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ABSTRACT

Geography and the Determinants of Firm Exports in Indonesia

This paper uses data from the Indonesian manufacturing census in order to uncover the determinants of firm exports over the period 1990-2005. We examine to what extent differences in firm export propensity and intensity are a consequence of firm-level (microeconomic), of place-based (macroeconomic) first- and second-nature geography characteristics, or of a combination of the two. The results indicate that both internal and external factors matter. Second-nature, rather than first-nature, geography makes an important difference. The conditions of a firm's province and those of neighboring provinces shape firm exports. Agglomeration effects, education and transport infrastructure endowment play a particularly relevant role in Indonesian firms' export propensity, while export spillovers increase export intensity.

JEL Classification: F1, F2 and R1
Keywords: asia, export intensity, export propensity, geography, indonesia, macro-factors and micro-factors

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1. INTRODUCTION

In development circles, Indonesia has been regarded in recent years as an example to follow. A large and densely populated Islamic country which was stuck in low levels of development achieved, after reforms in the late 1980s and early 1990s, a period of intermittent high growth which has now lasted two decades. It has also been capable of overturning not only the negative effects of the 1997 Asian crisis and of the 2008 Great Recession, but to also cope with civil unrest and armed conflict (Aceh, Timor, Papua) and huge natural disasters, such as the 2004 Boxing Day tsunami. Much of the recent economic success has been put down to reforms that led to an opening of the country to imports and exports and allowed many of its firms to blossom. Indeed, exports have grown at a relatively high pace over the last two decades. Figure 1 shows the evolution of the export of manufactures, as a percentage of GDP, in Indonesia, in comparison to three BRIC countries (Brazil, China, and India).

Figure 1 here

As seen in Figure 1, Indonesia has an export share of manufactures which clearly exceeded those of Brazil and India, especially during the 1990s and early 2000s. Manufacturing exports make up around 50% of Indonesian merchandise exports, with a high share of textiles and clothing, office machines and telecom equipment, chemicals, electrical equipment, and semi-manufactures. Japan is Indonesia's main export partner, followed at a distance by the EU and the US. China is increasingly emerging as one of the main destinations for Indonesian exports.

However, despite the importance of manufacturing exports in the Indonesian economy, there is little understanding of what drives export propensity, i.e. the likelihood of exporting, and export intensity, i.e. the share of exports in output, across Indonesian manufacturing firms and whether the factors behind the rise in exports at the firm level are sustainable. In this paper we ask precisely these questions. What makes Indonesian firms export? And are the factors behind firm export propensity and intensity inherent to the firm or fundamentally external?

We address these questions by combining two strands of literature that have been particularly vibrant in recent years, namely the literatures on spatial agglomeration and on the firm-level determinants of exports. While a large number of studies have analyzed firm-level determinants of exports, location has typically been reduced to a control dummy (see, e.g. Aitken, Hanson, & Harrison, 1997; Bernard & Jensen, 1999; Clerides, Lach, & Tybout, 1998; Greenaway & Kneller, 2004; Roberts & Tybout, 1997). Similarly, while the agglomeration literature has explored the relationship with exporting, most focus on the agglomeration–export relationship has not taken into account how both of these are shaped by regional characteristics (see, e.g. Aitken et al., 1997; Antonietti & Cainelli, 2011; Bernard & Jensen, 2004; Greenaway & Kneller, 2004; Koenig, 2009; Koenig, Mayneris, & Poncet, 2010; Lovely, Rosenthal, & Sharma, 2005; Malmberg, Malmberg, & Lundequist, 2000; Mittelstaedt, Ward, & Nowlin, 2006).

For the empirical analysis we resort to an econometric estimation using the manufacturing census data, covering more than 15,000 Indonesian firms between 1990 and 2005, complemented by socioeconomic data on the regions where individual firms are located and of the neighbouring regions, as a means to capture the geographical dimension behind the determinants of export propensity and intensity in Indonesia.

2. FIRMS, REGIONS AND EXPORTS

Traditionally research on firm export propensity and intensity has tended to focus on firm-specific characteristics and on national macroeconomic and regulatory settings. However, the factors determining the probability of exporting as well as the share of sales of a firm that is exported are associated not only with its specific characteristics and with the national environment, but also with the character and conditions of the host region where the firm is located and with the supra-regional environment. Nevertheless, while the characteristics of a firm have attracted considerable attention, regional and supra-regional endowments have been virtually overlooked by past analyses of firm exports.

While several studies have examined regional determinants of firm-level foreign direct investment [e.g. Deichmann, Karidis, and Sayek (2003) for Turkey, and Amiti and Javorcik (2008) for China)], there are no international trade studies to our knowledge that explicitly integrate regional and supra-regional determinants of export propensity and intensity. Note that in this study regional determinants do not refer to agglomeration economies, which have been included in several studies on the determinants of exports (see, e.g. Aitken et al., 1997; Antonietti & Cainelli, 2011; Bernard & Jensen, 2004; Greenaway & Kneller, 2004; Koenig, 2009; Koenig et al., 2010; Lovely et al., 2005; Malmberg et al., 2000; Mittelstaedt et al., 2006).

Yet the characteristics of the territories where firms are located – and those of neighboring regions – are crucial in order to explain exports, both in developed and in emerging economies. Firms depend on their surrounding geographical environment for qualified labor, information and knowledge spillovers. Location also determines access to certain economic inputs and trade facilities. And the presence of adequate infrastructure and of agglomeration economies may boost a firm's export potential. In this section we explore the firm-specific and location-bound advantages that allow firms to trade beyond domestic markets.

(a) Characteristics of a firm and exports

Firms base their export choices on the costs and benefits of production for domestic and foreign markets. Firm-specific characteristics that affect the costs and benefits of production and product quality are crucial for explaining firm level exports (Sjöholm, 2003). The key characteristics shaping a firm's potential to export include foreign ownership capital stock, productivity, its age, and the sunk entry costs of exporting among others. This strand of literature typically adds regional dummies along with industry dummies to the firm-level determinants of exporting, since

location might account for most of the differences between exporters and non-exporters.

The sunk entry costs of exporting explain a large part of a firm's decision to enter the export market. While sunk entry costs may act as barrier to start exporting, firms that paid sunk entry costs in the past are more likely to export today compared to firms that did not (Aitken et al., 1997; Bernard & Jensen, 1999; Clerides et al., 1998; Greenaway & Kneller, 2004; Roberts & Tybout, 1997). In addition to sunk entry costs, the following firm-level characteristics have been identified as determinants of both export propensity and the percentage of a firm's exports in output.

First, foreign ownership is expected to have a positive effect on export propensity and export intensity. Multinational corporations by definition have an international network (Sjöholm, 2003) and thus tend to be better able to produce internationally marketable products and to possess marketing networks (Ramstetter, 1999: 45). In addition, transaction costs associated with international trade tend to be lower for multinationals than for local firms (Ramstetter, 1999: 45). Emerging and transition economies are no exception. Studies have confirmed that foreign ownership increases the probability of exporting (e.g. Aitken et al., 1997; Cole, Elliott, & Virakul, 2010). Filatotchev, Stephan, and Jindra (2008) have shown that ownership has an important influence on export intensity in transition economies. While, in the specific case of Indonesia, it has been reported that foreign owned firms have a higher export capacity than local firms in sectors such as auto parts, electronics and garments (Rasiah, 2005).

An additional factor affecting export propensity and intensity is the capital stock of a firm. A large proportion of large-scale firm manufacturing in Indonesia is labor-intensive assembly production geared towards export markets (Berry, Rodriguez, & Sandee, 2002: 142). These firms, by and large, have a greater capital stock than equivalent firms targeting the national market. Studies confirm that a higher capital stock increases the likelihood of exporting (e.g. Clerides et al., 1998; Roberts & Tybout, 1997).

Productivity plays an important role in firm export propensity and export intensity. Numerous studies have shown that more productive firms (e.g. through technological upgrading or through an increase in capital per worker) are more capable of tapping into export markets (Aw, Chung, & Roberts, 2000; Bernard & Jensen, 1999; Cole et al., 2010; Delgado, Farinas, & Ruano, 2002; Greenaway & Kneller, 2004). Productivity also influences the sunk entry costs of exporting. Studies argue that only the more productive and profitable firms are able to incur large fixed costs when entering export markets. Hence, exports can be considered a result of increases in productivity, rather than a cause (Blalock & Gertler, 2004: 398).

Finally the age of a firm has been shown to affect export propensity and the share of sales that is exported. However, the impact of firm age on exports is far from clear-cut. On the one hand, it can be envisaged that the involvement of a firm with international markets is a gradual development process (Bilkey & Tesar, 1977; Johanson & Vahlne, 1977). Firms would export more once they have found their footing in national markets and acquired greater knowledge about foreign markets and operations, leading to an increase of the export propensity (Roberts & Tybout, 1997) and intensity of a firm with age (Jenkins, 2006; Moen & Servais, 2002).

On the other hand, age can also be a handicap. Many studies have highlighted that export-oriented firms are born that way and not bred into exporting. These firms have been termed the 'international new ventures' (McDougall, Shane, & Oviatt, 1994), the 'born globals' (Knight & Cavusgil, 1996), 'instant internationals' (Preece, Miles, & Baetz, 1998) or 'global start-ups' (Oviatt & McDougall, 1994), that is firms which are heavily involved in exporting from the time they are set up (Moen & Servais, 2002) and which represent a substantial portion of exports in emerging economies. Due to the balancing of these two offsetting effects, a number of studies tend to find no clear effect of age on exporting (e.g. Clerides et al., 1998).

(b) Regional and supra-regional characteristics and exports

Next to the traditional focus on firm-specific characteristics, the local host environment and the comparative advantages of different locations play a non-negligible role in the potential of individual firms to export. The growing body of trade literature on the determinants of exports at the firm-level typically adds regional dummies along with industry dummies to the firm-level determinants of exports, since location may account for part of the differences between exporters and non-exporters and between high and low export intensity, respectively. While such regional dummies may point to the existence of regional differences, they do not reveal which specific characteristics determine the propensity or intensity of exporting.

From a policy perspective, identifying such regional determinants is essential, since regional characteristics influence the costs of exporting, e.g. through the availability of skills, transport costs, infrastructure, or institutions in the region. Firms have to rely on locational advantages and regional resources and capabilities which contribute to their export propensity and intensity (Barney, Wright, & Ketchen, 2001). A good location, an adequate sectoral structure, a decent endowment of human capital, knowledge and infrastructure are all factors which facilitate the capacity of firms to deal with external markets and also to become more successful.

The first source of locational advantages arises from geography – and from what some economists have called first-nature geography (Krugman, 1993). First-nature geography implies the inherent features of an area that are independent of human activity and includes topography, latitude, incidence of natural resource endowment, agricultural potential (soil quality and rainfall), and climate (Naudé, 2009: 2). These natural features are exogenous the economy. First-nature geography is linked to proximity between economic agents and an adequate natural environment. The agglomeration of firms can be explained by an accidental accumulation of favorable natural features (Roos, 2005). In spite of the changes brought about by globalization, trade in goods continues to be highly sensible to transportation costs (Ghemawat, 2007). The higher the proximity to export centers – that means ports, in particular, and the coast, in general – the lower the transportation costs. Moreover, firms which are geographically distant from a port are not only likely to export less or not to participate in exporting at all, but, in particular in peripheral regions, they may also face greater barriers to obtaining knowledge about local market opportunities, coordinating sales strategies, and monitoring agents (Ellis, 2007; Estrin et al., 2008; Wu, Sinkovics, Cavusgil, & Roath, 2007). Coastal regions are also likely to enjoy a

wider scope of the market and better access to international trade than inland regions (Gallup, Sachs, & Mellinger, 1999). However, since Indonesia has a somewhat unique geography, covering more than 17,500 islands, distance to ports might play a less important role compared to other countries and, in particular, to landlocked ones.

The geographical advantages of the host location with respect to inputs into the production process also determine the kind of operations which may be located there (Dunning, 1998; Estrin et al., 2008). They emphasize the efficiency gains from proximity between economic agents (Ottaviano & Thisse, 2005). Such factors are also known as second-nature geography factors and refer to features that depend on the interaction between people in an area but are not necessarily inherited. Second-nature geography includes population density, population location and composition, among others (Naudé, 2009: 2), factors which are important in explaining why regions with similar first-nature geography may end up at different levels of development (Naudé, 2009: 2). Second-nature geography factors can be divided into agglomeration economies and regional endowments.

Agglomeration economies can have a particularly favorable influence on a firm's propensity and intensity to export as they allow firms to participate profitably and competitively in wide trade networks (Berry et al., 2002). Agglomeration economies can lower (i) production costs through sharing of resources, mainly social and physical infrastructure, and (ii) transportation and transaction costs through increased interaction between suppliers and customers on site (Malmberg et al., 2000). Regions with high agglomeration economies are expected to attract and retain industries which are primarily oriented to markets outside their own country.

On the other hand, agglomerations may be characterized by high congestion costs (Krugman, 1991) which can increase (i) production costs through the sharing of resources (e.g. power outages), and (ii) transportation and transaction costs through increased waiting times (e.g. for intermediate inputs or licenses). These effects can counterbalance the gains from agglomerations as described above. The net effect may therefore be ambiguous.

Regional endowments such as the regional sectoral composition, the regional educational endowment, and the physical infrastructure of the regions (e.g. electricity or transport infrastructure), among others are also essential for a firm's export performance. For example, regions with low-cost semi-skilled labor or with rich natural resources may attract investments that specifically aim to exploit arbitrage opportunities (Ghemawat, 2007). Firms would also export if their resource endowment makes them better suited within a region to serve particular markets. Thus export propensity and export intensity arise from firm-specific advantages (Rugman & Verbeke, 2001) that are grounded in resources that are both firm-specific and location bound (Estrin et al., 2008).

However, second-nature geography also depends on the spatial interaction between people and firms in an area (locality, city, and region) (Naudé, 2009). According to Marshall, second-nature geography may be explained by mutually reinforcing external effects (Ottaviano & Thisse, 2005: 1713). These spatial externalities occur through trade between regions, interregional labor migration and capital mobility, knowledge spillovers, technology transfers and forward and

backward linkages, and more generally regional externalities, that lead to geographically dependent localities and regions (Ertur & Le Gallo, 2003; Pfaffermayr, 2009; Tselios, 2009).

These supra-regional effects are of capital importance in this study because externalities are primarily intra-national in scope, indicating that spillovers are confined within a country (Branstetter, 2001). Due to language, cultural and other institutional differences, regional externalities are more easily captured within national boundaries (Feldman, 2000). These interactions and externalities, which cross weak regional boundaries, are important in accounting for the performance of a firm. Consequently, the export propensity and export intensity of a firm is expected to be influenced not only by the specific characteristics of the region in which the firm are located, but also by the characteristics of the neighboring regions.

A first example of the importance of the supra-regional effects is the stock infrastructure of the neighboring regions. Good infrastructural endowments in neighboring regions may contribute to output gains and to increase the production inputs and outputs of the hosted firms (Abreu, De Groot, & Florax, 2005). Another example is that a significant fraction of the total flow of spillovers that affects a firm's research productivity originates from other firms (Jaffe, 1986). From a theoretical perspective, the importance of spatial externalities and interactions are central themes in the new economic geography theories and the endogenous growth theories (Rey & Janikas, 2005).

3. EMPIRICAL MODEL

(a) Econometric specification

As indicated in the previous section, differences in firms' characteristics and in regional and supra-regional endowments determine the differences in the capacity of firms to export. In other words, the export propensity and export intensity of a firm are a function of both firm- and place-based (regional-based and supra-regional-based) characteristics. The aim of this paper is to determine to what extent these factors account for a significant proportion of the observed differences in the export performance of manufacturing firms in Indonesia.

In order to do this, we resort to an econometric specification considering not only the individual characteristics of a firm, but also the socioeconomic characteristics and endowments of the region where the firm is located and those of the neighboring regions. Based on the theoretical background, the existing empirical studies in the field and the data availability, the model adopts the following form:[1]

[1]Our firm-level dataset does not provide the precise location of each firm. This does not allow us to deal with spatially dependent observations at firm-level, either using a spatial error model, which is based on the assumption that spatial dependence works through omitted firm-level variables, or a spatial autoregressive model, which is based on the assumption that dependence works through a dependent variable (export propensity or export intensity) (Anselin, 1988). These models have the advantage that we are able to explore the microeconomic linkages across firms and to test for the occurrence of inter-firm spillovers. They also show that the export performance for a particular firm

$$exports_{ir,t} = \delta_1 firm_{ir,t} + \delta_2 geography_r + \delta_3 region_{r,t} + \delta_4 extra\_region_{r,t} + \delta_5 int_{r,t} + \upsilon_{ir,t} \quad (1)$$

where $exports_{ir,t}$ is the export propensity or export intensity of firm i in region r at time t. *firm* represents a matrix of firm-specific characteristics which may affect export propensity and intensity. *geography* indicates how first-nature geography influences the potential of firms to export. Many factors have been used in order to proxy for first-nature geography. In this paper, we use what is possibly the most common of all first-nature geography proxies, proximity to the coast, while *region* and *extra_region* are time-variant matrices that control for other second-nature geography factors expected to affect the export propensity and intensity of firms at regional and supra-regional level, respectively. They also include various measures of agglomeration, namely localization effects, urbanization effects, and export spillovers, at the regional and supra-regional level. *int* designates the interaction terms of each regional variable with the respective supra-regional variable: $region_{r,t} * extra\_region_{r,t}$. δ_1, δ_2, δ_3, δ_4 and δ_5 are vectors of coefficients of the above matrices and $\upsilon_{ir,t}$ is the composite error.

The supra-regional endowments are calculated using a spatial weights matrix which represents the specification of the regional interaction structure (external effects). This spatial weights matrix is equal to 1 in cases where the Euclidian distance between the capitals of regions is smaller to a distance threshold δ, and 0 otherwise. It is defined as follows:

$$\begin{cases} w_{ij}^*(\delta) = 0 \; if \; i = j \\ w_{ij}^*(\delta) = 1 \; if \; d_{ij} \leq \delta \\ w_{ij}^*(\delta) = 0 \; if \; d_{ij} > \delta \end{cases}$$

where d_{ij} is the Euclidian distance between the capitals of regions *i* and *j*.

This matrix is then row-standardized so the elements (w_{ij}) in each row add up to 1. Therefore:

$$w_{ij}(\delta) = w_{ij}^*(\delta) \Big/ \sum_j w_{ij}^*(\delta)$$

The geographical location of the Indonesian major cities and provinces matters for the choice of the fixed cut-off parameter. After pondering a threshold distance $250km \leq \delta \leq 500km$, we ended up with δ =400km as the most appropriate spatial weights scheme, in order to minimize the number of regions which have no neighbors ('islands'), while keeping the threshold level relatively low (see Appendix 1).[2]

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depends not only on its decision, but also on those taken by other firms (Tselios, 2008). However, the determinants of a firm's export activity are related to the distance between economic agents, firms and regions underpinning the role of geography (Tselios, 2008).

[2] We performed a sensitivity analysis using δ = 300, 350, 400, 450, 500km in our regressions (available upon request). The regional and supra-regional effects are similar for δ = 300, 350 and 400km in terms

As supra-regional effects are likely to be conditional on the presence of such effects in the region in which a firm is located, we also include the interaction terms of each regional variable with the respective supra-regional variable. The overall effect of a regional variable on a firm's export behavior is, thus, $\delta_4 + \delta_5 extra-region$.

Using these criteria means that each region is not affected by the same number of regions (Figure 2). Core and small-sized Indonesian regions interact with more regions than peripheral and big-sized ones. For example, the province of Lampung, in Southern Sumatra, interacts with four regions, while the province of Nanggroe Aceh Darussalam, in the opposite tip of Sumatra, interacts with only one region. Our spatial weights matrix includes 4 'islands' (i.e. regions where the export performance of their firms is not affected by the interaction with other provinces): these 'islands' are the remote provinces of Kalimantan Barat, Kalimantan Timur, Maluku and Papua.

Figure 2 here

By developing equation (1), we obtain the following model:

$$\begin{aligned} exports_{ir,t} &= \beta_1 ownership_{ir,t} + \beta_2 capital\_intensity_{ir,t} \\ &+ \beta_3 productivity_{ir,t} + \beta_4 age_{ir,t} + \beta_5 age\_squared_{ir,t} \\ &+ \beta_6 prox\_coast_r + \beta_7 localization_{jr,t} \\ &+ \beta_8 sector\_concentration_{r,t} + \beta_9 export\_spillovers_{r,t} \\ &+ \beta_{10} education_{r,t} + \beta_{11} electricity_{r,t} + \beta_{12} road\_density_r \\ &+ \beta_{13}[Wsector\_concentration]_{r,t} + \beta_{14}[Wexport\_spillovers]_{r,t} \\ &+ \beta_{15}[Weducation]_{r,t} + \beta_{16}[Welectricity]_{r,t} + \beta_{17}[Wroad\_density]_r \\ &+ \beta_{18}[INTsector\_concentration]_{r,t} + \beta_{19}[INTexport\_spillovers]_{r,t} \\ &+ \beta_{20}[INTeducation]_{r,t} + \beta_{21}[INTelectricity]_{r,t} + \beta_{22}[INTroad\_density]_r + \upsilon_{ir,t} \end{aligned} \quad (2)$$

where $ownership_{ir,t}$ measures the percentage of firm i, in region r in foreign hands at time t. $capital\_intensity_{ir,t}$ represents the natural logarithm of total capital stock (buildings and construction, machines and equipment, land, vehicles, and other capital goods) per worker of firm i, in region r, at time t.

$productivity_{ir,t}$ depicts total factor productivity of firm i, in region r, at time t. According to the Solow (1957) growth decomposition model, a firm's linearly homogeneous production function can be subdivided into the growth rates of the input factors and the growth rate of some unexplained residual. However, econometric estimates often suffer from simultaneity since productivity is known to firms when

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of significance and coefficient sign. The results for δ = 450 and 500km tend to show a less positive or more negative impact, but are generally less significant. The results seem to suggest that spillovers level off with distance.

they choose their profit-maximizing input levels. In order to estimate the production function parameters and, thus, total factor productivity consistently, we apply the methodology of Levinsohn and Petrin (2003) who use intermediate inputs (including fuels) as a proxy for unobservable productivity shocks (see Petrin, Poi, & Levinsohn, 2004). This is a modified version of the estimator developed by Olley and Pakes (1996) which uses investment as a proxy for productivity shocks. $age_{ir,t}$ is a measure of the age of firm i, in region r, at time t. It is calculated as the difference between the year of observation and the starting year of commercial production in the region plus one in natural logarithms. Due to the contrasting results of existing analyses, we include a squared term of age, $age\_squared_{ir,t}$, to allow for non-linear effects.

$prox\_coast_r$ is our first-nature geography variable and is time-invariant. It indicates the proximity of the capital of province r to the coast and is measured as the natural logarithm of distance (in meters).

We include three types of regional agglomeration economies at the regional and supra-regional level. (1) $localization_{jr,t}$ captures the number of firms within an industry *j* in region *r* as percentage of Indonesia's total number of firms within the same industry *j* at time *t*. Since this measure is at both the regional and sectoral level, and not at the regional level only, we cannot include supra-regional effects. (2) $sector\_concentration_{r,t}$ is the Hirschman-Herfindahl index of sectoral concentration by region *r* at time *t*, defined as the sum of squares of an industry's output share to capture *urbanization effects*. $[Wsector\_concentration]_{r,t}$ accordingly captures supra-regional effects of sectoral concentration in the neighboring regions at time t, while $[INTsector\_concentration]_{r,t}$ denotes the interaction term. (3) $export\_spillovers_{r,t}$ is a region's number of exporters as a percentage of the region's total number of firms at time *t*, $[Wexport\_spillovers]_{r,t}$ measures export spillovers of neighboring regions at time t, while $[INTexport\_spillovers]_{r,t}$ represents the interaction term.

Other regional, supra-regional, and interaction variables in our model are as follows. $education_{r,t}$ is a proxy for regional educational endowment of region r at time t, which is measured by the average years of schooling of the adult population (15 and older), $[W\ education]_{r,t}$ is the average educational endowment of the neighboring regions of region r at time t, and $[INT\ education]_{r,t}$ refers to the interaction term. $electricity_{r,t}$ represents the percentage of household access to electricity of region r at time t, $[W\ electricity]_{r,t}$ denotes the access to electricity of the neighboring regions, and $[INT\ electricity]_{r,t}$ captures the interaction term. Our regional proxy for transport infrastructure is $road\_density_r$ which measures the total length (in kilometers) of national, province and district roads divided by the size of the region (in squared-kilometers). $[W\ road\_density]_r$ is the road density of the neighboring regions, while $[INT\ road\_density]_r$ is the interaction term. Given the limitations of obtaining good quality road infrastructure data, we have to assume that the road density in any given Indonesian province remains constant over our period of analysis. This implies ignoring the considerable infrastructure effort conducted by the Indonesian government and making the further assumption that any potential changes in road infrastructure endowments are proportional across regions and do not imply

significant changes in provincial ranks. The electricity and road variables represent the endowments of the provinces.

Finally $\upsilon_{ir,t}$ is the composite error [$\upsilon_{ir,t} = \alpha_i + \varphi_r + \xi_t + \varepsilon_{i,t}$, where α_i represents the fixed effects, φ_r denotes regional dummies (regional specific effects), ξ_t denotes time-dummies (time period fixed effects), and $\varepsilon_{i,t}$ is the disturbance term (idiosyncratic error)]. The coefficient β_1, and the elasticity coefficients β_2 to β_5 represent the firm-based effects to exports, while the elasticity coefficient β_6 and the coefficients β_7 to β_{22} represent place-based effects.

(b) Estimation strategy

Researchers have long debated whether exporters perform better because of self-selection or because of learning-by-exporting. Self-selection refers to ex-ante differences across firms, while learning-by-exporting refers to ex-post gains of exporters versus non-exporters. Self-selection takes into account the fact that exporting involves additional costs, including transportation, marketing, and distribution costs, employees with specific skills, and production costs for necessary adjustments which only more productive firms are able to absorb. Learning-by-exporting factors in the knowledge flows that exporting firms absorb from international buyers and competitors which renders them more productive (Wagner, 2007).

In order to account for a possible selection bias due to self-selection into exporting, we apply the Heckman two-stage selection model (1979). In a first step, this approach estimates a probit model as specified in equation (2) with a firm's export propensity as the dependent variable. Export propensity equals 1 if a firm exports and 0 otherwise. In a second step, the model estimates the impact on export intensity based on the sample of firms that export. Export intensity denotes the exports of a firm as a percentage of total output.

The Heckman procedure requires identifying at least one factor (instrumental variable) which affects the propensity to export, but not export intensity. A natural variable to include are sunk entry costs to exporting, as they affect the probability of exporting, but should not affect the share of exports once a firm has started to export. We therefore follow Robert and Tybout (1997) and a number of other studies that use past export experience as a proxy for paid sunk entry costs of exporting. That is, firms that exported in the previous period no longer have to pay sunk entry costs, which makes it more likely for them to export today.

(c) Data

The microeconomic data used in the analysis are extracted from the Indonesian Manufacturing Census, which gathers data for more than 15,000 firms over the period 1990-2005 for export propensity and 1990-2000 and 2004 for export intensity. 1990 is the first year with information on a firms export activity. The Manufacturing Census is a survey of manufacturing firms with at least 20 workers which is conducted every

year by the Indonesian Bureau of Statistics (Badan Pusat Statistik, BPS). The Census Data classifies firms into 5-digit ISIC Rev. 2 industries.

All inputs and output including exports were deflated using a value added deflator, while net investment flows were deflated using an investment price deflator. The value added deflator was constructed by dividing manufacturing value added in current prices by manufacturing value added in 1995 constant prices. Likewise, the investment price deflator was constructed by dividing the gross capital formation in current prices by gross capital formation in constant 1995 prices. These were available from the World Development Indicator database. The capital stock was then constructed using the perpetual inventory method using depreciation rates taken from Arnold and Javorcik (2009): 3.3% for buildings, 10% for machinery and equipment, and 20% for transport equipment. Land is not assumed to depreciate. Wages were reported in 1995 prices.

Currently, Indonesia consists of 33 provinces, seven of which have been created since 2000. The Manufacturing Census Data covers all provinces except for Sulawesi Barat. In order to make the provinces comparable over the period 1990-2005, we grouped all newly created provinces back to their original provinces which leads to a total of 26 provinces in this study. For a list of provinces see Appendix 1.

This microeconomic information is complemented with data from BPS-RI (Susenas), National Labor Force Statistic (BPS), and Statistical Yearbook of Indonesia (BPS) datasets measuring the regional and supra-regional endowments and characteristics of 26 Indonesian provinces (regions). Finally, we used a spatial weights matrix (GIS mapping) which represents the Euclidian distance between the capitals of regions in order to capture the regional interaction structure (external effects).

(d) Descriptive statistics

Our dataset with averages, standard deviations, and minimum and maximum value for each of the variables for 1990, 1997 and 2004 is reported in Table 1. The descriptive statistics show that the dataset is unbalanced, which is amenable to estimation methods that manage potential heterogeneity bias (Rodríguez-Pose & Tselios, 2009).

Table 1 here

Appendices 2 and 3 show the correlation matrices for the firm-level and regional variables, respectively. As can be seen from the tables, multi-collinearity does not seem to be a major issue for all firm-level variables and for most regional variables. Among the regional variables, there are only two instances where the correlation between variables slightly exceeds 0.5. Localization and sector concentration show a negative correlation of 0.56, while education and electricity show a positive correlation of 0.56. Overall, this points to the fact that the results of the estimations should not be driven by strong collinearity.

Figures 3 and 4 display the total number of firms and the export intensity and propensity in Indonesia across provinces in 1990 and 2004. As expected, the maps show that the majority of firms are located in Java and, in particular, in the largest

provinces in terms of population, such as Jakarta, Jawa Barat, Jawa Tengah, and Jawa Timur both in 1990 and in 2004 (Figure 3). By contrast, exporting firms are not necessarily linked to population. A large number of exporters in 1990 could be found in the provinces of Kalimantan (Barat, Tengah, Selatan and Timur) (Figure 4). The provinces of Kalimantan Tengah, Bali, Kalimantan Timur, and Yogyakarta had a high concentration of exporting firms in 2004. Equally, firms with a high export intensity have tended to be found outside Java. That is the case of Nusa Tenggara Timur, Nusa Tenggara Barat, Bengkulu, and Nanggroe Aceh Darussalam, in 1990 and of Sulawesi Utara, Bengkulu, Papua, and Jambi in 2004.

4. EMPIRICAL RESULTS

(a) The determinants of firm export propensity

The regression analysis of firm export propensity (Regressions 1 to 4, Table 2) covers the period 1990-2005. As mentioned earlier, we apply the Heckman two-stage selection model. All specifications are robust to heteroscedasticity and include sector fixed effects at the 3-digit ISIC Rev. 2 level (29 sectors) to each of the specifications. We also added region fixed effects (for the 26 provinces considered) to specifications without regional variables. The results use clustered standard errors at the province level to allow for the possibility that the error terms are correlated across firms within provinces. The overall results for the period 1990-2005 are shown in Table 2. First of all, the Wald tests in all regressions indicate a highly significant correlation, which reinforce the use of Heckman's technique. Moreover, the correlation coefficients between the error terms are negative correlated which means that the unobserved factors that make a firm more likely to export tend to be associated with a lower share of firm's exports to total sales.

Table 2 here

(i) Firm-specific results

Regression 1 shows the results when we only include firm-level determinants of exporting and control for sector-fixed effects, region-fixed effects, and year-fixed effects, as specified in equation (2). Paid sunk entry costs, foreign ownership, capital intensity and TFP all have a significantly positive impact on exporting, while firm age shows a U-shaped effect on export propensity. That is, firm age hampers exporting up to a certain point after which it increases the likelihood of exporting again. The firm-level effects in regressions 2 to 4 show similar results in terms of coefficient sign and significance.

(ii) First-nature geography

Our first-nature geography variable denotes proximity to the sea from the capital of every province. It is expected that having the main city located on the coast would facilitate exports. In regression 2 we add the proximity of the capital of province r to the coast and exclude region-fixed effects, as specified in equation (2). In principle, higher distance to the coast has no impact on exporting. However, when including all

place-based variables, a higher distance to the coast displays a significantly positive coefficient (regression 4).

(iii) Agglomeration effects

In regression 3, we introduce three types of agglomeration economies, namely localization effects, urbanization effects, and export spillovers. A higher share of firms within the same industry in a province (localization economies) and a higher sectoral concentration in a province, our measure of urbanization economies, have no effect on a firm's export propensity. A higher share of exporting firms, by contrast,, has a significantly positive effect on exporting, clearly indicating the benefits from agglomerations.

(iv) Regional and supra-regional factors

The years of schooling of the regional population has a positive but insignificant effect on the propensity to export, while road density has a positive effect on a firm's export propensity Access to electricity has a negative impact on a firm's likelihood to export.

Regression 5 shows the results including both regional, supra-regional effects and their interaction terms as specified in equation (2). The regional effects are similar to the ones already described for regression 3, with education becoming significant and electricity becoming insignificant. Interestingly, education and road density in neighboring regions also display a positive coefficient on exporting. Focusing on the interaction terms, the interaction term of the regional and supra-regional education variables is negative and significant. In other words, the positive impact of a region's educational level on exporting becomes smaller the higher the educational level is in neighboring regions. This implies that the regional endowment of skilled labor becomes less critical, if a good endowment of human capital is available in neighboring regions. The interaction term of the regional and supra-regional road density variables also shows a negative and significant effect. A good endowment of road infrastructure in neighboring regions makes local transport infrastructure less critical for exporters.[3]

(b) The determinants of firm export intensity

Regressions 5 to 8 of Table 2 display the second stage of the Heckman selection model for firm export intensity as specified in equation (2). As described above, the regressions only include exporting firms.

[3] We also interact regional variables with firm age to see whether the determinants of export propensity change for older firms (results available upon request). Interestingly, the interaction of first-nature geography with age is positive and significant, while distance to the coast now shows a negative impact on exporting, suggesting that the negative effect of distance on export propensity becomes less negative the older a firm is. This implies that older firms find ways to bypass the effect of distance. The interaction of road density with age is negative and significant, implying that the positive effect of road density on the likelihood of exporting is smaller for older firms (results available upon request). This suggests that younger firms' exporting activity benefits more strongly from a better road infrastructure. The interaction terms of other regional variables with age have no significant impact on exporting.

(i) Firm-specific results

Foreign ownership of Indonesian firms is a relatively good predictor of firm export intensity. Private firms with a higher share of foreign ownership tend to export a higher percentage of their output than firms with lower levels of foreign ownership. Surprisingly, the capital intensity of a firm displays a negative and statistically significant coefficient for export intensity. This may imply that capital-intensive firms export lower shares of their output, although capital intensity positively affects a firm's likelihood to export in the first place. Similarly, the productivity of a firm has a significantly negative impact on export intensity, suggesting that less-productive firms tend to export higher shares of their output. This may be a consequence of the tendency of Indonesian firms to specialize in exports at the lower echelons of the technology scale. As in the export propensity regressions, age has a U-shaped impact on export intensity.

(ii) First-nature geography

As in the case of export propensity, regression 5 shows that firms in provinces whose capital is located further away from the coast are less likely to export, once the infrastructural endowment of the province and of neighboring provinces is controlled for. However, the coefficients are non-significant in all specifications. This implies that, although distance from the sea could be, in principle, considered detrimental for exports, in an island country such as Indonesia, where large cities are generally never too far removed from the coast and access to ports along some of the busiest trade routes in the world is not particularly difficult, other factors – i.e. second-nature geography factors – are much more influential for firm export intensity (and propensity) than first-nature of geography.

(iii) Agglomeration effects

Agglomeration effects are also an important determinant of export intensity (regression 7). Firms located in areas with a concentration of other exporting firms consistently export a higher share of their output than firms in other areas. This confirms the findings of the export propensity regressions. Moreover, the interaction term is negative and significant, suggesting that the positive effect of existing exporters in a region becomes smaller, if neighboring regions also contain a large number of exporters.

By contrast, localization effects no longer seem to have a positive influence on export intensity. As was the case for export participation, a greater sectoral concentration is not connected to firm export intensity.

(iv) Regional and supra-regional factors

The regional and supra-regional second-nature geography factors are much more pertinent in explaining the export intensity of individual Indonesian firms than access to the sea. A number of the regional and supra-regional variables included in the analysis tend to be relevant in determining the capacity of Indonesian firms to export, although their association with firm export intensity does not always have the predicted sign.

The level of education in the region is not conducive to greater firm-level exports. The years of schooling of the local population and of neighboring regions tend to reduce a firm's capacity to export (regression 8). The interaction term is positive, implying that the negative effect of skill levels in a region on export intensity becomes smaller if neighboring regions have a relatively well-educated population. This reinforces the idea that the low- to mid-technology exports which drive Indonesia's foreign trade do not necessarily require high levels of education. Indeed, higher levels of education will tend to erode one of its main comparative advantages, which is lower labor costs and salaries, thus limiting export intensity.

Access to adequate basic infrastructure, such as electricity, also plays a relatively subdued role on a firm's export intensity. Firms in regions with a better access to electricity are less likely to export more than firms in areas with weaker endowments in basic utilities (regression 7). However, the negative effect becomes insignificant in the full model (regression 8).

Road density also reduces individual firm export intensity, that is firms in regions with good access to roads tend to export less (regression 7). One potential explanation may be linked to the fact that the majority of exports tend to happen by ship and a higher road density is a sign of high population density and congestion. However, the negative effect disappears in the full model (regression 8).[4]

(c) Robustness check

As an additional robustness check, we estimate the export propensity model using a dynamic probit estimator which controls for past export experience. The results are shown in Table 3 (regressions 1 to 4). The probit model and Heckman selection model are almost identical in terms of coefficient sign and very similar in terms of statistical significance. In the full model (regression 4), the signs and significance of the coefficients of Table 2 tend to be confirmed. Moreover, the probit model suggests a positive and significant impact of sector concentration on exporting.

In a next step, we estimate the export intensity model using fixed effects in order to control for time-invariant characteristics. In contrast to the Heckman approach, the fixed effects estimator allows for the inclusion of firms that do not export. It controls a) for the effects of the omitted variables that are specific to each firm and accommodates sectoral heterogeneity (through α_i), and b) for the unobserved first-nature geography effects (through φ_r). This estimator wipes out all the sector-specific and space-specific time-invariant variables, but a failure to account for these variables increases the risk that biased estimation results may be obtained (Baltagi, 2005).

[4] We also investigate how firm age influences the impact of regional variables on export intensity (results available upon request). As was the case for export propensity, the interaction term with distance to coast shows a positive and significant impact on export intensity, while the interaction effect is negative and significant for road density. In addition, the interaction terms of localization economies, sector concentration and education with age all show a positive and significant effect on export intensity, indicating that the effect of these regional endowments is more positive (or less negative) for older firms.

Given their time-invariant condition, it is impossible to estimate the impact of the proximity to coast ($prox\_coast_r$) and road density ($road\_density_r$) on export intensity by fixed effects. We have to resort in some regressions to random effects estimators. Hence, we also check the p-values of Hausman's (1978) statistic to test whether the random effect estimator is an appropriate alternative to the fixed-effects estimator. Finally, our model includes time-dummies (ξ_t) as a means to control for all time-specific spatial-invariant variables.

The results are shown in Table 3, regressions 5 to 10. If we focus on the fixed effects estimator (regressions 5, 7 and 9), the results are similar to the Heckman approach. Regarding firm-level effects, all effects are the same in terms of coefficient sign, but age and productivity are no longer significant. Regarding the regional effects, the positive impact of export spillovers and the negative effect of electricity are also confirmed. Only supra-regional effects differ, now showing a negative and significant supra-regional effect of electricity.

As a way to include time-invariant effects, we use the random effect estimator in regressions 6, 8 and 10. The firm-level variables show inverse signs for capital intensity and productivity. In these cases, we trust the consistent results of the fixed effects estimator. Focusing on the time-invariant variables, proximity to coast shows no effect on exporting, while road density significantly increases a firm's export intensity. The latter result conflicts with the Heckman approach and should therefore be interpreted with caution.

5. CONCLUSIONS

In this paper we have looked at the factors which determined the export propensity and intensity of manufacturing firms in Indonesia during the period between 1990 and 2005. We have paid special attention whether the drivers of firm exports in Indonesia were fundamentally related to firm-specific characteristics or to the environment and the conditions of the environment in which the firm is located. By environment, we understand both the conditions internal to the region where the firm is located, as well as those in surrounding regions.

The results highlight that both internal and external factors made a difference, but that they mattered in ways that may not have always been predicted by the theory. At the internal level of the firm, export propensity has been fundamentally driven by past export experience, the share of foreign ownership, TFP, capital intensity, and age of the firm. More productive firms, with past export experience, a greater capital stock, and a degree of foreign-ownership have been more likely to export. Age shows a U-shaped effect on export propensity. That is, firm age hampered exporting up to a certain point, after which the likelihood of exporting increased again.

While the effect of foreign ownership and age were the same for a firm's export intensity, capital intensity and productivity seemed to reduce export intensity. This may imply that capital-intensive firms exported a lower share of their output, while less-productive firms exported a higher share, probably reflecting the tendency of

Indonesian firms to specialize in exports at the lower echelons of the technology scale.

External factors also matter. But it is second-nature, rather than first-nature, geography that makes the difference. The conditions of the provinces where a firm is located and those of their neighbors influence exports, making regional policy a potentially important tool for promoting exports (Roos, 2005: 606). But, rather than pure population agglomeration, the factors that play a more relevant role are those linked to agglomeration effects, education and transport infrastructure endowment. Firms export and export a greater share of their output when they are surrounded by other exporting firms and by other firms in the same industry. Education and road density in a province and in neighboring regions also affect the likelihood of exporting, while the positive impact of a region's educational level on the likelihood of exporting becomes smaller, the higher the educational level in neighboring regions. This implies that having a good endowment of skilled labor becomes less critical if adequate human resources are available in neighboring regions. Equally, infrastructure becomes less relevant for export propensity, if neighboring regions possess a good road infrastructure.

Overall, both the internal and external results highlight that the conditions which have affected firm export intensity in Indonesia are those typical of areas relying on low to medium-tech manufacturing production. Once firms have become exporters, their comparative advantage lies in producing standardized goods at relatively low prices and the factors which would drive a substantial leap in the technology content of exports are relatively absent. This happens both at the level of the firm and of the geographical context where exporting firms are located. At the level of exporters, higher capital intensity and productivity are not associated with export intensity, emphasizing the low cost, low tech nature of manufacturing exports in the country. At the external level, it is human capital and some infrastructure endowments, such as access to reliable electricity supplies and road density that reduce the share of exports in a firm's output.

In brief, the analysis tends to point to the fact that many exporting Indonesian manufacturing firms may have become stuck in a low-tech, low cost trap during the period of analysis, with relatively little potential to make the leap into a different stage of development and to make the current export-driven growth sustainable without a radical overhaul of the exporting model.

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Table 1: Descriptive statistics

Year	Variable	Obs	Mean	Std. Dev.	Min	Max
1990		16,525	0.1170	0.3215	0	1
1997	*export_propensity*	22,372	0.1367	0.3436	0	1
2004		20,685	0.1627	0.3691	0	1
1990		16,525	0.0783	0.2430	0	1
1997	*export_intensity*	22,370	0.0996	0.2746	0	1
2004		20,685	0.1153	0.2957	0	1
1990		16,525	2.3316	12.7460	0	100
1997	*ownership*	22,372	4.7464	19.1622	0	100
2004		20,685	6.7471	23.5656	0	100
1990		14,894	8.4957	1.5617	-0.3357	20.2109
1997	*capital_intensity*	16,707	8.5584	1.6006	1.3333	17.8925
2004		17,418	8.4651	1.7621	-4.7124	18.7008
1990		13,728	5.7339	1.1705	-4.0265	12.6471
1997	*productivity*	15,447	5.9462	1.1566	-0.7478	13.4403
2004		15,772	5.8714	1.3043	-3.4443	12.8138
1990		16,524	18.7108	19.8239	1	91
1997	*age*	22,053	19.2941	20.7289	1	98
2004		18,774	23.6824	22.1305	2	105
1990		16,524	743.0576	1,765.9880	1	8,281
1997	*age_squared*	22,053	801.9295	1,953.0960	1	9,604
2004		18,774	1,050.5890	2,281.6260	4	11,025
1990		16,525	9.4396	1.3692	5.3026	11.1302
1997	*prox_coast*	22,372	9.4725	1.3998	5.3026	11.1302
2004		20,685	9.5295	1.3809	5.3026	11.1302
1990		16,525	22.3038	14.3838	0.0547	57.9605
1997	$localization_j$	22,372	21.8572	13.9165	0.0392	56.7506
2004		20,685	23.4659	15.5271	0.0521	66.6667
1990		16,525	0.1686	0.1214	0.1005	0.9112
1997	*sector_concentration*	22,372	0.1574	0.1083	0.0878	0.8326
2004		20,685	0.1496	0.0965	0.0922	0.6858
1990		16,201	0.2322	0.0969	0.1590	0.9112
1997	*W sector_concentration*	21,984	0.2495	0.1035	0.1302	0.8326
2004		20,337	0.2422	0.1068	0.1052	0.6858
1990		16,525	11.7035	5.3258	7.1834	34.3284
1997	*export_spillovers*	22,372	13.6733	7.8789	4.5455	52.3936
2004		20,685	16.2727	7.4805	10.6061	53.8462
1990		16,201	13.1090	4.0156	7.3300	34.3284
1997	*W export_spillovers*	21,984	16.8026	6.8933	7.6923	35.4167
2004		20,337	24.5853	8.2040	13.1579	53.8462
1990		0				
1997	*education*	22,372	7.8263	0.8743	6.8300	10.1200
2004		20,685	8.3005	0.7940	7.5100	10.4500
1990		0				
1997	*W education*	21,984	8.1580	0.4246	7.3050	8.6450
2004		20,337	8.7598	0.3922	7.8150	9.1150
1990		0				
1997	*electricity*	22,372	83.5508	10.2351	27.7178	99.6041
2004		20,685	94.2162	8.1276	37.5735	99.5992
1990		0				
1997	*W electricity*	21,984	76.6695	11.3506	44.9895	92.1086
2004		20,337	87.2248	9.6885	58.4240	97.6201
1990		16,525	0.1722	0.0665	0.0098	0.4892
1997	*road_density*	22,372	0.1755	0.0699	0.0098	0.4892
2004		20,685	0.1752	0.0708	0.0098	0.4892
1990		16,201	0.2143	0.1155	0.0188	0.3846

1997	*W road_density*	21,984	0.2250	0.1172	0.0188	0.3846
2004		20,337	0.2217	0.1156	0.0188	0.3846

* The distance threshold considered for all variables is 400 kilometers

Table 2: Heckman two-stage selection model

	Export propensity equation (*selection equation*)				Export intensity equation			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$export\_propensity_{ir,t-1}$	1.8734***	1.8968***	1.8664***	1.8678***				
$ownership_{ir,t}$	0.0057***	0.0055***	0.0056***	0.0055***	0.0011***	0.0011***	0.0011***	0.0011***
$capital\_intensity_{ir,t}$	0.0900***	0.0857***	0.0878***	0.0923***	-0.0189***	-0.0181***	-0.0191***	-0.0186***
$productivity_{ir,t}$	0.1698***	0.1617***	0.1674***	0.1696***	-0.0173***	-0.0170***	-0.0199***	-0.0199***
$age_{ir,t}$	-0.0108***	-0.0105***	-0.0103***	-0.0110***	-0.0066***	-0.0066***	-0.0063***	-0.0065***
$age\_squared_{ir,t}$	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
$prox\_coast_{r}$		-0.0122	-0.0105	0.0363**		-0.0073	-0.0023	-0.0041
$localization_{jr,t}$			0.0028	0.0042**			-0.0001	0.0005
$sector\_concentration_{r,t}$			-0.0231	0.5374			-0.0165	0.0044
$export\_spillovers_{r,t}$			0.0184***	0.0296***			0.0020***	0.0041***
$education_{r,t}$			0.0016	0.6236*			0.0005	-0.3085*
$electricity_{r,t}$			-0.0030*	-0.0050			-0.0013*	0.0014
$road\_density_{r}$			0.9093***	3.0821**			-0.1290***	-0.5492
$[W\ sector\_concentration]_{r,t}$				0.2768				-0.1673
$[W\ export\_spillovers]_{r,t}$				0.0070				0.0038***
$[W\ education]_{r,t}$				0.5802*				-0.3215*
$[W\ electricity]_{r,t}$				-0.0050				0.0011
$[W\ road\_density]_{r}$				3.6739***				-0.4265
$[INT\ sector\_concentration]_{r,t}$				-0.7218				-0.0229
$[INT\ export\_spillovers]_{r,t}$				-0.0003				-0.0001**
$[INT\ education]_{r,t}$				-0.0763*				0.0385*
$[INT\ electricity]_{r,t}$				-0.0000				-0.0000
$[INT\ road\_density]_{r}$				-13.0181**				2.0187
Time-dummies	YES	YES	YES	YES	YES	YES	YES	YES
Industry-dummies	YES	YES	YES	YES	YES	YES	YES	YES
Region-dummies	YES	NO	NO	NO	YES	NO	NO	NO
Constant	-3.6205***	-3.0970***	-3.4163***	-9.1974***	1.0923***	1.1422***	1.1955***	3.6493**
Observations	160,912	160,912	149,252	146,862	134,414	134,414	124,457	122,941
Rho	-0.1259	-0.1342	-0.1241	-0.1215				
	(0.0182)	(0.0160)	(0.0202)	(0.0203)				
Log-pseudolikelihood	-44213.93	-44829.9	-41016.16	-40101.79				
Wald test of indep. eqns (*df*=1):	46.66	68.62	37.13	35.11				
chi-square	(0.0000)	(0.0000)	(0.0000)	(0.0000)				

Robust standard errors are not reported and are adjusted for clustering; *** p<0.01, ** p<0.05, * p<0.1; Rho is an estimate of the correlation coefficient between the error terms of the export propensity and export intensity equations. The distance threshold considered for all variables is 400 kilometers.

Table 3: Robustness check

	Export propensity Dependent variable: *export_propensity*$_{ir,t}$				Export intensity Dependent variable: *export_intensity*$_{ir,t}$					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
export_propensity$_{ir,t-1}$	1.8672***	1.8961***	1.8507***	1.8518***						
ownership$_{ir,t}$	0.0058***	0.0057***	0.0056***	0.0056***	0.0012***	0.0020***	0.0012***	0.0020***	0.0012***	0.0020***
capital_intensity$_{ir,t}$	0.0892***	0.0845***	0.0859***	0.0896***	-0.0060**	0.0072***	-0.0054***	0.0075***	-0.0058***	0.0079***
productivity$_{ir,t}$	0.1660***	0.1578***	0.1630***	0.1648***	0.0007	0.0105***	-0.0008	0.0097***	-0.0011	0.0095***
age$_{ir,t}$	-0.0106***	-0.0107***	-0.0104***	-0.0109***	-0.0010	-0.0034***	-0.0011	-0.0031***	0.0027	-0.0032***
age_squared$_{ir,t}$	0.0001***	0.0001***	0.0001***	0.0001***	0.0000***	0.0000***	0.0000**	0.0000***	0.0000**	0.0000***
prox_coast$_{r}$		-0.0106	-0.0142**	0.0261**		-0.0013		-0.0013		0.0031
localization$_{ir,t}$			0.0035*	0.0045**			0.0006	0.0007**	0.0003	0.0007*
sector_concentration$_{r,t}$			-0.0132	0.7946*			-0.0480	-0.0311	-0.0669	0.0167
export_spillovers$_{r,t}$			0.0183***	0.0266***			0.0075***	0.0072***	0.0067***	0.0072***
education$_{r,t}$			-0.0065	0.5452*			0.0127	0.0016	-0.0448	0.0289
electricity$_{r,t}$			-0.0031**	-0.0032			-0.0009***	-0.0008***	-0.0008**	-0.0010**
road_density$_{r}$			0.7631***	2.6474***				0.2155***		0.3832*
[W sector_concentration]$_{r,t}$				0.5922					-0.0106	-0.0191
[W export_spillovers]$_{r,t}$				0.0048					-0.0008	-0.0003
[W education]$_{r,t}$				0.5237*					-0.0477	0.0208
[W electricity]$_{r,t}$				-0.0028					-0.0013***	-0.0008*
[W road_density]$_{r}$				3.1619***						0.3985*
[INT sector_concentration]$_{r,t}$				-1.4173					0.0321	-0.0609
[INT export_spillovers]$_{r,t}$				-0.0002					0.0000	0.0000
[INT education]$_{r,t}$				-0.0682*					0.0054	-0.0029
[INT electricity]$_{r,t}$				-0.0000					0.0000	-0.0000
[INT road_density]$_{r}$				-10.9797**						-1.2480
Time-dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry-dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Region-dummies	YES	NO	NO	NO	YES	NO	NO	NO	NO	NO
Constant	-3.3384***	-2.8847***	-3.1969***	-8.2678***	0.1849***	-0.0051	-0.0103	-0.1072**	0.4940	-0.3649
Observations	202,088	202,088	180,338	177,527	192,269	192,269	164,688	164,688	162,038	162,038
Log-pseudolikelihood	-51964.603	-52419.306	-46315.289	-45249.478						
Pseudo-Rsq	0.4430	0.4381	0.4424	0.4405						
FEs/REs					FEs	REs	FEs	REs	FEs	REs
R-within					0.0405		0.0618		0.0596	

Robust standard errors are not reported and are adjusted for clustering; *** p<0.01, ** p<0.05, * p<0.1. The distance threshold considered for all variables is 400 kilometers.

Figure 1: Evolution of manufactures' exports, as a percentage of GDP, 1990-2009

Source: Own illustration. Data: World Development Indicators.

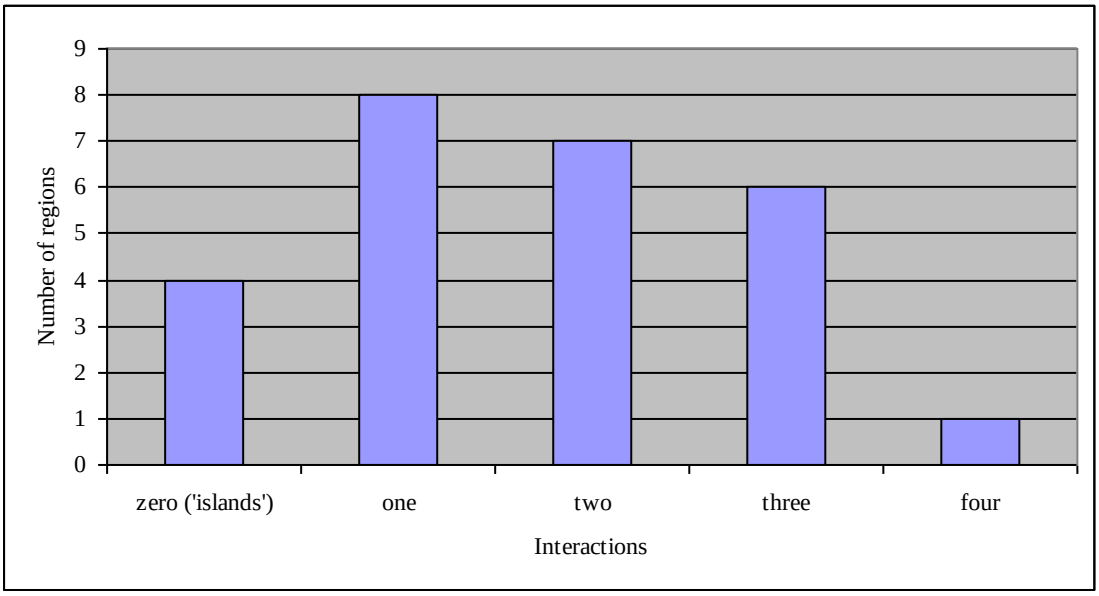


Figure 2: Classification of Indonesian provinces according to number of interactions

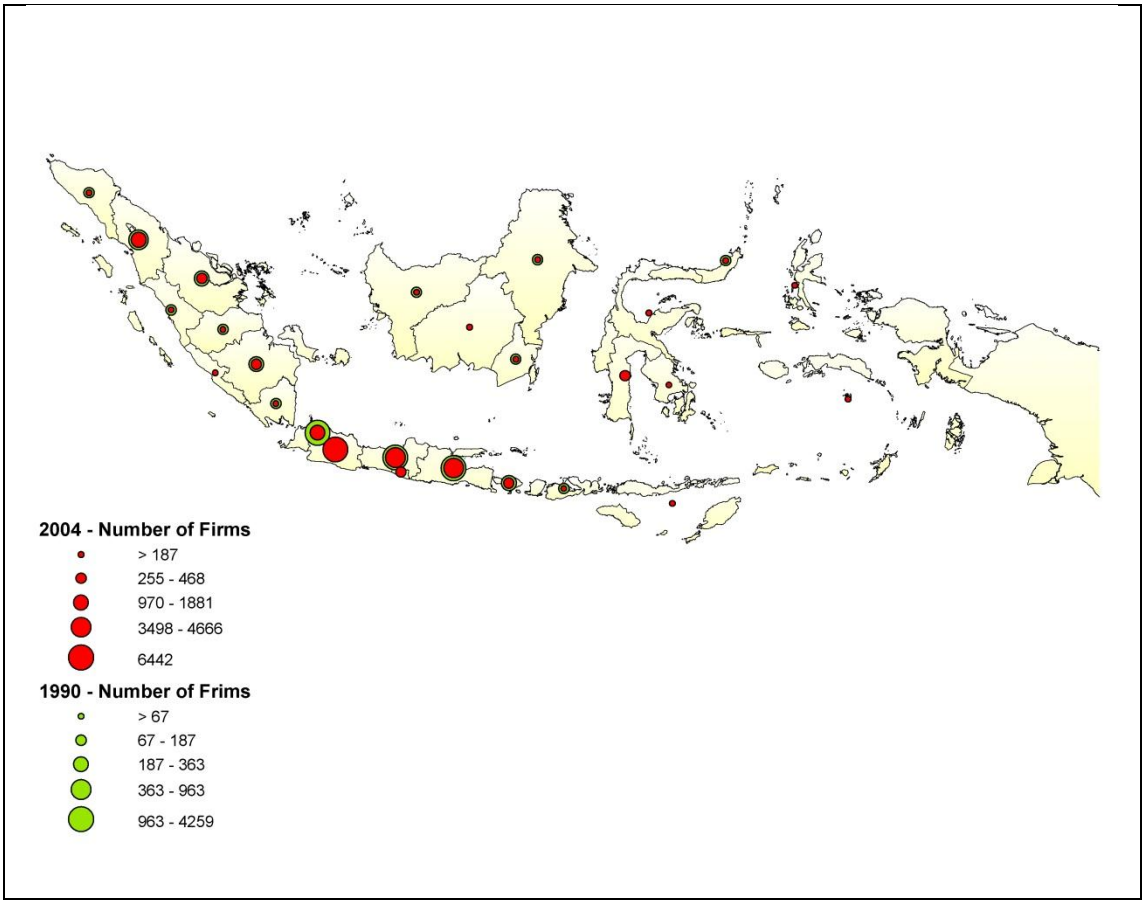


Figure 3: Total number of firms in 1990 and 2004

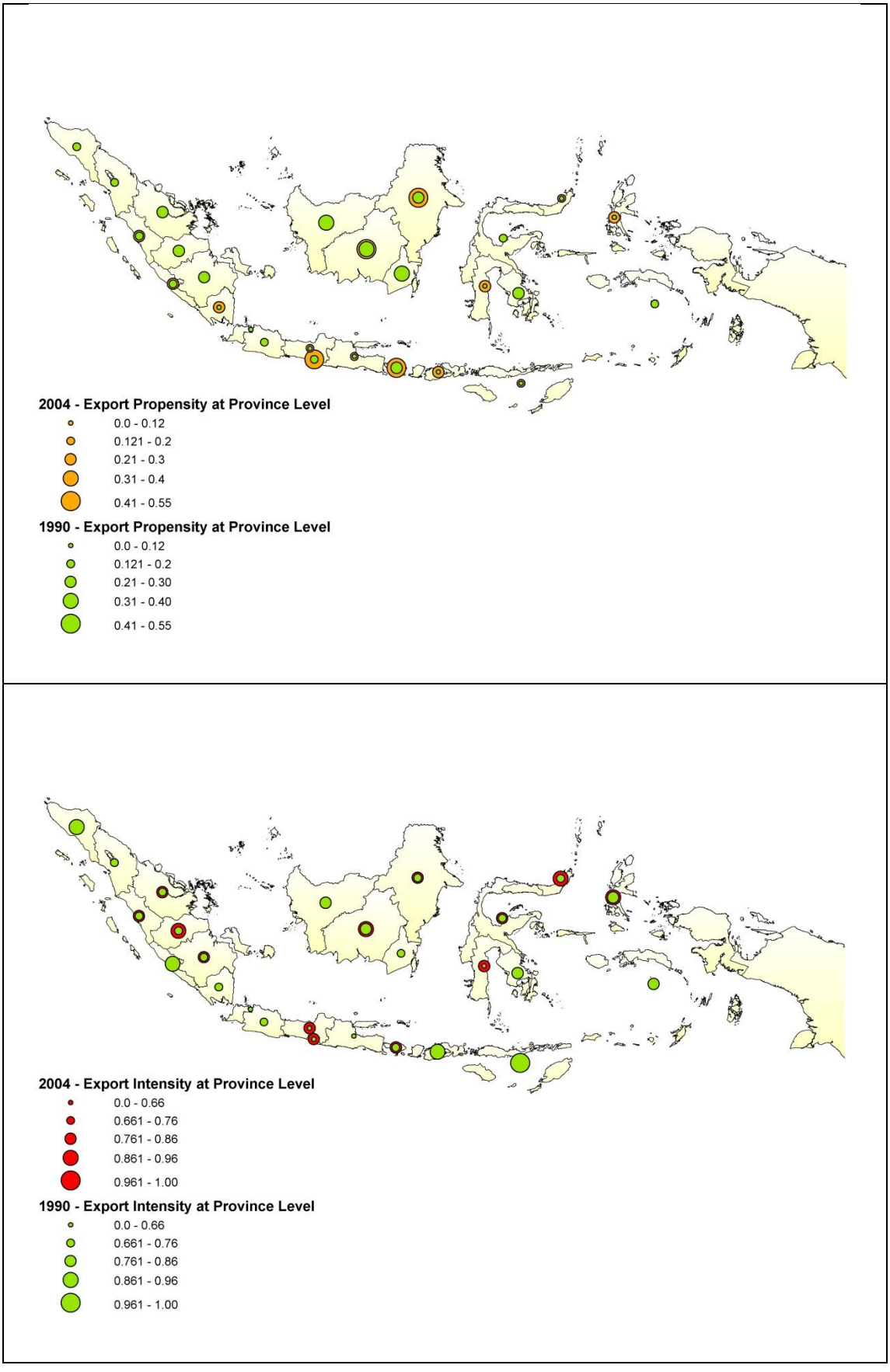
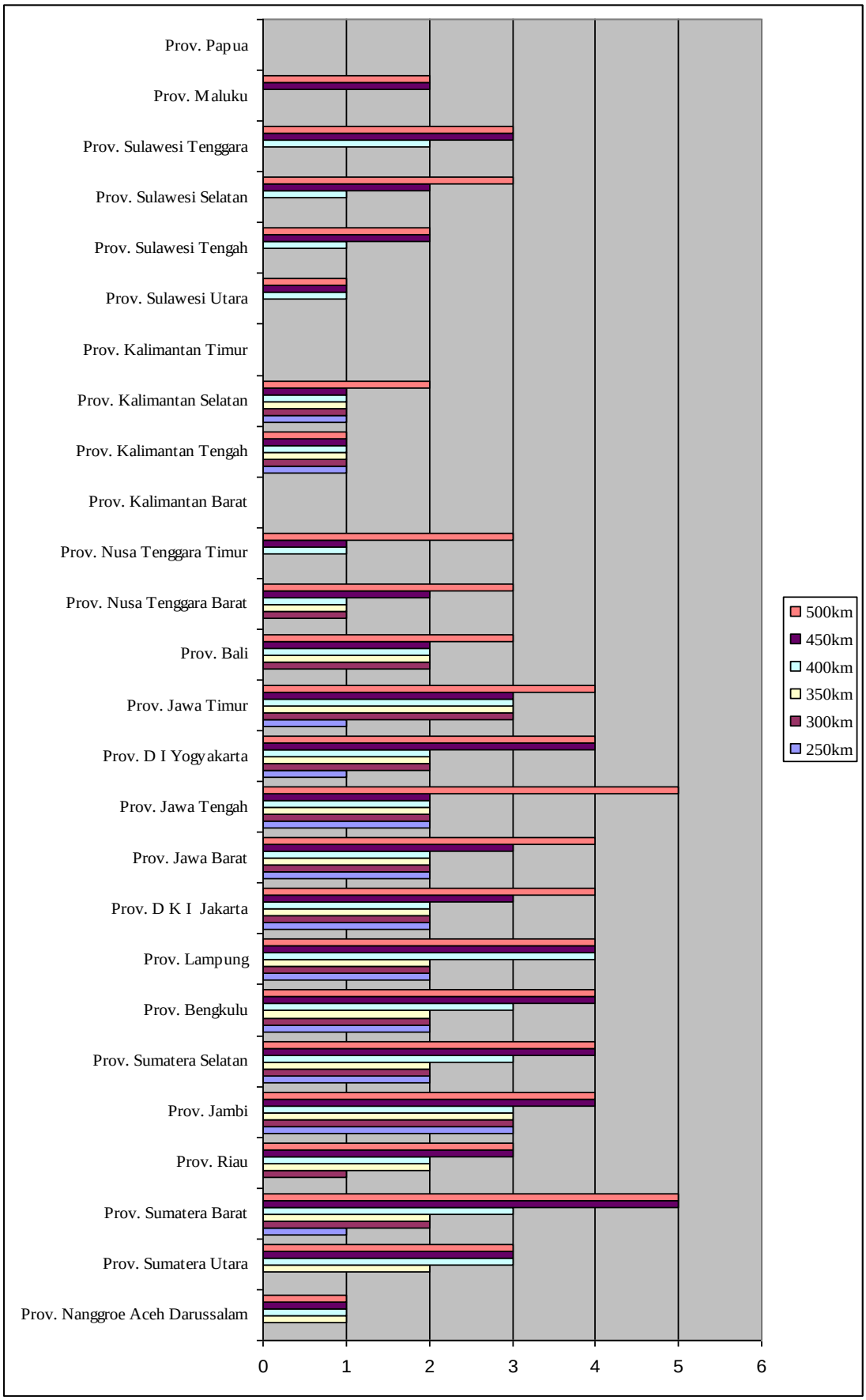


Figure 4: Export propensity and export intensity at province level in 1990 and 2004

Appendix 1: Number of neighboring provinces by province and threshold distance



Appendix 2: Correlation matrix for firm-level variables

Obs=239,160	*1*	*2*	*3*	*4*
1. $ownership_{ir,t}$	1.0000			
2. $capital\_intensity_{ir,t}$	0.2153	1.0000		
3. $productivity_{ir,t}$	0.2473	0.1092	1.0000	
4. $age_{ir,t}$	-0.0307	0.0408	0.0040	1.0000

Appendix 3: Correlation matrix for regional variables

Obs=201,487	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. $prox\_coast_{r}$	1.0000						
2. $localization_{jr,t}$	0.1976	1.0000					
3. $sector\_concentration_{r,t}$	-0.2025	-0.5625	1.0000				
4. $export\_spillovers_{r,t}$	-0.0548	-0.3059	0.3078	1.0000			
5. $education_{r,t}$	-0.2296	-0.2467	0.0769	0.0138	1.0000		
6. $electricity_{r,t}$	0.1080	0.2388	-0.3951	-0.2674	0.5569	1.0000	
7. $road\_density_{r}$	0.1490	-0.0074	-0.2700	0.0602	0.0550	0.2776	1.0000