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# Do backward linkages in export processing zones increase dynamically? Firm-level evidence from Costa Rica

Mauricio Jenkins\*, Ronald Arce\*

INCAE Business School, Costa Rica

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## ABSTRACT

This study statistically examines how the passage of time affects backward linkage creation in export processing zones. Using data collected by the government of Costa Rica, the study finds after controlling for a number of industry- and firm-specific characteristics that backward linkages at the firm level do in fact tend to increase with time, albeit by only a fraction of a percentage point per year. This result seems robust to the measure that the study uses to proxy for backward linkage formation and to several econometric specifications.

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## 1. Introduction

As part of an export-led strategy of economic development, many nations around the world have export processing zones (EPZs) operating within their domestic territories. In many of these nations the zones represent a key policy instrument to attract foreign direct investment (FDI), boost exports, and generate employment and much-needed foreign exchange. The number of countries with EPZs and the number of EPZs themselves start to increase rapidly in the early 1970s. By the mid-1990s The United Nations Industrial Development Organization (UNIDO, 1995) reports hundreds of EPZs operating in more than 65 nations. More recently, Milberg and Amengual (2008) find in their survey more than one hundred countries with thousands of EPZs around the world.

Also, the economic importance of the zones in terms of exports and employment is quite substantial in many countries nowadays (e.g., Jenkins, Larrain, & Esquivel, 1998; Milberg & Amengual, 2008). In fact, Maurer and Degain (2010) estimate that about one-fifth of exports from the developing world comes from EPZ activity. Thus, given the number of countries with EPZs and the economic importance of the zones for many of these countries, understanding the effects of EPZs on host economies and the channels through which host nations may benefit from EPZ activity is of crucial importance.

One of the ways the host nation may gain from EPZs is through the generation of backward linkages between EPZ firms (downstream)

and local suppliers of intermediate inputs (upstream). Despite their conceptual importance, however, the empirical investigations of backward linkage formation in EPZs are mainly anecdotic or single-case studies (e.g., Johansson & Nilsson, 1997; Kaplinsky, 1993; Rondinelli, 1987; Warr, 1989a, 1989b; Willmore, 1995). Researchers need to further and systematically investigate the scale, types, and determinants of backward linkages created by EPZ activity. This is the main purpose of this study. In particular, this study econometrically examines backward linkage creation in EPZs using firm-level data from the Costa Rican EPZ system. The study focuses on investigating whether backward linkages increase as EPZ firms accumulate more experience in the local economy (i.e., across time).

Besides the novelty of the topic, this research is important for other reasons. First, it focuses on the Costa Rican case. The Costa Rican case is ideal for studying backward linkage formation from EPZ activity given the success of the country in attracting foreign direct investment (FDI) to its EPZs, see, for example, Comisión Económica para América Latina y el Caribe (CEPAL, 2014) and Paus and Gallagher (2008), and because of the diversity of the industries and activities that operate under the Costa Rican regime (Jenkins, 2006). Second, based on the nature of the Costa Rican data, the study constructs a panel dataset of firm-level observations that allows for the control of unobservable firm-specific characteristics in the econometric analysis.

The organization of the rest of the paper is as follows. Section 2 reviews the theoretical arguments behind the potential benefits of backward linkages to host nations. Section 3 discusses the factors that may affect backward linkage creation in EPZs. Section 4 gives an overview of the data this study employs and the estimation strategy it follows. Section 5 reports the results of the econometric analysis. Finally, Section 6 provides the study's concluding remarks.

\* Corresponding authors at: INCAE Business School, Campus INCAE, Alajuela, Costa Rica.  
 E-mail addresses: Mauricio.jenkins@incae.edu (M. Jenkins), ronald.arce@incae.edu (R. Arce).

## 2. Backward linkages and welfare gains

The classic EPZ models of Wei (1993) and Din, M.-u. (1994) show that under certain conditions, backward linkages can stimulate the production of intermediate inputs in the local economy, which in turn, increase national income and welfare. In particular, Wei (1993) builds a model that captures the potential indirect employment effects of EPZs in the host nation (i.e., the vertical linkage). In his model, a larger output in the EPZs raises the demand for domestic intermediate inputs, whose production (exclusively) requires domestic labor. In turn, the additional demand for labor reduces unemployment and increases wages in the host nation, increasing national income and welfare. In Din, M.-u.'s. (1994) EPZ model, the production of the intermediate input requires both (domestic) capital and (domestic) labor. In his paper, Din, M.-u. (1994) is able to show that national income and welfare may also increase with larger EPZ activity. In particular, when the intermediate input is a non-traded good national income increases if that input is also labor intensive, or under certain conditions related to the input-factor intensity of the other sectors in the economy, if that input is, on the other hand, capital intensive. According to the Din, M.-u. (1994) model, if the intermediate input is traded internationally, larger EPZ activity does not change national income or welfare.

The FDI literature also recognizes the potential significant stimulating effects of backward linkages in host economies. For example, the well-known models of Rivera-Batiz and Rivera-Batiz (1990), Rodríguez-Clare (1996), and Markusen and Venables (1999) show that the presence of foreign enterprises in a host nation can generate a positive externality in the local economy in the form of increased demand for local intermediate inputs, which may also increase domestic income and welfare. The derivations and implications of these models are highly relevant for EPZs since one of the zones' primary objectives is to attract FDI and multinational enterprise (MNE) operations account for a large fraction of EPZ activity (Jenkins, 2000).

Besides stimulating intermediate-input-producing sectors, backward linkages from EPZ activity may benefit the host nation in another important way. In particular, backward linkages serve as a conduit for the transfer of technology, acquisition of knowledge, demonstration effects, and other potential FDI spillovers. Javorcik (2004) states that the transfer of technology, knowledge spillovers, and other positive externalities from FDI activity are more likely to occur via backward linkage formation. Presumably, foreign firms often have stricter requirements in terms of product quality, delivery times, and offering prices. According to the United Nations Conference on Trade and Development (UNCTAD, 2006), all these requirements often demand productivity increases, knowledge acquisition, and technology upgrades in domestic producers of inputs. Empirically, Javorcik (2004), Blalock and Gertler (2008), and Javorcik and Spatareanu (2011) all find that a larger foreign presence in industries downstream has a positive and significant effect on the productivity of domestic firms upstream.

Thus, the creation of backward linkages can increase income and welfare in host nations by stimulating local producers of intermediate inputs and by increasing the productivity of local businesses, which often need to upgrade quality, improve efficiency, adopt new technologies, and reduce costs and delivery times in order to become MNE and EPZ suppliers. Pursuing these potential benefits and gains, by 2006 more than 50 developing nations already have formal programs for generating backward linkages between MNEs and domestic suppliers of inputs and services (UNCTAD, 2006).

## 3. Determinants of backward linkages

The propensity of EPZ firms to purchase local inputs is likely to increase with the firm's experience in the host economy. This tendency is well documented in the FDI literature (e.g., Caves, 1996; Dunning, 1993). Presumably, as a foreign firm becomes more familiar with the domestic environment and ways of doing business, its reliance on

domestic suppliers of intermediate inputs tends to increase. For example, in their study of backward linkages of manufacturing firms in Ireland, McAleese and McDonald (1978) find a positive and statistically significant relationship between the length of time a project is in operation and its propensity to purchase Irish goods from local suppliers. Likewise, Görg, Hanley, and Strobl (2011) find that among foreign affiliates of multinationals in Ireland, plants with longer establishment histories tend to develop more linkages with domestic suppliers of inputs. More recently, Belderbos, Capannelli, and Fukao (2001) report that local content in production as a fraction of total sales for affiliates of Japanese multinationals abroad increases significantly with the experience of the affiliate in a foreign location. Similarly, in their study of affiliates of Japanese multinationals abroad, Kiyota, Matsuura, Urata, and Wei (2008) find a positive and significant effect of the experience of the foreign affiliate on local procurement. Liu (2011) also finds a positive relationship between the experience in the host country of affiliates of Taiwanese multinationals abroad and local sourcing. However, Smith and Barkley (1991) find a negative correlation between purchases of local inputs and the age of the firm, while Jordaan (2011), in his survey of manufacturing firms in northern Mexico, reports no effect of the age of the enterprise per se on the propensity of the firm to use local suppliers of inputs.

This study employs the age of the firm to proxy for the experience of the enterprise in the local economy, as follows:

$AGE_{it}$  The number of years of experience the  $ith$  firm has in the Costa Rican EPZ regime at time  $t$ .

Since industries systematically differ in their usage of intermediate inputs in production, the size and scope of their backward linkages may also systematically vary. For example, Hanson, Mataloni, and Slaughter (2005) state that some industries are more amenable to local sourcing of inputs than others since certain production processes involve different stages that may be physically easier to separate, while others may not. In his study of sourcing patterns of affiliates of Taiwanese multinationals abroad, Liu (2011) finds that information and communications technologies, and electronics and electrical equipment firms tend to purchase relatively fewer inputs in the local economy. In his study of local procurement by foreign firms in northern Mexico, Jordaan (2011) finds statistically significant differences in the propensity of automotive, electronics, and chemical firms to use local suppliers of inputs. To control for the industries in the Costa Rican EPZ regime, this study employs four dummy variables ( $DMED$ ,  $DELEC$ ,  $DTEXT$ , and  $DFOOD$ ) in the econometric analysis, as follows:

$DMED_i$  A binary variable where  $DMED_i = 1$  if the  $ith$  firm is a medical device or instruments firm and 0 otherwise

$DELEC_i$  A binary variable where  $DELEC_i = 1$  if the  $ith$  firm is an electric machinery or electronics firm and 0 otherwise

$DTEXT_i$  A binary variable where  $DTEXT_i = 1$  if the  $ith$  firm is a textile or garment firm and 0 otherwise

$DFOOD_i$  A binary variable where  $DFOOD_i = 1$  if the  $ith$  firm is a food-processing firm and 0 otherwise.

The study includes the first three dummy variables ( $DMED$ ,  $DELEC$ , and  $DTEXT$ ) to control for the three main industries operating in the Costa Rican EPZ system (i.e., medical devices, electric machinery and electronics, and textile and garment firms). The study adds the fourth dummy variable ( $DFOOD$ ) because given the nature of their production processes, food-processing enterprises tend to locate themselves close to the sources of food items to reduce transportation costs and to prevent the deterioration of the food items during transportation or storage. Hence, the study expects firms in the food-processing industry to purchase a relatively large share of inputs from domestic suppliers.

EPZ firms, even those within the same industry, employ different production technologies and techniques and therefore, may demand

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