The Role of Services for Firms’ Export Intensity

Magnus Lodefalk
Economics
Swedish Business School
Örebro University
SE-701 82 Örebro
magnus.lodefalk@oru.se

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ABSTRACT

Manufacturing firms are increasingly focusing on services. This trend is evident in their composition of input, in-house production and seemingly also in total sale. Manufacturing firms’ services intensity is likely to affect productivity and thereby their competitiveness abroad. However, only bits and pieces of the relation between services and manufacturing’s export performance have been analysed in theoretical and empirical literature. This study contributes by discussing the role of services for the manufacturing firm, arriving at some conjectures and testing them empirically. Export intensity is regressed on two services parameters, applying a fractional Tobit model to a rich panel of firms in Sweden in the period 2001-2007. The microeconometric results indicate that there is an effect of services inputs, while controlling for covariates and firm heterogeneity. Raising the proportion of services in in-house production yields higher export intensity. Furthermore, buying-in more services seems to affect export intensity positively although the effect is smaller than for in-house services. Overall, the study provides new firm-level evidence of the importance of services as an input into manufacturing. By using more services, the manufacturing firm may become more competitive internationally.

Keywords: firm, export intensity, manufacturing, services, intangibles, innovation
JEL codes: F14, L24, L25, L60, 033

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1. Introduction

There is evidence that manufacturing in industrialised countries uses services more intensively than before and there are some indications that manufacturing’s share of services in total turnover is up (Pilat and Wölfl, 2005; Francois and Woerz, 2008; and Lodefalk, 2010). Services used or produced by manufacturing firms include research and development (R&D) but also extend to knowledge or intangible capital services more generally, as well as to services such as telecommunication and transport, see the typology of services in figure 1.²

On the one hand, an increased focus on services could act as a drag on manufacturing’s total export, since services are less tradable. On the other hand, there are arguments why services in manufacturing may support exports. There might be a link between services, through productivity, to exports, as will be explained. Moreover, changes on the demand side in industrialised countries are likely to favour manufacturing firms that focus more on the services content of their offer. Firms’ customers increasingly demand services (Schettkat and Yocarini, 2006).³ They also care more and more about environmental and social aspects of the product and its production. Empirically, knowledge is poor on exporters’ buying-in, production and sales of services and only some pieces of the relation between services and export performance have been studied.

This study adds to the empirical evidence on export determinants by analysing the role of services for manufacturing firms’ competitiveness abroad, using a rich panel of manufacturing firms in Sweden in the period 2001-2007. The specification is estimated using

² The extensive use of services in manufacturing firms is illustrated in the Swedish multinational Sandvik (National Board of Trade, 2010). Its tooling company alone uses 40 types of services, of which less than 25 per cent are transport services. Generally, in manufacturing, the three largest services categories bought-in are: other business services; transport, storage and communication, excl. post and telecommunication; and wholesale and retail trade. R&D constitutes a minor share of services in manufacturing, see figure A.1 in the appendix.

³ Case studies from the Swedish motor vehicle industry indicate that customers increasingly take services for granted when buying new vehicles, services which therefore are included in the price of the vehicles (Witell et al, 2009). Moreover, services contribute substantially to differentiating the firms’ offers, making them more competitive vis-à-vis foreign competitors. For the environmental sector, a study by USITC (2005) reports that services – such as R&D and maintenance – often are integrated into the price of air pollution control equipment and may constitute 10-30 per cent of the purchase price.
a fractional Tobit estimator. I control for the usual covariates that have been found to be associated with export performance as well as for firm heterogeneity.

The results indicate that expanding the proportion of services in in-house activities of manufacturing on average yields higher export intensity for the firm, when controlling for initial labour productivity and human and physical capital intensity. The results are statistically significant and robust to different specifications, models and estimation methods. Furthermore, buying-in more services seems to affect export intensity positively, although the effect is smaller than the one from expanding the proportion of services in in-house production. The overall conclusion is that manufacturing firms gain in export intensity from using more services. Services may act to improve firms’ productivity and upgrade their products, thereby facilitating for them to bear export costs and become more competitive internationally.

The outline of the rest of the paper is as follows. In section two, the conceptual framework is developed. Differences in exports and other key variables for firms with less and more services-focus are also studied. The specification and estimation strategy is discussed in section three. Section four analyses econometrically whether services can explain
differences in export intensity. Section five concludes. (Additional tables and information on data are found in the appendix.)

2. Conceptual framework and data

2.1 Background

Firms who want to participate in exports need to cope with certain challenges, including trade costs and more intense competition on the world market. With respect to trade costs firms have to find out what rules and regulations apply to exporting their product to a specific market. They have to do some market research, possibly modify both their product and how they market it and establish a distribution network. Merely distribution costs may be corresponding to as much as half of the retail price (Burstein et al, 2003). These kind of costs are sunk and therefore contribute to persistence in exporting (see e.g. Roberts and Tybout, 1997). As regards variable cost, each delivery by a firm involves costs for insurance, transportation and tariffs. Time lost in transport and at the border can add substantially to these costs (Hummels, 2001). Negotiating and maintaining business contracts and contacts with authorities abroad is also likely to be costly. In addition, monitoring and adjustment to changes on the foreign market as well as its rules and regulations are associated with costs. Transaction costs are substantially higher for more distant export markets (Egger, 2008; and Nordås, 2008). Variable costs put a continuous pressure on exporters to keep on performing better than non-exporters.

Bearing the export barriers in mind, we would expect that firms that export are the better firms within their industry. Indeed, the empirical literature on firms’ exports establishes that exporters are different from non-exporters in the same industry in terms of size, productivity and capital intensity (Bernard and Jensen, 1995 and 1999; and Bernard et al, 2007). The productivity premium of exporting firms has been hypothesised to be the result of more productive firms self-selecting into exports or of exports making participating firms
more productive. The latter hypothesis – learning-by-exporting – is discussed in the literature on international technology transfer. Greenaway and Kneller (2005) and Wagner (2007) survey the extensive empirical evidence and find that exporting firms are more productive already before they enter into exports, put simply “the good firms go abroad”. The jury is still out there on whether exporting itself contributes to the productivity premium of exporters. Recent studies lend support to the learning-by-exporting hypothesis though (Andersson and Lööf, 2009; Aw et al, 2010; Damijan et al, 2010; and De Loecker, 2010).

The presence of trade costs and exporting firms that are more productive than non-exporters within their industry has been incorporated in modern trade theory. In their important contributions, Melitz (2003) and Bernard et al (2003) develop general equilibrium models with heterogeneous firms, monopolistic competition and international trade. The productivity of the firm is exogenously determined. The productivity level then decides whether the firm can bear the fixed and/or variable costs related to export. When trade is liberalised, the most productive firms export more and expand, the second most productive firms start to export and expand, less productive firms contract, and the least productive firms die. As a consequence, productivity is up at the aggregate level, even without learning-by-exporting. Drawbacks with these models are that productivity is exogenous and the differentiation of products is not elaborated upon. More recently, exporters’ pre-entry productivity premiums have been made endogenous in trade models. Costantini and Melitz (2008) is an example where expectations of trade liberalisation influence firms’ decision to innovate. This implies that productivity may deliberately be raised before the firm starts to export. Another example is López’ (2004) model of firms in a developing country. Firms consider whether to export or not. If the firm is productive enough it consciously self-selects to export and as a preparation buys and applies new technology so as to become more
productive and be able to produce a competitive good (price- and character-wise) for the foreign market.

2.2 A theoretical perspective

Unfortunately, the literature on firms’ export behaviour does not consider services in general and the use and production of services in manufacturing. However, manufacturing firms in industrialised countries are likely to use services such as R&D in preparation for export-entry and such as market monitoring and design for continued presence on the export market. Services may thus boost productivity.\(^4\) Productivity, in turn, improves export performance – the propensity to and intensity of export – according to trade theory reviewed above. Empirically, the link between firm productivity and export propensity is well established and ISGEP (2008) verifies the link between firm productivity and export intensity.\(^5\) This motivates an attempt to provide a theoretical perspective on the role of services for firms’ export intensity.

To frame the discussion on these linkages at the firm level it is useful to take a production function as a starting point, where firm output is the product of: skilled labour (SL); unskilled labour (UL); physical capital (K); material input (M); and services input (S). SL, UL, K, M and S have diminishing marginal returns. In this setting, services figure in two places, as a share of labour input and of intermediates. Both of these two will be discussed in turn, after a brief overview of assumptions made about the manufacturing firm of the industrialised country.

Assume that the manufacturing firm has increasing returns to scale. Further, output is sold on the presumably open domestic market but may also be sold abroad. Selling abroad

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\(^4\) R&D services are likely to account for an important but limited share of this effect. R&D constitutes about seven percent of bought-in services in Swedish manufacturing according to Input-Output data, see figure A.1 in the appendix. Moreover, just six percent of those employed in manufacturing do R&D, according to calculations based on official data from Statistics Sweden.

\(^5\) In 13 out of 14 OECD-countries in the ISGEP (2008) study, a positive and statistically significant relation is found between productivity and export intensity, using firm-level panel data.
incurs additional variable and fixed transaction costs, both which differ across destinations. Therefore, the firm only exports if its productivity is high enough to bear the extra costs involved. The higher its productivity, the more markets it will enter and the higher is its export intensity. The firm sells manufactures and potentially also services.

The firm’s labour productivity is positively correlated with the level of technology that it uses for combining inputs into the final product. Technology, in turn, is a positive function of the firm’s stock of knowledge capital. Knowledge capital consists of the firm’s computerised information;\(^6\) innovation capital, that is, scientific and creative property; and economic competences such as brand name, education and organisational capital (Corrado et al, 2004).\(^7\) Together, the level of the firm’s knowledge capital and SL determine its ability to comprehend and exploit technology advances elsewhere, what is known as absorptive capacity (Cohen and Levinthal, 1990). The firm may prepare for or sustain exports by raising productivity, for example through increasing its knowledge capital.

2.2.1 \textit{Labour input}\n
SL has post-secondary education and is made up of employees in services-related occupations. UL has elementary or upper-secondary education. UL consists mainly of manual workers but has a minor share of employees in services-related occupations. In total, the group of services-related employees is dominated by labour with skills equivalent to upper secondary education or higher.\(^8\)

\(^6\) Software may be considered a general purpose technology, which results in increasing returns-to-scale (Bresnahan and Trajtenberg, 1995; and Hall and Trajtenberg, 2004).

\(^7\) Moving beyond R&D to capture firm-specific assets, Braunerhjelm (1996) also suggests a measure that includes cumulated investment in R&D, software, marketing and education. As regards organisational capital, Bloom and Van Reenen (2010) find that management practices have an important and significant effect on firm performance, using cross-section firm-level data from different countries.

\(^8\) This is in line with the educational requirements in the International Standard Classification of Occupations (ISCO). Alternatively, the skills may be acquired through job experience.
Those occupied in services-related occupations are more skilled than other employees, on average.\textsuperscript{9} Therefore the group of services-related employees is central for the firm. Through its activities in for example R&D, software design, market research, education and organisational development the group contributes to the knowledge capital of the firm.\textsuperscript{10} Additionally, they facilitate for the firm to absorb foreign technology. This suggests that increasing the share of services-related employees, who are more skilled and perform core tasks, may be seen as an effort by the profit-maximising firm to raise productivity.

There are several ways in which a larger share of services-related employees raises firm productivity, all else equal. It assists the firm in lowering input requirements; use UL more efficiently; or in raising output price while continuing to compete on the market. Lower input requirements may be the result of engineering or supply chain management (Nordås, 2007). Raising price while continuing to compete is made possible by up-grading or differentiating the product or the entire offer (Chamberlin, 1933).\textsuperscript{11} A second-order effect of upgrading or differentiating the product/offer, for example, by adding services, is that it may increase demand abroad. Greater demand allows the firm to operate at higher scale. Moreover, as discussed above, a higher skills level augments the firm’s absorptive capacity and thus its productivity. Overall, the rise in productivity due to a larger proportion of services-related employees is expected to cause exports to go up, in comparison with sales on the small domestic market, that is, export intensity rises.

As regards differentiation and up-grading, the firm has the advantage of closeness to: customers demanding quality (the Linder, 1961, hypothesis); customers concerned about environmental and social aspects of the product and its production; and to customers who

\textsuperscript{9} In 2006, 31 percentage points of the 46 per cent employed in services-related occupations in Swedish manufacturing have post-secondary education (Lodefalk, 2010). For 13 OECD-countries, the corresponding mean is 27 percentage points out of 44 per cent in 2002 (Pilat and Wölf, 2005). Services-related employees constitute less than 30 per cent of unskilled labour, which does not need to have any specific education.

\textsuperscript{10} These are all activities connected to the components of the firm’s knowledge capital, as defined by Corrado et al (2004).

\textsuperscript{11} Chamberlin (1933) included intangible factors in the concept of product differentiation.
Increasingly demand services (Schettkat and Yocarini, 2006). Close contacts with customers is expected to contribute to innovation (Miroudot, 2006). Moreover, the firm has relative abundant access to SL, R&D and advanced technology. These aspects on the demand and supply side make the manufacturing firm well positioned to focus on producing the most advanced products, as predicted by Vernon (1966), and those products are likely to increasingly incorporate and be accompanied by services.

2.2.2 Intermediate inputs

S and M bought-in by the firm substitute for labour (SL+UL) and K. S also substitute for M, and vice versa. On the positive side, buying-in from external providers instead of producing all intermediates itself allows the firm to focus on its core area of competence, whose relative share of firm activities rises and improves productivity (Andersson et al, 2011). As regards cross-border trade, imported S and M may carry foreign technology that contributes to the firm’s productivity. Importing S is also partly about the firm buying-in new varieties and new activities (Nordås, 2007). Substituting own low-skill activities with high-skill bought-in ones, or just adding the latter, helps in differentiating the firm’s manufactures, and thereby increases demand, production scale and thus productivity. Generally, the manufacturing firm is inclined to outsource or offshore low-skill activities.

On the negative side, outsourcing and offshoring involve higher transaction costs than insourcing, and especially so for services, which still are less homogenous and tradable. Particularly regarding services, buying-in may diminish the manufacturing firm’s capacity to absorb foreign technology, for example, by substituting external for own R&D. However,

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12 The latter two through high domestic expenditure on R&D and through an open trade regime.

13 One way in which manufacturing firms can develop their offer is by adding services over the manufacture’s lifetime. In this way the contact with the customers can be extended far beyond the actual sales event (Potts, 1988; and Wise and Baumgartner, 1999). Especially if the installed-base-to-new ratio is high, the after-sales market can be substantial. An example of how to exploit the installed base is long-distance monitoring of products, such as an airplane engine sold by one firm and subsequently monitored by its own engineers in order to prevent unnecessary losses of airtime for the customer.

14 Nordås’ (2007) argument is based on the observation that externally sourced services are becoming more important in manufacturing while in-house services production shows no decline.
being able to focus on other activities such as innovation in the firm’s core area of
competence reduces such negative effects. On balance, increasing the share of S in total input,
all else equal, is hypothesised to contribute to the firm’s productivity and therefore affect
export intensity positively.\textsuperscript{15}

2.3 Empirical evidence
To what extent firms actually use services other than directly trade-related ones to be
successful in exports is less well-known. Most of the studies on the relation between services
and export performance are limited to subsets of services that are bought-in by manufacturing
firms and their effect on firms’ propensity to export.

The manufacturing industry in industrialised countries focuses more and more on
services. Pilat and Wölfl (2005) use data at various levels for OECD-countries and find that
the manufacturing industry increasingly uses services and that the share of services in total
turnover appears to be growing.\textsuperscript{16} In-house services production is on the rise in manufacturing
(Pilat and Wölfl, 2005; and Lodefalk, 2010). As regards its composition, in-house services
production increasingly involves hiring employees such as mathematicians, engineers,
computing professionals and business professionals. At the same time, imports of
intermediate goods are up (Falk and Koebel, 2002).

The link between in-house services and exports is touched upon in Bernard and Jensen
verify an export premium in terms of non-production workers over total employment.

However, the share of non-production workers has no statistically significant effect on the

\textsuperscript{15} However, causality runs in the other direction too. A rising share of manufacturing exports in total sales is
associated with a larger proportion of directly trade-related services in total input. This needs to be considered in
empirical analysis.

\textsuperscript{16} Lodefalk (2010) finds a similar pattern for Sweden, using firm and enterprise group data as well as input-
output tables. With respect to export, services more than doubled in the period 1998-2006, in real terms. Nordås
(2007) establishes that the ratio of bought-in services to value-added increases across all manufacturing
industries. 30-55 per cent of total cost in manufacturing consists of intermediate goods and about 20 per cent of
intermediate services.
probability of starting to export (Bernard and Jensen, 1999). Braunerhjelm (1996) regress export intensity on intangible capital and concludes that it has a positive and statistically significant effect, using micro-level data for Swedish manufacturing. At the macro-level, empirical studies show that investments in intangibles account for a relatively large share of economic growth in recent years (see e.g. Corrado et al, 2009; and Edquist, 2009). With respect to innovation and exports, Hirsch and Bijaou (1985) find a positive correlation between R&D and exports and most subsequent studies find a link between innovation inputs or outputs, on the one hand, and exports, on the other (see the survey in Cassiman and Martínez-Ros, 2007; and studies by e.g. Girma et al, 2008, and Aw et al, 2010). Cassiman et al (2010) contribute by analysing the innovation-productivity-export link, using Spanish firm-level data. Their results suggest that innovation contributes to the noted productivity of exporters-to-become. This is in line with Baldwin and Gu (2004) who show that exporters are more innovative and that their productivity is higher and grows faster already before entering into exports.

A related empirical literature is the one on outsourcing of services and firm performance; where outsourcing is measured as the share of services in some other aggregate such as total input or wages. Yet, few studies analyse what happens to in-house production of services. Görzig and Stephan (2002) do, though, and they find that firms that outsource services (while cutting in-house labour costs) perform better in terms of return per employee but worse in terms of gross operating surplus. As regards productivity and outsourcing/offshoring of services, the results are not clear cut (Bjerring Olsen, 2006). However, there are firm-level studies finding that services trade liberalisation boosts productivity in manufacturing (Arnold et al, 2006 and 2010).

17 It can be added that Hulten et al (2009) analyse the gap between book and market value in 12 R&D-intensive German firms and find that intangibles explain a big part of the gap.

18 Griffith et al (2006) provide a largely affirmative empirical study of the innovation-productivity link, using micro-level data for four countries.
Using more business services seems to be positively correlated with exports, according to analysis of cross-country data at the industry level. Buying-in more business services in a manufacturing industry is associated with a higher value-to-weight ratio in exports (Nordås, 2007). The intensity of using knowledge-intensive business services has been found to be positively correlated with comparative advantage at the industry level, when the thickness of the market is taken into account (Bottini and Tajoli, 2010). Importing more business services is also associated with improved exports, as well as value-added and employment, for skill and technology intensive manufacturing (Francois and Woerz, 2008). One possible explanation for these patterns is that firms who buy-in more business services benefit from them directly in up-grading and differentiating their manufactures. Another possible interpretation is that firms may focus on high-skill and core activities such as R&D if they increasingly buy-in other more easily traded and non-core business services.

This review shows that bits and pieces of the relation between the services and export performance have been studied empirically. However, effects of the wide range of services that firms use and produce on firm export intensity have not been analysed. Manufacturing firms increasingly focus on services and may do so in their preparations for and efforts in exporting. Firms are likely to use services to improve their ability to bear extra costs associated with exports, to manage more intense competition on world markets and to accommodate for changes in demand. I expect that in-house and bought-in services contribute to manufacturing firms’ export intensity.

2.4 Measuring services in manufacturing
With respect to services, I construct one measure of the relative importance of services in the firm’s total activities and another on its relative importance in the firm’s overall sourcing of input.
The first measure is based on an OECD-classification of occupations as services-related (Pilat and Wölfl, 2005). The classification is based on the International Standard Classification of Occupations (ISCO). I define services-related occupations to include the following occupations, with ISCO codes within parenthesis: legislators, senior officials and managers (100); professionals (200); technicians and associated professionals (300); clerks (400); services workers and shop and market sales workers (500); and selected occupations in the remaining categories.\(^{19}\) I then divide the firm’s expenses for wages to services employees by the firm’s total wages.

The second measure is based on data about the firm’s costs for externally and internally sourced input. The measure is calculated as the proportion of costs for services bought-in by the firm in sales, where sales represent the total value of input used by the firm. The numerator, costs for bought-in services, ranges from costs for real estate services to R&D services.

### 2.5 Data and overall descriptive statistics

The unbalanced panel data set used in this study contains core financial, employment and foreign trade information for all Swedish manufacturing firms (ISIC 10-37) active in the period 2001-2007.\(^{20}\) Moreover, it includes data on firms’ in-house activities. This enables me to distinguish between different services components. However, only firms with at least 20 full-time employees are included since reliable information on services variables is limited to those firms. (For details on data, see the appendix.)

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\(^{19}\) The other occupations included are: drivers and mobile plant workers (830) among plant and machine operators and assemblers; sales and services elementary occupations (910) as well as transport labourers and freight handlers (933) among elementary occupations.

\(^{20}\) Data is not deflated. Firstly, deflation of firm-level data is not a clear-cut issue. Deflators are at best approximations at the industry level, e.g. the producer price index, which still does not take input price developments into account. Moreover, to consider price changes by deflating with producer price index at the industry level does not change the results when industry heterogeneity already is controlled for, as in this study.
Definitions of key variables and their data sources are displayed in table 1. The first variable in the table is export intensity, which is the response variable of the study. Export intensity is defined as the share of merchandise export in total sales. Preferably it would also include services export in the numerator. Unfortunately, panel data on service export is only available for a small subset of Swedish firms. However, services export may still be included in this measure. Firstly, services may be integrated into the merchandise itself, for example, software. Secondly, the firm’s offer to customers may be a bundle of a manufacture and related services such as financial solutions, training as well as maintenance and repair. The bundle may be recorded as export of manufacture. Only case-studies would enable us to separate a bundle into its components.21

<table>
<thead>
<tr>
<th>Table 1: Variables</th>
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<tbody>
<tr>
<td>Variable</td>
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<tr>
<td>Export intensity (eint)</td>
</tr>
<tr>
<td>Services in-house share (sh)</td>
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<tr>
<td>Services input share (si)</td>
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<tr>
<td>Log of employment (emp)</td>
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<tr>
<td>Log of labour productivity (lp)</td>
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<tr>
<td>Log of human capital intensity (hcap)</td>
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<tr>
<td>Log of physical capital intensity (pcap)</td>
</tr>
<tr>
<td>Services sales share (ss)</td>
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<tr>
<td>Multinational (mine)</td>
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<tr>
<td>Exporter (exp)</td>
</tr>
</tbody>
</table>

Note: The sources from Statistics Sweden are Structural business statistics (SBS); register based labour market statistics (RAMS); Foreign Trade Statistics (FTS); and Enterprise Group Register (EGR).

Descriptive statistics for a snapshot of the Swedish panel are provided in table 2. In 2007, there are about 4 000 manufacturing firms. Most of them are small or medium-sized

21 Having data on cross-border services export would be valuable but still non-comprehensive in terms of total services export. For example, a firm may provide services to foreign customers via commercial presence or foreign partners. The sale of those services is at best indirectly captured in the firm’s own cross-border services exports.
companies with a median value of 44 employees. The majority of firms trade internationally but their median export intensity is a low 10 per cent. However, the presence of large firms leads to substantially larger means for parameters such as export intensity and number of employees. 46 per cent of the firms are part of a multinational enterprise. With respect to services, most manufacturing firms have a substantial share of services in in-house production – an average of 45 per cent – but a limited share of services in total sales. 22

<table>
<thead>
<tr>
<th></th>
<th>No. of Obs.</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export intensity</td>
<td>4027</td>
<td>0.24</td>
<td>0.10</td>
<td>0.29</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Services in-house share</td>
<td>4027</td>
<td>0.45</td>
<td>0.40</td>
<td>0.22</td>
<td>0.01</td>
<td>1.00</td>
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<tr>
<td>Services input share</td>
<td>4027</td>
<td>0.17</td>
<td>0.15</td>
<td>0.10</td>
<td>-0.24</td>
<td>0.95</td>
</tr>
<tr>
<td>Employment</td>
<td>4027</td>
<td>139</td>
<td>44</td>
<td>657</td>
<td>20</td>
<td>na</td>
</tr>
<tr>
<td>Labour productivity</td>
<td>4027</td>
<td>667</td>
<td>581</td>
<td>390</td>
<td>13</td>
<td>7701</td>
</tr>
<tr>
<td>Human capital intensity</td>
<td>4027</td>
<td>0.19</td>
<td>0.14</td>
<td>0.15</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Physical capital intensity</td>
<td>4027</td>
<td>324</td>
<td>188</td>
<td>548</td>
<td>0</td>
<td>11681</td>
</tr>
<tr>
<td>Services sales share</td>
<td>4027</td>
<td>0.10</td>
<td>0.01</td>
<td>0.19</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Multinational status</td>
<td>4027</td>
<td>0.46</td>
<td>0.00</td>
<td>0.50</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Exporter</td>
<td>4027</td>
<td>0.81</td>
<td>1.00</td>
<td>0.39</td>
<td>0.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Notes: i) Monetary values are in 1 000 SEK and employment in number of employees. ii) Only merchandise trade is considered.

2.6 Descriptive statistics on the relation between services and exports
How different are firms that are more services-intense in terms of exports and other key economic variables, when compared with other firms? To describe this, and in analogy with the concept of premia in the heterogeneous firm literature on exports, the "premia" for manufacturing firms that are more services-intense is estimated. The regression model is:

\[
\ln X_{it} = \beta_0 + \beta_1 \ln S_{it} + \beta_3 \ln \text{Ind}_{it} + \beta_4 \ln \text{Emp}_{it} + \varepsilon_{it}, \tag{1}
\]

where \(X_{it}\) is a particular characteristic of firm \(i\) (export intensity, labour productivity or human capital intensity); \(S_{it}\) is the firm’s share of services in in-house production or bought-in services in total input; \(\text{Ind}_{it}\) is the firm’s industry at the three-digit level; \(\text{Emp}_{it}\) measures size (number of full-time employees); and \(\varepsilon_{it}\) is an idiosyncratic error term. The "premia" are

22 As for the negative minimum value of the share of bought-in services in total sales, it is explained by repurchases of services suppliers, according to Statistics Sweden.
reported in table 3. They measure the elasticity of variables of interest with respect to services.

<table>
<thead>
<tr>
<th>Table 3: Services premia, in terms of elasticities</th>
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<tbody>
<tr>
<td>Premia \ Shares</td>
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<tr>
<td>------------------</td>
</tr>
<tr>
<td>Export intensity</td>
</tr>
<tr>
<td>Labour productivity</td>
</tr>
<tr>
<td>Human capital intensity</td>
</tr>
</tbody>
</table>

Notes: i) Pooled OLS-estimates. ii) Significant at the *** 1%, ** 5%, and * 10% level, respectively.

The in-house services premium is positive and strongly significant in terms of export intensity. A 10 per cent higher share of services in in-house production is associated with more than 4 per cent higher export intensity. Likewise, there is a premium in terms of human capital intensity, where a 10 per cent increase in in-house services is associated with more than 10 per cent higher human capital intensity. This indicates that labour hired in manufacturing for performing services tasks is more skilled. The premium in terms of productivity is smaller but not trivial and statistically significant. In contrast, a higher proportion of bought-in services in total input is mostly associated with premia that are non-significant and practically of little importance.

So far, we have only looked at the average relationship between services and export intensity. However, the correlation between services and export intensity might vary with the level of the services variable in a non-linear fashion. To explore this, the distribution of export intensity is analysed across firms with various levels of services usage. Results for the share of services in in-house production are displayed in table 4. Export intensity rises with the level of the in-house services share. However, the relation seems to be somewhat hump-shaped. At very high shares of services in in-house production the export intensity declines, in line with our assumption of diminishing returns to factors of production. Moreover, a high share of in-house services seems to entail higher risk: compared with firms with at the lower end of share of services in in-house production, firms at the upper end have almost 60 per cent
higher standard deviation in export intensity. It can be added that the shares of bought-in services in total input also displays a hump-shaped relation with export intensity but the “hump” emerges much earlier in the distribution, see table A1 in the appendix.

<table>
<thead>
<tr>
<th>Table 4: Export intensity of firms with various levels of services share in in-house production</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Obs.</td>
</tr>
<tr>
<td>≤ 20%</td>
</tr>
<tr>
<td>&gt; 20% and ≤ 40%</td>
</tr>
<tr>
<td>&gt; 40% and ≤ 60%</td>
</tr>
<tr>
<td>&gt; 60% and ≤ 80%</td>
</tr>
<tr>
<td>&gt; 80%</td>
</tr>
</tbody>
</table>

To recapitulate, there are signs that firms with higher shares of services in in-house production are different and perform better in terms of export intensity, albeit at a higher risk.

3 Empirical specification and estimation strategy

3.1 Empirical specification

Turning to the empirical specification, both internally and externally sourced services are included as explanatory variables. Besides services input, I control for other supply side factors that are specific to the firm and are known to be associated with export performance. These include: size; productivity; affiliations and previous export experience. In addition to the covariates mentioned, I include factor proportions (human and physical capital intensities); services sales intensity; and dummies for industry-specific effects at the three-digit level and for year-specific effects. Unobserved firm heterogeneity is also considered. However, general factors such as tariffs and non-tariff barriers are excluded from the analysis since focus is on determinants of exports at the micro, not the meso or macro, level.23

23 For an overview of firm characteristics associated with export performance, see for example Bernard et al (2007); Greenaway and Kneller (2005 and 2007); and Hiep and Nishijima (2009). As regards size, the effect on export performance is not entirely clear, Fryges and Wagner (2010) find a positive effect as does Sterlacchini (2001). However, in both those studies there is a level effect. Possibly, larger exporters move on to serve foreign markets mainly through foreign direct investments rather than exports. I therefore include the square of size, measured by the number of full time employees, in the sensitivity analysis. With respect to services sales
To summarise, a firm’s expected conditional export intensity is modelled as a function of services-intensity, covariates, interaction terms and firm heterogeneity:

\[
E(y_{it} \mid X_{it-n}, Z_{it-n}, c_i) = X_{it-n}\beta_X + Z_{it-n}\beta_Z + A_{it-n}\beta_A + T\beta_T + c_i,
\]  

(2)

where \(i\) is the firm; \(t\) is the year; \(n\) is the lag; \(y_{it}\) is the export intensity scalar; \(X_{it-n}\) is a \(1 \times K_1\) vector of services-intensity variables that includes the shares of services in in-house production and of bought-in services in total input, as well as the squared value of shares; \(Z_{it-n}\) is a \(1 \times K_2\) vector of covariates (firm size, labour productivity, multinational status, previous export experience, human and physical capital intensities, services sale intensity and its square and industry at the three-digit level); \(A_{it-n}\) is a \(1 \times K_3\) vector of interaction terms; \(T\) is a \(1 \times K_4\) vector of year dummies; and \(c_i\) is an unobserved firm-specific effect.

Conditional on the covariates in equation (2), the average effect of services on those who use them more intensively is assumed not to be biased by sample selection (those using services more intensively being different from those who do not). By viewing treatment as randomly assigned, conditioned on the covariates, we can interpret estimation results as average causal effects (Angrist and Pischke, 2009).\(^{24}\)

The model is dynamic in the sense that it has a lagged structure.\(^{25}\) An increased focus on services in a firm could arguably be viewed as an investment, which entails structural adjustments and future pay-offs. Of course this applies to activities such as R&D but it is reasonable to assume that it also applies to many other services activities. Moreover, there might be a lag between an increased services focus of the firm and pay-offs in terms of customer recognition. Lastly, endogeneity of covariates, such as productivity, to services intensity, it is defined as the share of services in total sales. Including the variable controls for potential influence of services output when estimating the effect of services input on merchandise export.

\(^{24}\) Potential reverse causality is considered by using a lagged specification, which is discussed below, and by using Generalised Method of Moments (GMM) as one of the key estimators in the econometric analysis, see section 3.3.

\(^{25}\) As a consequence, two years of the seven year panel are lost and we end up with 16 429 observations.
could bias the coefficient estimates of interest. The dynamic model fixes the values of the covariates before the services variables are established.

### 3.2 Estimation strategy

To estimate the model in equation (2) we would ideally use fractional and partially censored regression with firm heterogeneity. By definition the response variable is a limited dependent variable, $0 \leq y_{it} \leq 1$, with many observations in the low-end corner.\(^{26}\) With many corner observations we should avoid the practice to adjust data for example by adding a small constant. The precise number chosen to replace corner observations may affect results in a non-trivial way. Moreover, the effect of predictor variables should not be constant with a fractional response variable, but rather diminish at high levels of those variables. This suggests that a non-linear model is appropriate (Papke and Wooldridge, 1996). Wagner (2001) surveys potential models for estimating effects on fractional response variables and concludes that newly developed fractional models are to prefer over previously used approaches. Relevant models include the fractional logit and probit models proposed by Papke and Wooldridge (1996 and 2008). However, in our application the numerator of the response variable is partially truncated. Firms’ export to the rest of the EU below a threshold is not reported, while there is no threshold for export to the rest of the world. The consequence is even more zeros in the response variable. For 5 861 (21 per cent) of the 27 871 observations there is no registered export to the EU. Thus, I accommodate for this partial truncation by using censored maximum likelihood estimation, which also takes the fractional nature of the response variable into account. Finally, firms’ heterogeneity is considered by including an unobserved firm specific random effect.

In essence, this results in a constrained and two-limit Tobit regression (henceforth, fractional Tobit). The model is well suited for the fractional response variable that has a partly

\(^{26}\) 17 per cent of the 27 871 observations have zero export values.
truncated numerator and the model exploits both within and between variation in the unbalanced seven year panel. The latent variable is:

\[
y_{1it}^* = \rho y_{2it} + X_{it} \beta_x + Z_{it} \beta_z + A_{it} \beta_a + T \beta_t + c_i + u_{it}
\]

\[
y_{1it} = \begin{cases} 
  d_{it}^# / s_{it} & \text{if } d_{it} \leq d_{it}^# \\
  y_{1it}^* & \text{if } d_{it}^# / s_{it} < y_{1it}^* < 1 \\
  1 & \text{if } y_{1it}^* \geq 1 
\end{cases}
\]

(3)

where the unobservable variable \(y_{1it}^*\) is the intensity of exports to the EU and \(y_{2it}\) is the intensity of exports to the rest of the world; \(c_i \sim N(0, \sigma^2)\) is a firm specific random effect; \(u_{it} \sim N(0, \sigma^2)\) is an idiosyncratic error term; and \(d_{it}\) is the value of exports to the EU. The lower corner of the response variable varies since it is the ratio of the threshold for exports to the EU (\(d_{it}^#\)) and the firm’s total sales (\(s_{it}\)). Finally, the partial truncation of a firm’s export is considered by separating the response variable \(y_{it}\) into intensity of EU exports \(y_{1it}\) and of exports to the rest of the world \(y_{2it}\) and moving the latter to the right-hand side of the equation while constraining the coefficient \(\rho\) to -1.

To get marginal effects, which are comparable to for example OLS coefficients, coefficients from the maximum likelihood estimation are multiplied with a scalar: the predicted probability of the latent variable being within the restricted range, evaluated at the mean of the regressor (Wooldridge, 2002). In this application this means that the more firms with truncated EU exports, the lower is that scalar and therefore also the marginal effect.

The system Generalised Method of Moments (GMM) estimator of Arellano and Bover (1995) / Blundell and Bond (1998) is used for analysing the robustness of the preferred estimator, in addition to pooled Ordinary Least Squares (OLS). The system GMM estimator is suitable for large panel settings with few time periods, potentially endogenous predictors, heterogeneous individuals and second-moment misspecification (heteroscedastic and serially
correlated residuals). More specifically, the estimator tries to control for endogeneity by adding all lags of predictor variables as instruments. This is useful in the present paper since export intense firms might self-select to focus more on services in order to better cope with the extra costs and competition abroad. It should be added that a drawback of the system GMM estimator is that it does not accommodate for the fractional nature of the response variable and its partial truncation, why the preferred estimator is the fractional Tobit.

4. Do services improve export intensity?
The average causal effect of firms’ sourcing strategies regarding services is displayed in table 5. Results from the preferred fractional Tobit estimation of equation (3) show that in-house services affect subsequent export intensity positively, as hypothesised. The marginal effect on export intensity of increasing the share of services in in-house production is 0.13. This means that if the share of in-house services rises by 10 per cent it results in a 1.3 per cent increase in export intensity, on average. The effect is statistically significant and, as all results, robust to within serial correlation and heteroscedasticity, using block bootstrap technique.

Firms with export experience gain substantially more from expanding in-house services than the reference group of firms without export experience. There is also an indication that larger firms, in terms of employment, benefit somewhat less than smaller firms from previous expansion of in-house services production. Furthermore, the estimation results suggest that there is diminishing return to raising the relative size of in-house services production. The coefficient of the squared in-house services variable is negative and almost significant (p-value 0.103).

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27 For an introduction, see Roodman (2009).
28 An alternative benchmark might be generated by modelling export performance in two steps, the decision to export and how much to export. However, this requires an exclusion criterion, which is not available. Moreover, such models do not consider the fractional nature of export intensity. Theoretically, Wagner (2001) rejects two-step models, when modelling export intensity, since exporting and how much to export is a simultaneous decision.
On the whole, taking first and second order as well as interaction effects into account, the elasticity at the mean of the in-house services variable is 0.06. Thus, a 10 per cent increase of the ratio of in-house services production is expected to yield roughly 0.6 per cent higher export intensity in the next year, on average.

Turning to outsourcing, the preferred estimation indicates no statistically significant effect of increasing the share of bought-in services inputs relative to total input. However, the estimated marginal effect is close to being statistically significant at the 10 per cent level and
of an important magnitude. Moreover, this does not rule out a statistically significant effect of subsets of bought-in services.

In line with previous literature, we find that a firm’s export performance is positively related to previous export experience, size and productivity. Previous export experience matters the most, according to the estimation results. Firm size is also important. Another predictor of export intensity is the multinational status of the firm.

In table 5 results from the preferred model are compared with results from a pooled OLS regression and a one step system GMM regression, treating all predictors as potentially endogenous. Findings above on the causal effect of the services variables on export intensity are by and large robust to estimation method. The results for the in-house services variable and its square are the same as from the preferred model although the magnitudes differ and the latter is now statistically significant: In-house services yield higher subsequent export intensity but a declining rate. However, in contrast to the preferred estimation, the GMM estimation indicates that gains in export intensity from expanding in-house services production are moderated by a negative interaction with a larger share of bought-in services in total input. This may suggest that internal and external services are substitutes and/or that there is diminishing marginal return to services. The results from the GMM estimation also differ when it comes to the interactions between in-house services and size, which is statistically significant in the preferred but not in the GMM estimation.

As regards the bought-in services variable, it is significant and quite substantial in both the GMM and pooled OLS estimation. This together with the almost significant effect in the preferred estimation provides some evidence that raising the share of bought-in services in total input yields higher export intensity, as hypothesised. According to the preferred
estimation, the marginal effect of expanding bought-in services with 10 per cent is a subsequent increase in export intensity of 0.6 per cent, on average.29

Next, the relation between services in-house and R&D is examined, as a sensitivity analysis. It is conceivable that the share of services in in-house production to an extent captures R&D, which has been found to be linked to exports. R&D is not controlled for in equation (3) due to a lack of data. However, a proxy is the share of services provided by employees with doctor’s degree. I therefore disaggregate human capital intensity into medium-skill and high-skill human capital intensity, where the latter represents employees with a doctor’s degree. Furthermore, high-skill human capital intensity is controlled for in the same period as the in-house services variable. Thus, a significant coefficient for the share of services in in-house production would be capturing something else than the link between R&D and export. The extended results indicate that the services share in in-house production is even more important for export intensity than in the main results. My interpretation is that the effect of in-house services share is not likely only to be capturing the effect of R&D.30 Meanwhile, and as expected, the R&D proxy – high-skill human capital intensity – shows to be important for export intensity.31

Additionally, I have analysed how partial truncation of the numerator of the response variable affects results from the preferred model. Firstly, the model is run with total export intensity treated as a non-truncated response variable. The results diverge substantially from those of the main model. This could be expected. A large fraction of the observations are zeros and among the other observations with EU exports the median export EU value is only 17 700 mn SEK, in 2007, which is not very far from the export threshold of 4 500 mn. Thus,

29 Following the GMM estimation, I apply the Arellano-Bond test for serial correlation of higher orders in the first-differenced errors and the result is negative.
30 Moreover, only seven per cent of bought-in services in manufacturing are R&D services, see fig. A1 in the appendix, and an even smaller share of employees do R&D, according to own calculations based on official data from Statistics Sweden.
31 Results available upon request.
ignoring truncation would risk to severely bias results. Secondly, I would like to see if the message from the main estimation holds when limiting the analysis to exports to the rest of the world. Such an analysis cannot provide the full picture since export to the rest of the world is only a fraction of total exports from Sweden (34 per cent in 2007). However, export to the rest of the world is not truncated, making it useful for an additional reality check. The results from this extra estimation confirm the previous findings. Thus, the results hold also when looking at non-truncated exports.

Checks for misspecification of the preferred model and for its numerical accuracy have also been done. For example, higher powers of some variables are added. Adding the squared value of size increases the coefficient for size itself while the magnitude of the squared size’s coefficient is practically negligible and other results are unaffected. Higher powers of the services variables are also be added in order to consider further non-linearity. However, the coefficients of these powers are not robust. Moreover, the number of lags in the model has been experimented with, without it altering the main results. The numerical accuracy of the estimation might be another issue. The preferred model is a maximum likelihood model that computes the log likelihood using adaptive Gauss-Hermite quadrature, where the results can be sensitive to the number of quadrature points used. Therefore the estimation has been rerun using different number of quadrature points. The results change only marginally and consequently the estimation does a good job.

5. Conclusions and final remarks
Manufacturing firms are increasingly focusing on services. This trend is evident in their composition of input, in-house production and seemingly also in their composition of total sale. Manufacturing firms’ services intensity is likely to affect productivity and

32 Generally, the effects of most explanatory variables are smaller. The diminishing return to in-house services is now both statistically and practically much less important. The share of bought-in services in total input is now statistically significant, at the 10% level, also in the preferred estimation.
competitiveness abroad. However, only bits and pieces of the relation between services and export performance have been analysed in theoretical and empirical literature.

The contribution of this study is therefore to discuss the role of services for the manufacturing firm, arrive at some conjectures and then test them empirically. In brief, the manufacturing firm may raise its services intensity in preparations for and efforts in exporting. Services improve the firm’s ability to bear extra costs associated with exports, to manage more intense competition on the world market and to accommodate for changes in demand. Based on the conceptual framework and earlier findings, I hypothesise that increasing the share of services in in-house production affects the firm’s export intensity positively and raising the share of bought-in services in total input is also likely to have a positive effect. Thus, after an initial descriptive analysis, export intensity is regressed on two services parameters and covariates, using a rich unbalanced panel of manufacturing firms in Sweden in the period 2001-2007.

The descriptive analysis shows that firms with a larger proportion of services in in-house production are different and perform substantially better in terms of export intensity. However, having a considerable share of services in in-house production seems to entail higher risk. Firms at the upper end of share of in-house services have higher standard deviation in export intensity than firms at the lower end.

The microeconometric results indicate that there is an effect of services inputs, when controlling for the usual covariates and firm heterogeneity. A 10 percent rise in the ratio of services in in-house production is expected to yield about 0.6 per cent higher export intensity next year, on average and taking second order effects into account. The result is statistically significant and robust to clustered and heteroscedastic disturbances, different specifications, models and estimation methods. Furthermore, buying-in more services affect export intensity positively. However, this effect is smaller and also more uncertain than the one from raising
the share of services in in-house production, being close to statistically significant in the preferred estimation but significant in the two alternative estimations.

The increased focus on services in manufacturing firms may partly be seen as a response to the growing competition from emerging economies. Manufacturing in industrialised countries focuses on activities in the value-chain where it has comparative advantages. The advantages of relative abundant highly skilled labour, research and development as well as previous agglomeration patterns favour specialisation in high-value added manufacturing and services activities. Another reason for the more intense use of services is likely to be changes on the firms’ demand side. Customers increasingly demand quality and services and they are more and more concerned about environmental and social aspects of products and their production.

Overall, the results underline the importance of services – in-house and bought-in – as inputs into manufacturing. By using more services, manufacturing firms in industrialised countries may become more competitive internationally. From a policy-making perspective, efforts to enhance access to services – for example, through liberalisation of the movement of services and services suppliers – would indeed seem worthwhile.
References


Bottini, Novella and Lucia Tajoli (2010). Does the interaction between service and manufacturing explain the recent trends in export specialization? A look at the evidence from the EU, Draft paper at the Workshop on The Role of Business Services for Innovation, Internationalisation and Growth, University of Rome La Sapienza, 2-3 December 2010.


Appendix

Figure A1: Services usage in manufacturing, shares of total (%) in 2005

Table A1: Export intensity of firms with various levels of services input share

<table>
<thead>
<tr>
<th>Services Usage (%)</th>
<th>No. of Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 10%</td>
<td>4,363</td>
<td>0.206</td>
<td>0.277</td>
<td>0.065</td>
</tr>
<tr>
<td>&gt; 10% and ≤ 30%</td>
<td>20,925</td>
<td>0.260</td>
<td>0.293</td>
<td>0.134</td>
</tr>
<tr>
<td>&gt; 30% and ≤ 50%</td>
<td>2,216</td>
<td>0.220</td>
<td>0.306</td>
<td>0.034</td>
</tr>
<tr>
<td>&gt; 50% and ≤ 70%</td>
<td>273</td>
<td>0.176</td>
<td>0.302</td>
<td>0.002</td>
</tr>
<tr>
<td>&gt; 70%</td>
<td>94</td>
<td>0.140</td>
<td>0.304</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table A2: Pairwise correlation

<table>
<thead>
<tr>
<th></th>
<th>ent</th>
<th>sh</th>
<th>si</th>
<th>emp</th>
<th>lp</th>
<th>pcap</th>
<th>hcap</th>
<th>ss</th>
<th>mne</th>
<th>exp</th>
</tr>
</thead>
<tbody>
<tr>
<td>ent</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sh</td>
<td>0.151</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>si</td>
<td>0.016</td>
<td>0.241</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>emp</td>
<td>0.315</td>
<td>0.117</td>
<td>0.098</td>
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<td></td>
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<td></td>
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<tr>
<td>lp</td>
<td>0.169</td>
<td>0.167</td>
<td>-0.115</td>
<td>0.157</td>
<td>1.000</td>
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</tr>
<tr>
<td>pcap</td>
<td>0.121</td>
<td>-0.075</td>
<td>-0.021</td>
<td>0.119</td>
<td>0.119</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hcap</td>
<td>0.185</td>
<td>0.322</td>
<td>0.097</td>
<td>0.215</td>
<td>0.122</td>
<td>0.013</td>
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<tr>
<td>ss</td>
<td>-0.013</td>
<td>0.256</td>
<td>0.072</td>
<td>0.143</td>
<td>0.081</td>
<td>-0.100</td>
<td>0.078</td>
<td>1.000</td>
<td></td>
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</tr>
<tr>
<td>mne</td>
<td>0.384</td>
<td>0.253</td>
<td>0.077</td>
<td>0.450</td>
<td>0.156</td>
<td>0.072</td>
<td>0.211</td>
<td>0.140</td>
<td>1.000</td>
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</tr>
<tr>
<td>exp</td>
<td>0.386</td>
<td>0.075</td>
<td>-0.029</td>
<td>0.242</td>
<td>0.098</td>
<td>0.159</td>
<td>0.164</td>
<td>0.021</td>
<td>0.289</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Notes: i) Number of observations in the 2001–2007 period is 27,872. ii) Values are in 1,000 SEK.
ent: Export intensity (merchandise export / total net sales)
sh: Services share in in-house production (services wages / total wages)
si: Services share in costs for externally sourced input
emp: Log of employment (measured as the number of full-time equivalents)
lp: Log of labour productivity (value-added / employment)
picap: Log of capital intensity (capital stock / employment)
hcap: Log of human capital intensity (employment with post-secondary education or higher / total employment)
ss: Services share in total net sales
mne: Multinational enterprise dummy
exp: Exporter dummy
Data


Financial information comes from the Swedish Structural Business Statistics (SBS). The SBS is based on data of the Swedish Tax Authority but is supplemented by survey data for some variables as well as for the largest firms. A firm is generally defined as the smallest legal entity. However, there are some 50 “composite firms” who report for more than one legal entity within the same enterprise group. Industry affiliation of firms and entities is from the Business Register and is done using the Swedish standard industrial classification (SNI 2002). SNI 2002 corresponds to NACE (rev. 1.1) up to 4-digit level and to ISIC (rev. 3) up to the 2-digit level.

Information on enterprise affiliation comes from the Swedish Enterprise Group Register (EGR). Data has been collected by Statistics Sweden and PAR AB. An enterprise group is defined as a group consisting of a mother firm and at least one more firm, where the mother holds the absolute and therefore controlling majority (>50%) of the stocks.

Statistics on highest education attained for each resident aged 16-74 comes from the register based labour market statistics (RAMS). Since 2001 RAMS also contains information on number of employees, their occupation and remuneration.

Foreign trade data is from the Swedish Foreign Trade Statistics (FTS). It includes value (SEK) and country of origin or destination. With respect to merchandise trade with non-EU countries, data comes from compulsory registration information of the Swedish Customs. Regarding intra-EU merchandise trade, data covers the trade of all firms with an annual

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33 For 2006, 55 “composite firms” enclosed 1071 other legal entities.
34 In 2006 about 70 per cent of firms in the EGR were in Swedish-only groups, 17 per cent in foreign ones and 13 per cent in Swedish multinationals.
import or export of 2.2 and 4.5 million SEK, respectively.\textsuperscript{35} For services trade, all collated bank transactions larger than 150,000 SEK crossing the Swedish border is included before 2003. Since 2003 data is based on a quarterly survey. A representative sample of some 5,000 services traders is included in the survey – 10 per cent of the population – and a third of the sample is replaced each year.\textsuperscript{36}

\textsuperscript{35} The earlier limit for exports and imports being covered was 1.5 mn SEK (1998-2004). For trade via another EU member, information on the actual sender or receiver is unavailable.

\textsuperscript{36} Data for travel funds and some government authorities are reported separately by the Central Bank to Statistics Sweden.