategy, 13*(1), 69–93.

Verdoorn, P. J. (1960). The intra-block trade of Benelux. In E.A.G. Robinson (Ed.), *Economic consequences of the size of Nations*. Proceedings of a conference held by the International Economic Association. London: Macmillan.

Volpe, C., & Carballo, J. (2009). Survival of new exporters in developing countries: Does it matter how they diversify? (IDB Working Paper Series 9291). Washington, DC: Inter-American Development Bank.