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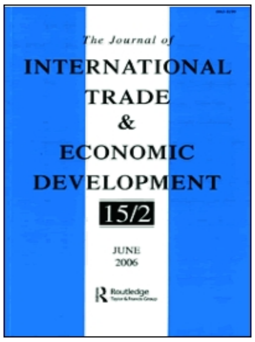

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The domestic content of Mexico's maquiladora exports: A long-run perspective

Juan Carlos Castillo[a] and Gaaitzen de Vries[b]

[a]United Nations University – Maastricht Economic and Social Research Institute on Innovation and Technology, Maastricht, The Netherlands; [b]Faculty of Economics and Business, University of Groningen, The Netherlands

ABSTRACT

This paper studies the domestic value-added content of exports by Mexico's maquiladoras (export-processing firms) during the period from 1981 to 2006. We combine a specific input–output table for maquiladora firms with detailed longitudinal data on outputs and inputs. Policy shifts and major currency devaluations (both taking place in 1982 and 1994) drastically altered the foreign sourcing structure of most maquila firms and conditioned their demand for domestic inputs in the years thereafter. A long-run gradual decline in aggregate domestic value added in maquiladora exports is largely accounted for by the falling domestic content within electronics manufacturing.

KEYWORDS Domestic content; industrial policy; export processing; Mexico

JEL CLASSIFICATIONS C67, F14, O20

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1. Introduction

Mexico's maquiladoras (export-processing firms) are part of one of the oldest and largest international production networks in the world. The first maquiladoras were already established during the 1960s. Maquiladoras were allowed to import material and equipment without paying tariffs. In combination with low wages, it was attractive for multinational enterprises to set up export-processing subsidiaries in Mexico. As a result, employment in maquiladoras increased from about 120,000 in 1980 to 1.2 million in 2006. In 2006, maquiladoras accounted for about 20% of Mexican manufacturing value added and about half the country's exports (Bergin, Feenstra, and Hanson 2009).

This paper is first to study long-run trends in the domestic content of Mexico's maquiladora exports. We combine a specific input–output table (IOT) for maquiladora firms with detailed longitudinal data on value added, gross exports, employment by skill type, and domestic and imported intermediate inputs. Maquiladoras in Mexico predominantly export finished goods (Verhoogen 2008). This contrasts to a 'typical' firm, which might produce intermediate inputs for use by other firms or sell goods in the local and

CONTACT Gaaitzen de Vries g.j.de.vries@rug.nl

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foreign market. In contrast, a maquiladora assembles a good and sells it in the United States.[1] We study whether these maquiladoras upgraded their activities as reflected by an increase in their local source of intermediate inputs. We seek to relate upgrading by maquiladoras to Mexican industrial policies. It should be emphasized, however, that our approach is unable to causally link policies to upgrading by maquiladoras. Rather we will characterize major shifts taking place in maquiladoras.

We find that the share of domestic value added in aggregate maquiladora exports fell from about 27% in 1981 to about 13% in 2006. To better explain this decline, our period of analysis is divided according to two major breaks that implied a substantial drop in the domestic content of maquila exports: (1) the debt crisis and opening up of the economy that took place in 1982, and (2) the currency crisis as well as the adoption of the North American Free Trade Agreement (NAFTA) in 1994. Mexico's accession to GATT in 1985 and, the emergence of China by 2001, also appear related to a gradual decline in the domestic value added of aggregate maquiladora exports. A decomposition analysis suggests this is partly driven by the demise of textile manufacturing that has relatively high domestic value-added content. But the overall long-run decline in the aggregate domestic value added embodied in maquila exports appears largely accounted for by the falling domestic content within electrical machinery products manufacturing.

Our paper is most closely related to de la Cruz et al. (2011, 2013).[2] de la Cruz et al. (2011, 2013) measure the domestic content of Mexico's exports for the period from 2000 to 2006. Similar to this paper, they use the 2003 IOT that distinguishes processing and non-processing firms. Their results for the domestic content share in Maquiladora exports in 2003 are fairly similar. But changes during 2000–2006 in their estimates of domestic content are only due to variation in the export composition. In contrast, in this paper, we collect and use information on production and inputs. Hence, we allow the domestic content to vary if input cost shares change over time, which is more accurate. The purpose of de la Cruz et al. (2011, 2013) is also different from ours. They aim to provide point estimates for the domestic content in Mexico's processing and non-processing exports and compare these to China. This paper aims to examine trends over the long-run; we study the period from 1981 to 2006. Typically, if activities shift to higher value-adding stages of production (say from assembly to product development), we expect these shifts to be accompanied by an increase in skills and capital. Therefore, to account for this issue, our paper also provides additional figures on the aggregate productivity performance of maquiladoras and on the aggregate changes in their share of non-production workers over time.

The remainder of the paper is organized as follows. In the next section, we give an overview of industrial policies for the maquiladora industry from its inception in the 1960s until the merging of the program in a broader framework in 2006. In Section 3, we discuss the data and provide a descriptive analysis of changes in the use of domestic intermediate inputs by maquiladoras, as well as productivity growth and the use of skilled workers within maquiladoras. Section 4 discusses the estimation of time series IOTs and describes the method to measure the domestic value-added content of exports. This section also provides additional insights to account for the reliability from our time series projections. Section 5 presents empirical results along with a brief discussion on the mechanism behind the substantial drops in domestic content after 1982 and 1994. Section 6 provides concluding remarks.

2. Industrial policy and Mexican maquiladoras: an overview

The maquiladora program was devised in the 1960s as an emergency program to cope with rising unemployment observed in the northern part of Mexico. Mexicans were unable to find work in the United States due to the end of the *bracero* guest-worker program. Initially, the maquila program was restrictive (Contreras and Munguía 2007). For example, export-processing firms were supposed to be located within 20 kilometers of the Mexican border; have a minimum national ownership of 51%; and they had the obligation of re-exporting their entire production. This restrictive legal framework was put in place, because the program was not in line with the Import Substitution Industrialization (ISI) policies prevailing in Mexico at the time. Tariff exemptions for manufacturing firms that were partly foreign-owned were clearly a policy contrary to the strategy of ISI. As a consequence of this ISI, the government of Mexico also hardly implemented industrial policies related to firms operating under the maquiladora program.

In 1982, as the country struggled with the debt crisis, Mexico formally abandoned the ISI in favor of a more export-oriented strategy. In line with this economic model, the government finally recognized the potential of maquila firms. A maquila decree in 1983 regarded this industry not only as a source of foreign exchange and jobs, but also as a way of catalyzing industrial endogenous development (Wilson 1992). Easier and faster administrative procedures were established to allow for the operation of more maquila firms. Another key policy change was Mexico joining the General Agreement on Tariffs and Trade (GATT) in 1985, which served as an additional push for domestic and international trade reforms during the upcoming years.[3]

Output and employment expanded fast during the 1990s. And, as we will show below, the composition of output increasingly shifted towards the production of electronic and transport equipment goods. In 1994, the removal of trade and investment barriers in the NAFTA gave rise to another output boost for the maquila industry. The NAFTA agreement increased the preferential access of maquiladoras to the US market relative to firms outside the NAFTA area due to the execution of the principles of national treatment and most-favored-nation (NAFTA Article 102). Non-NAFTA-originated inputs had to pay Mexico's most favored nation (MFN) tax, around 35% in 1994, while the intermediate goods originating in the NAFTA region could be imported free of duty. Hence, these new regulations created an important incentive for the production of parts and components in maquiladoras because the inputs eligible for the tariff exemption were not only those including pure NAFTA content, but also those from other regions that have been previously processed in Mexico.[4] In addition, with the NAFTA agreement, the benefits to maquila firms were extended to companies that supplied them goods and services thereby increasing the incentive for domestic firms to supply maquiladoras.

A large contraction of output and employment in the maquiladora industry occurred during the early 2000s. This was in part due to the 2001 recession of the US economy with the collapse of the dot.com bubble, and in part due to the industrial emergence of China and its entry to the WTO in 2001. China's emergence has had a profound negative effect on maquiladoras. The reason for this negative effect is often sought in the similarity of the composition of US imports from Chinese and Mexican producers (Dussel Peters 2005; Gallagher and Shafaeddin 2008).

In light of increasing competition, the government of Mexico implemented more changes in the legal framework that aimed to induce an increasing number of maquiladoras to exit low-tech, labor-intensive industries and evolve toward higher value-added, technology-intensive sectors (Sargent and Mathews 2008). During the early 2000s, the government provided substantial tax incentives to maquiladora firms that engaged in research and development activities (R&D) and created a fund to promote Mexico's software industry (Ruiz Durán, Piore, and Schrank 2005). The government in Mexico was especially interested in attracting new companies engaged in applied research, product and process development, product testing, and high-tech manufacturing in five industries: biotechnology, mechatronics, information technology, health, and nanotechnology (Sargent and Mathews 2008).

In a nutshell, Mexico's industrial policy towards maquiladoras gradually shifted from viewing them as mere providers of employment towards promoting the sourcing of intermediates from upstream domestic firms and technological upgrading within maquiladora firms.

3. Database construction and descriptive statistics for maquila industries

The newly constructed dataset for maquiladoras that we will use to examine long-run trends consists of longitudinal information on output (gross output and value added), gross exports, as well intermediate inputs (all reported in current Mexican pesos) and information on the number of production and non-production workers. These data are derived from various publications by the statistical office (INEGI 1991, 2001, 2005). The data presented in these publications are based on the monthly statistical surveys for the maquiladora industry as well as the five-yearly economic census. The monthly sample survey of the maquiladora industry collects detailed information on the business operations of maquilas. The setup of the survey has not changed much during the period analyzed, and the economic census is a full census of economic activity that underpins this monthly survey. Data from 1990 to 2006 can be readily obtained from the national statistical office's website, but to trace the development further back and to obtain more industry detail, we collected and digitized hard copies of various reports (notably INEGI 1991, 2001). Detailed industry data following Mexico's industry classification is matched to two-digit industries in the International Standard Industrial Classification 3.1.[5]

After 2006, the maquiladora program was merged with another program that offers duty relief for temporary imports, the PITEX program (Programas de Importación Temporal para Producir Articulos de Exportación). As a result, the statistical office no longer updates information for maquiladoras. Information that includes maquiladoras and other firms is reported in the monthly statistical report of the IMMEX program from 2007 onwards. Our time series stop in 2006, because it is not possible to distinguish maquiladoras in these reports. Also, policies specific to maquiladoras are no longer present from 2006 onwards. Thus, we focus on the domestic content of maquila exports in the period from 1981 to 2006.

Columns 1–5 of Table 1 show gross output shares by industry for 1981, 1983, 1995, 2001, and 2006. 1981 and 2006 refer to the first and last years of analysis in our dataset. 1983, 1995, and 2001 refer to critical years in the evolution of maquila firms (i.e. debt crisis, implementation of NAFTA, and the industrial emergence of China, respectively). Note that gross output equals exports for maquiladoras since everything produced is subsequently exported (this is further discussed in Section 4). Changes in gross output shares reflect changes in the industry composition. Textile products, electronics, and transport equipment account for the majority of gross output.[6]

Table 1. Descriptive statistics, size, and domestic input use in maquiladora industries.

	Gross output shares					Domestic intermediate use shares
	1981 (1)	1983 (2)	1995 (3)	2001 (4)	2006 (5)	2006 (6)
Food, beverages, and tobacco	1.9	1.6	0.6	0.4	0.8	37.9
Textiles and textile products	15.5	13.0	9.3	12.2	7.4	16
Leather, leather and footwear	1	1.0	0.9	0.6	0.3	16
Pulp, paper, printing and publishing	1.5	1.6	3.4	2.0	1.9	17.7
Chemicals and chemical products	–	–	0.2	0.3	0.2	35.1
Rubber and plastics	2.3	2.4	2.0	2.4	3.1	22.9
Other non-metallic minerals	0.4	0.4	0.7	0.7	1.9	10.5
Basic metals and fabricated metal	2.4	2.5	3.1	3.1	3.2	21.4
Machinery	1.8	1.2	1.9	1.8	2.3	17.3
Electronics	55.3	50.3	48.7	51.5	53	6.8
Transport equipment	11.4	21.1	20.8	16.8	17.2	14.2
Miscellaneous manufacturing	2.3	2.2	7.5	6.2	6.9	10.1
Business services	4.2	2.8	0.8	2.0	1.8	24.5
Total	100	100	100	100	100	10.9

Notes: Columns 1–5 show gross output shares in current prices by industry. Column 6 shows the share of domestic intermediate inputs in total intermediate inputs. Total refers to total maquila industries (numbers may not sum due to rounding). Wood and products of wood and cork are included in pulp, paper, printing and publishing manufacturing. Sources: INEGI (1991, 2001, and 2005); see main text.

During the 1980s, transport equipment and miscellaneous manufacturing (including furniture, jewelry, musical instruments, sports goods, and toy production) grew substantially faster as compared to other sectors such as textiles and electronics. The opposite pattern is observed for the 1990s. After 2000, we observe a sharp drop in the relative importance of textile manufacturing. This drop might be related to the entry of China to the WTO in 2001 and the end of the Multi-Fiber Agreement in 2004 that eliminated import quotas for textile products. Mexican textile firms faced increasing competition from Chinese firms at home and in the US market (Iacovone, Ferdinand, and Winters 2013; Utar and Torres Ruiz 2013).

Changes in the relative size of sectors carry important implications for the composition of maquila exports and subsequently also for the aggregate domestic value-added content of exports. In column 6 of Table 1, we report the share of domestic intermediate inputs in total intermediate inputs in 2006. The share of domestic intermediates varies substantially across industries. Food processing manufacturing is sourcing a lot of inputs domestically (37.9% in 2006) as fresh produce typically requires immediate processing. However, most inputs in the more technologically advanced electronics manufacturing sector are sourced from abroad. The domestic share is only 6.8% in 2006. The share of domestic inputs directly used in production reflects the direct domestic content of maquila exports. Hence, the continuous decline of textile manufacturing (with a high share of domestically produced intermediates), the relative expansion of transport equipment manufacturing (with a low domestic content after 2000), and the fact that electronics has continuously kept the largest share in total output over the years (with a very limited use of domestic inputs) suggest that the domestic content in aggregate exports has declined. We will examine this more formally in Section 5.

Figure 1 shows various indicators of aggregate technological development within maquiladora industries. The top panel shows productivity growth for the total and the

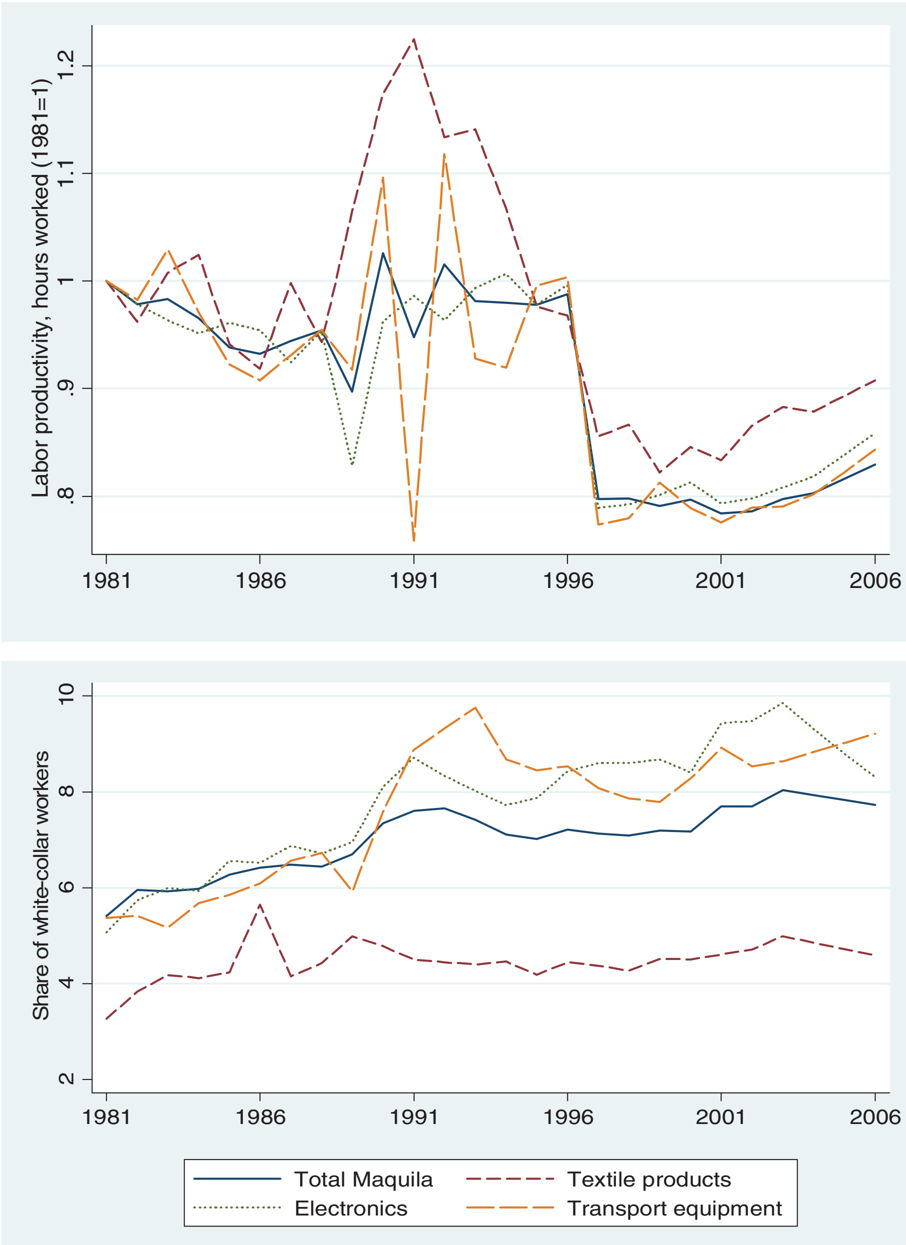

Figure 1. Productivity growth and share of non-production workers, 1981–2006.
Notes: The first panel shows productivity growth, which is based on the growth in real value added divided by persons engaged (the index equals 1 in 1981). The second panel shows the percentage share of non-production (white-collar) workers in total persons engaged. Sources: INEGI (1991, 2001, 2005) and others; see text.

three largest sectors (textile, electronics, and transport equipment manufacturing). We divided real value added by hours worked to measure labor productivity. Based on growth rates of labor productivity, an index is constructed, which equals 1 in 1981. The trend is volatile and it suggests that productivity remained stagnant during the period considered as the index is below 1 in 2006. In 1997, there is a substantial drop in labor productivity, which arises from a new tax regulation imposed on the profits earned by maquiladora firms.[7] From the late 1990s onwards, productivity improved modestly but without recovery from the permanent downward break of 1997.

The dataset we constructed distinguishes between production and non-production workers. Production workers mainly undertake manual less-skilled tasks, whereas non-production workers mainly undertake managerial and administrative tasks. The bottom panel of Figure 1 shows the share of non-production workers in total persons engaged which proxies for the quality of jobs. The figure reveals that more technology-intensive sectors such as electronics and transport equipment manufacturing have a higher share of non-production workers compared to less technology-intensive sectors such as textile manufacturing. A slightly upward trend, though from low initial levels, can be observed.

Overall, however, the stagnant trend in labor productivity and the small increase in non-production workers suggest that technological development in the maquiladora industry has not advanced at a fast pace. In the next sections, we complement this analysis by studying the domestic content of exports. We first describe the method and time series IOTs to measure the domestic content of exports before turning to the empirical analysis.

4. The domestic content of maquila exports

This section is divided in two parts. First, we outline the method to measure the domestic content of maquila exports. Second, we discuss the (G)RAS procedure to estimate time series IOTs for Mexico to measure the domestic content.

4.1. Method

We use the approach from Los, Timmer, and de Vries (2016) to measure Mexican value added embodied in maquila exports. There is a big debate in the literature about how to measure domestic value added in gross exports in global or inter-regional IOTs, and various methods are proposed (see e.g. Daudin, Rifflart, and Schweisguth 2011; Johnson and Noguera 2012; Foster-McGregor and Stehrer 2013). In an influential article, Koopman, Wang, and Wei (2014) provide a complete decomposition of the gross exports value of a country into nine terms, based on an input–output representation of the world economy. However, their accounting approach is mathematically tedious. And a key issue in that paper concerns what to do with the so-called 'pure double-counted' terms in measuring the domestic content of exports. When there is two-way trade in intermediates, meaning that country A needs inputs from country B to produce inputs for B, it is typically difficult to establish the origin of these pure double-counted terms. Conceptually, tables can be constructed that trace this two-way trade, but empirical IOTs will never have the required level of detail and it is hard to imagine they ever will, given the amount of information that would be needed. It implies that *all* tasks in *all* supply chains in the world should be represented as separate industries.

Table 2. Expanded input–output table for Mexico.

	Intermediate use		Final use		
	D	*P*	*FD*	*EXP*	*TOT*
D	$\mathbf{Z}^{DD}$	$\mathbf{Z}^{DP}$	$\mathbf{f}^{D}$	$\mathbf{e}^{D}$	$\mathbf{x}^{D}$
P	0	0	0	$\mathbf{e}^{P}$	$\mathbf{x}^{P}$
IMP	$\mathbf{M}^{D}$	$\mathbf{M}^{P}$	$\mathbf{f}^{M}$	0	$\mathbf{x}^{M}$
VA	$(\mathbf{v}^{D})'$	$(\mathbf{v}^{P})'$			
TOT	$(\mathbf{x}^{D})'$	$(\mathbf{x}^{P})'$			

D = industries producing for domestic use; *P* = maquila industries (export processing); *FD* = final demand; *EXP* = exports; *TOT* = industry gross outputs (and total imports in the column *TOT*); *IMP* = imports; and *VA* = value added.

Los, Timmer, and de Vries (2016) introduce an elegant and intuitive method to measure domestic value added in gross exports. They extract all export flows from a country and calculate how much value added would be generated in that hypothetical situation. Domestic value added in exports is defined as the difference between actual and hypothetical GDP in that country. They show their measure is equal to the first five terms in the key equation (36) of Koopman, Wang, and Wei (2014). These five terms in Koopman, Wang, and Wei (2014) do not include any pure double-counted terms. In addition, Los, Timmer, and de Vries (2016) show that the measure of domestic value added in exports is equal to one minus vertical specialization (VS), with VS as originally suggested by Hummels, Ishii, and Yi (2001).[8] In what follows, we write down formally how we measure Mexican value added in maquiladora exports.

Consider n industries and let the matrix $\mathbf{Z}$ denote domestic inter-industry flows from industry i to industry j. The vector of exports is denoted by $\mathbf{e}$, the final demand vector by $\mathbf{f}$, the vector of value added by $\mathbf{v}$, the vector of industry gross outputs by $\mathbf{x}$, and let $\mathbf{M}$ denote the import use matrix with a typical element m_{ij} the imports of industry i by industry j.

The domestic and imported intermediate input flows for both domestic and maquila industries can be depicted in an adaptation of the ordinary IOT (see Table 2). The framework is similar in structure to an inter-regional IOT with two regions. In this Table, the matrix $\mathbf{Z}^{DD}$ gives domestic industry deliveries to other domestic industries, whereas $\mathbf{Z}^{DP}$ gives domestic inter-industry flows to maquila industries. Likewise, the vector $\mathbf{v}^{D}$ gives value added generated in domestic industries whereas $\mathbf{v}^{P}$ gives value added in maquila (export-processing) industries.

Note that maquila firms in the final use block are assumed not to deliver output for final demand ($\mathbf{f}^{P} = 0$; see Table 2). INEGI (the national statistical office of Mexico) regularly carries out surveys, and consistently finds that maquiladoras sell less than 5% of their output domestically (Verhoogen 2008). Some of these domestic sales of maquiladoras may end up as intermediate inputs for domestic firms (which would be in the matrix $\mathbf{Z}^{PD}$, here set to zero). We are unable to take these intermediate transactions into account and this will result in a bias in our estimates. However, given the typically low values of these transactions, we presume this bias will not be large. We also assume $\mathbf{Z}^{PP}$ is zero; hence no intermediate deliveries among maquiladoras. This is a common assumption in the literature (see e.g. de la Cruz et al. 2011, 2013; Yang et al. 2015). However, the measured domestic content of maquila exports by sector will be biased if there are inter-industry flows among maquiladoras. In particular, if the use of each other's inputs has become more pervasive over time, changes in the domestic content may be overstated for some sectors and understated for others. In the Online Appendix (Supplementary material), we discuss an approach to infer the bias from this assumption and conclude the bias is likely to be small.

We assume that maquila output is exported, so gross output of maquila firms equals gross exports. This is consistent with procedures at the statistical office INEGI, which give the estimates for the maquiladora industries that are compatible with the Mexican Balance of Payments. In the Mexican Balance of Payments, gross output equals gross exports and imported intermediate inputs equals the total value of maquila imports such that the difference is the maquiladora trade balance.

The direct requirements for domestic input *i* per unit of output *j* are given by $\mathbf{A}^{\mathbf{DD}} = \mathbf{Z}^{\mathbf{DD}}\ (\widehat{\boldsymbol{x}^{\boldsymbol{D}}})^{-1}$ for domestic industries (with typical element $a_{ij}^{DD} = z_{ij}^{DD}/x_j^D$) and $\mathbf{A}^{\mathbf{DP}} = \mathbf{Z}^{\mathbf{DP}}\ (\widehat{\boldsymbol{x}^{\boldsymbol{P}}})^{-1}$ for maquila industries.[9]

Production typically requires domestic and imported inputs. However, these inputs in turn also require domestic and imported inputs. The latter effects are indirect effects. The size of these indirect effects depends on the interrelatedness of production across industries and countries. To include both direct and indirect effects in an analysis of the domestic content of exports, we calculate the total effect using the Leontief inverse $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$, where $\mathbf{I}$ is the identity matrix, a diagonal matrix of ones.

The total domestic content of aggregate maquila exports is one minus VS as in Hummels, Ishii, and Yi (2001), which is given by

$$DCE = \left(\boldsymbol{v}^P\right)'\left(\boldsymbol{I} - \boldsymbol{A}^{DP}\right)^{-1}\boldsymbol{e}^P / \left(\boldsymbol{u}'\boldsymbol{e}^P\right) \tag{1}$$

where $\mathbf{u}$ is a summation vector consisting of ones, and a prime (e.g. $\mathbf{u}'$) indicates transposition. We will use equation (1) to calculate the domestic content of maquila exports (DCE). In economic terms, equation (1) indicates the value-added contribution of direct and indirect local producers in Mexico, $(\boldsymbol{I} - \boldsymbol{A}^{DP})^{-1}$, to the gross value added embodied in the final output produced by a maquila firm, $(\boldsymbol{v}^P)'$'. The actual size of this contribution in the current Mexican pesos, i.e. the domestic content derived from local producers, is obtained by multiplying the latter terms by total exports $\boldsymbol{e}^P$. Finally, the ratio of domestic content to exports is our measure of DCE.

In order to measure the domestic content of exports annually from 1981 to 2006, we need a time series of the expanded IOTs. Constructing these will be the objective of the next section.

4.2. Construction of time series IOTs

For the purposes of this paper, we will project our required tables in two steps. First, we will project the 2003 extended IOT (see Table 2) using the detailed complementary data for the period from 1981 to 2006 discussed in Section 3. Second, we will use a 1980 IOT for the Mexican economy to account for the reliability of our projections during a specific period (the pre-NAFTA period). Here, we will use the official 1980 IOT for Mexico and the available share of imported and domestic input coefficients (from the 2003 table) to project additional tables from 1981 to 1993.

INEGI released an IOT for maquila and non-maquila industries for the year 2003 (INEGI 2010b).[10] The IOT is constructed on the basis of a supply and use table (SUT) at basic prices and additional assumptions concerning technology. To transform the SUT in an industry-by-industry IOT, we use the so-called 'fixed product-sales structure' assumption stating that each product has its own specific sales structure irrespective of the industry where it is produced. The sales structure assumption refers to the proportions of the output of the product in which it is sold to the respective intermediate and final users. This assumption is most widely used to transform SUTs into IOTs, not only because it is more realistic than its alternatives, but also because it requires a relative simple mechanical procedure. Furthermore, it does not generate any negatives in the IOT that would require manual rebalancing (see Miller and Blair (2009) for further discussion).

In constructing the maquila SUT, INEGI relies on various internal and externally available statistical sources. The main source for production data is the Monthly Statistical Report for the Maquiladora Industry undertaken by INEGI. This information is combined with the Foreign Trade Database prepared by the Central Bank of Mexico, which contains information on imported intermediate consumption. Trade margins (the difference between products valued at producer and purchasers' prices) are estimated from the 2004 Commercial Census. Gross value-added is the sum of the wage bill, net taxes on subsidies from production, and the gross operating surplus. The 'National Survey of Employment for 2003' prepared by INEGI in conjunction with the Monthly Statistical Report was the underlying source of information for these data. For further details on the methods and sources, see INEGI (2010a).

Temurshoev, Webb, and Yamano (2011) provide an overview and asses the performance of various projection methods. They find that (G)RAS gives one of the most reliable projections of the data. Therefore, we use the iterative algorithm of (G)RAS proposed by Lenzen, Wood, and Gallego (2007).[11] Basically, the G-RAS procedure requires a benchmark IOT – the domestic and maquila table for 2003 in our case – and row and columns sums for all years for which we would like to estimate IOTs. (G)RAS estimates new IO matrices for all years as close as possible to the benchmark table under the external constraints of the row and column sums. We implement this approach for the period from 1981 to 2006.

An important limitation from the approach here proposed is the absence of benchmark tables for earlier years.[12] Since we are only relying on 2003 official tables, our benchmarking approach is mostly capturing the intermediate sourcing structure for maquila (and non-maquila) firms that emerged with the signing of NAFTA in 1994 and the accession of China to the WTO in 2001. Our (G)RAS projections from 1994 to 2006 are thus trustable projections because the intermediate sourcing behavior of maquila firms during those years is characterized by those two events in 1994 and 2001. The next step is to identify an intermediate sourcing structure that captures that of maquila firms in the pre-NAFTA period (1981–1993).

Before the 2003 table, the most recent IOT for Mexico was only available for 1980 (INEGI 1986). This 1980 IOT is relevant for our research as it captures the intermediate sourcing structure of manufacturing firms in Mexico in the pre-NAFTA period. A split between maquila and non-maquila firms is not available for this 1980 table. In fact, such split is only available for the 2003 version. Therefore, to corroborate the reliability from our 1981–1993 projections, our research decided to project additional tables for this specific period by transferring the maquila (and non-maquila) sourcing structure from the 2003 table to the intermediate sourcing structure described in the 1980 table.

From Section 4.1, we know that the matrix $\mathbf{Z}^{DD}$ gives domestic industry deliveries to other domestic industries, and that $\mathbf{Z}^{DP}$ gives domestic inter-industry flows to maquila industries. Thus, the total within domestic deliveries $\mathbf{Z}$ can be defined as $\mathbf{Z} = \mathbf{Z}^{DD} + \mathbf{Z}^{DP}$. Since this notation relies on the 2003 tables, let us redefine all these elements as $\mathbf{Z}_{2003} = \mathbf{Z}^{DD}_{2003} + \mathbf{Z}^{DP}_{2003}$. The ratio of domestic inputs consumed by maquila firms to total domestic intermediate consumption is then given by $z\_share^{DP}_{i,j,2003} = z^{DP}_{i,j,2003}\,(z_{i,j,2003})^{-1}$. Likewise, the ratio of domestic inputs consumed by domestic firms to total domestic intermediate consumption is given by $z\_share^{DD}_{i,j,2003} = z^{DD}_{i,j,2003}\,(z_{i,j,2003})^{-1}$. In this context, the domestic sourcing structure in 1980 can be defined as $\mathbf{Z}^{DP}_{1980} = z\_share^{DP}_{i,j,2003}\,.\mathbf{Z}_{1980}$ for maquila firms and, $\mathbf{Z}^{DD}_{1980} = z\_share^{DD}_{i,j,2003}\,.\mathbf{Z}_{1980}$ for domestic firms, where $\mathbf{Z}_{1980} = \mathbf{Z}^{DD}_{1980} + \mathbf{Z}^{DP}_{1980}$. Following the exact same analogy for the case of the import matrix of 2003 ($\mathbf{M}_{2003}$), we can define the sourcing structure for imported inputs for maquila firms in 1980 as $\mathbf{M}^{P}_{1980} = m\_share^{P}_{i,j,2003}\,.\mathbf{M}_{1980}$ and $\mathbf{M}^{D}_{1980} = m\_share^{D}_{i,j,2003}\,.\mathbf{M}_{1980}$ for domestic firms, where $\mathbf{M}_{1980} = \mathbf{M}^{D}_{1980} + \mathbf{M}^{P}_{1980}$. These tables for 1980 will be our benchmark to project additional maquila and non-maquila tables from 1981 to 1993.

Using the 1980 table allows us to more closely approximate to the intermediate sourcing structure from the pre-NAFTA period. Nonetheless, combining this latter 1980 table with ratios derived from the 2003 maquila and non-maquila tables raises other important issues. A clear limitation is that, for most cases, our research might be assuming that the demand for intermediate inputs from industry *i* to industry *j* is similar between the periods of 1981–1993 and 1994–2006.

To account for the size of this bias in our proposed approximation of the pre-NAFTA intermediate sourcing structure, we compared the different inter-industry intermediate consumption described by the 1980 and 2003 tables. Here, we were interested in knowing whether the domestic and imported inter-industry demands for intermediates described by the maquila and non-maquila tables from 2003 were also present in the intermediate sourcing structure of 1980. For the case of the domestic intermediate use tables, only few inter-industry linkages not observed in 1980 appeared by 2003. Those new inter-industry linkages now accounted by the 2003 table mostly belong to the service sector. The latter is simply reflecting the growing importance of more detailed statistics to analyze the service sector. On the other hand, as for the imported use tables, a great number of inter-industry linkages not observed in the 1980 tables appeared by 2003. This is especially true after comparing the maquila imported use table ($\mathbf{M}^{P}_{2003}$) and, the imported use table for the total economy in 1980 ($\mathbf{M}_{1980}$). In our comparisons, the sectors of leather and footwear, wood, pulp and printing, rubber and plastics as well as other non-metallic minerals drastically modify their imported intermediate sourcing structure from the 1980 tables to the 2003 ones. This means that, by 2003, those maquila industries had a far more diversified demand for imported intermediate inputs produced by other foreign industries than the one that was possible by the structure of 1980 economy. The rest of maquila sectors (including Textiles, Electronics, and Transport Equipment) also modified their imported intermediate sourcing structure by 2003, but to a much smaller scale than the above-mentioned sectors.

In this context, we can conclude that our additional projections from 1981 to 1993 are not subject to important biases for the following two main reasons: (1) the complete absence of various inter-industry linkages for imported inputs in 1980 that became stronger or appeared over the years for maquila firms (as a result of Mexico's increasing outward orientation), and; (2) the resulting less diversified sourcing structure for imported inputs captured by 1980 table. For the second point, we believe that even if our approach attaches a high share of maquila-imported intermediate consumption (as defined by 2003 tables) to a given inter-industry demand for imported goods in the 1980 tables, such bias will be reduced by the little sectoral diversification in the sourcing structure for imported inputs in that same year. An empirical test and more insight about this latter claim are provided in the next section.

5. The domestic content of maquila exports

In this section, we describe the evolution of Mexico's value-added share in maquila exports for the period from 1981 to 2006. In Section 5.1, we document main trends and further argue about the empirical plausibility from our projections. Subsequently, we examine whether changes in the aggregate trend are driven by changes within industries or by changes in the industry composition in Section 5.2. Section 5.3 discusses mechanisms behind shocks to the domestic value-added content of exports in 1982 and 1994.

5.1. The domestic content of maquila exports: aggregate and industry trends

The share of domestic content in aggregate exports (DCE) is shown in Figure 2. To calculate domestic content for the period from 1981 to 2006, we use equation (1) and extended IOTs for two different benchmark years. Figure 2 presents two trends in the DCE: one trend using 2003 as a benchmark and yearly information from 1981 to 2006 and a second DCE trend using 1980 as a benchmark and yearly data from 1981 to 1993. The figure reports the total domestic content.

Let us first analyze the trend in the DCE during the pre-NAFTA period. In this period, our DCE calculations using different benchmark years overlap. As can be seen, the DCE

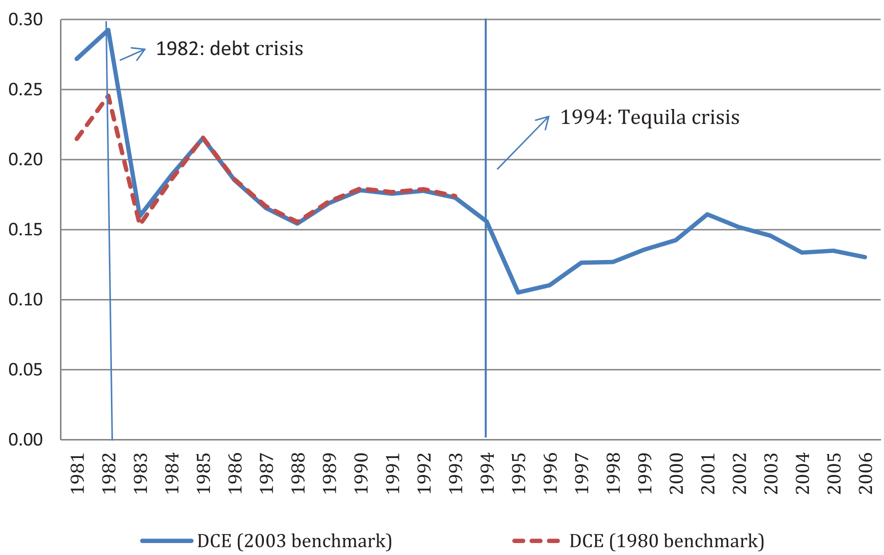

Figure 2. The domestic content of aggregate maquila exports (DCE).
Notes: Domestic content as a share in aggregate maquila exports. Authors' calculations using time series estimates and equation (1).

calculations using the 1980 and 2003 benchmarks follow the same tendency from 1981 to 1993. The most important difference is that during the first three years, the DCE trend from the 1980 tables is smaller than the DCE from the 2003 benchmark. In 1981, the domestic content share in Mexico's maquila exports is about 27% according to the 2003 benchmark. According to the 1980 benchmark, such DCE is around 21%. These differences in the DCE with different benchmark years disappear after 1982.[13] Henceforth, on the basis of these small differences, we believe that our projections from 1981 to 1993 using the 2003 table are also a trustable approximation to the sourcing structure during the pre-NAFTA period.

Before proceeding to the rest of the analysis for the aggregate trend in DCE, we will further discuss the reasons as to why we believe that our entire set of tables from 1981 to 2006 (using the 2003) can be now regarded as trustable projections. The increasing outward orientation of the Mexican economy allowed for higher foreign purchases from key intermediate inputs in maquila firms. It also allowed for higher purchases of less relevant foreign intermediate inputs that are complementary to their productive process. For instance, as a result of the events in 1982 and 1994, a maquila firm in the electronics sector had the incentive to import a higher amount of key imported inputs such as microchips, transistors, and other relevant parts and components. The new economic environment in Mexico also allowed this firm to externally source plastics and other packaging materials that are complementary for its final manufacturing output. Our comparison between the imported use table for maquila firms in 2003 and the imported use table for the total economy in 1980 indicates that the first table captures the foreign inter-industry purchases for both key and less relevant (complimentary) intermediate inputs. The 1980 table, on the other hand, is only capturing foreign purchases of key intermediate inputs. This latter assumption is supported by the fact that the 1980 table is still reflecting the sourcing structure from the ISI strategy. To avoid tariff penalizations, maquila firms were only importing key intermediate inputs during those ISI years. In this context, it can be argued that projecting tables from 1981 to 1993 using the 2003 benchmark tables implies that we are transferring the inter-industry demand for both key and complimentary foreign inputs to a period that might be characterized by purchases of mostly key intermediate inputs. Our additional projections from 1981 to 1993, using the 1980 tables, approximate to a sourcing structure that mostly relies in the purchases of key foreign inputs. The DCE results using the 1980 benchmark and the 2003 yield very similar results. Thus, it can be argued that all our projections from 1981 to 2006 are trustable projections as they ensure the analysis of key inter-industry demands for foreign inputs that have remained since the 1980s. Our research, however, is unable to empirically explain the extent by which those key inter-industry foreign purchases from maquila firms have changed since the 1980s.

The domestic content of maquila output varied substantially over the entire period here analyzed. In particular, the 1982 debt crisis and the 1994 currency crisis coincide with a substantial drop in domestic value added embodied in maquila output. During the pre-NAFTA period, we observe that the 1982 debt crisis induced a drastic decline in the DCE of maquila firms (16% by 1983). Such a decline was later reinforced by Mexico's entrance to GATT in 1986. By end of 1993, the share of domestic content in aggregate exports for maquila firms did not seem to have recovered from the 1982 shock. On the other hand, during the post-NAFTA period, the 1994 Tequila currency crisis seems to have induced yet another drastic drop in the DCE of maquila firms (11% by 1995). Figure 2 reveals increasing value-added content during the second half of the

Table 3. Domestic content of maquila exports, industry results (2003 benchmark).

	1981 (1)	1983 (2)	1995 (3)	2001 (4)	2006 (6)
Food, beverages, and tobacco	0.22	0.18	0.27	0.27	0.18
Textiles and textile products	0.22	0.16	0.15	0.24	0.21
Leather, leather and footwear	0.31	0.17	0.15	0.21	0.18
Pulp, paper, printing and publishing	0.24	0.19	0.12	0.25	0.19
Chemicals and chemical products	–	–	0.19	0.19	0.24
Rubber and plastics	0.31	0.23	0.17	0.22	0.20
Other non-metallic minerals	0.38	0.31	0.17	0.22	0.10
Basic metals and fabricated metal	0.24	0.15	0.16	0.19	0.15
Machinery	0.34	0.37	0.12	0.19	0.13
Electronics	0.23	0.14	0.08	0.12	0.09
Transport equipment	0.24	0.14	0.10	0.17	0.17
Miscellaneous manufacturing	0.31	0.21	0.13	0.20	0.19
Business services	0.56	0.34	0.26	0.23	0.25

Notes: Authors' calculations using time series estimates (2003 benchmark), and equation (1) where $\mathbf{e}^P$ is put on the main diagonal of a matrix of equal dimension as the number of industries.

1990s. This tendency is consistent with case study findings presented by Buitelaar and Perez (2000). Indeed, the abolition of US duties on Mexican intermediate inputs with the 1994 NAFTA agreements might have had a positive effect on domestic sourcing by maquiladoras. Despite some signs of recovery by the end of the decade, the 2001 US crisis and China's entrance to the WTO seem to have reinforced the negative impact from the 1994 shock (13% by 2006). These results suggest that aggregate patterns in the DCE appear mainly related to internal and external shocks, such as the 1982 and 1994 crises.

In Table 3, we further explore the domestic content of exports at the industry level using information from the 2003 benchmark. These results are obtained by replacing the export vector $\mathbf{e}^P$ in equation (1) by a diagonal matrix with the vector $\mathbf{e}^P$ on the main diagonal. The findings suggest that the domestic content differs substantially across sectors. In particular, the domestic content is low in electronics manufacturing (9% in 2006) as compared to textiles manufacturing (21%). The findings tend to suggest that the domestic content is lower in technology-intensive sectors.[14] The Online Appendix (Supplementary material) further discusses the sectoral variation over time of these manufacturing sectors.

5.2. *The domestic content of maquila exports: a disaggregation analysis*

We combine changes in the domestic content with changes in export shares to examine whether the aggregate patterns observed in Figure 2 are related to changes within industries or a result of changes in the product composition of exports. To disaggregate the aggregate change in domestic export content, we apply a 'within' and 'between' analysis, which can be written in the current context as follows:

$$DCE_{t+1} - DCE_t = \sum_i \left(\left(\left(DCE_{i,t+1} - DCE_{i,t}\right) \left(\frac{\omega_{i,t+1} + \omega_{i,t}}{2}\right) \right) + \left(\left(\omega_{i,t+1} - \omega_{i,t}\right) \left(\frac{DCE_{i,t+1} + DCE_{i,t}}{2}\right) \right) \right), \qquad (2)$$

Table 4. Sources of change in domestic content of value-added exports (2003 benchmark).

	Share of domestic content in exports		Contribution of (in percent):		
	(1)	(2)	(3)	(4)	
	Year T	Year t+1	Change in industry DCE intensity	Change in industry share in overall exports	**Total**
	1981	2006			
Total maquiladora	**0.27**	**0.13**			
Textile products	0.22	0.21	0.77	14.54	
Electrical machinery products	0.23	0.09	64.31	3.03	
Transport equipment products	0.24	0.17	8.13	− 9.84	
Other			25.42	− 6.35	
			98.62	1.38	100
	1981	1983			
Total maquiladora	**0.27**	**0.16**			
Textile products	0.22	0.16	9.2	5.1	
Electrical machinery products	0.23	0.14	49.4	10.3	
Transport equipment products	0.24	0.14	17.7	− 20.0	
Other			18.7	9.5	
			95.0	5.0	100
	1983	1995			
Total maquiladora	**0.16**	**0.11**			
Textile products	0.16	0.15	1.9	10.5	
Electrical machinery products	0.14	0.08	58.4	3.4	
Transport equipment products	0.14	0.10	15.5	0.6	
Other			21.7	− 12.0	
			97.5	2.5	100
	1995	2001			
Total maquiladora	**0.11**	**0.16**			
Textile products	0.15	0.24	17.25	9.88	
Electrical machinery products	0.08	0.12	34.17	4.99	
Transport equipment products	0.10	0.17	25.59	− 9.99	
Other			21.76	− 3.65	
			98.77	1.23	100
	2001	2006			
Total maquiladora	**0.16**	**0.13**			
Textile products	0.24	0.21	9.46	35.38	
Electrical machinery products	0.12	0.09	53.53	− 5.37	
Transport equipment products	0.17	0.17	2.81	− 2.27	
Other			23.23	− 16.77	
			89.02	10.98	100

Notes: Authors' calculations using equation (2).

where $DCE_{i,t}$ is the domestic content of exports by industry *i* in year *t*, and $\omega_{i,t}$ is industry *i*'s share in total exports at time *t*. The industry contribution in equation (2) is split into two terms. The first term gives the industry contribution due to changes in the industry-level DCE share (within), and the second term gives the contribution due to changes in the industry-level export share (between).

The results from this decomposition are given in Table 4. In line with our findings from Section 5.1, our decomposition results analyze changes for the entire period, as well as changes between critical years. The table distinguishes contributions by the three largest maquila sectors, namely textile products, electronics, and transport equipment. The other sectors are grouped. For the case of the entire period, the decomposition suggests that changes in the aggregate domestic content are mainly accounted for by changes within industries. From 1981 to 2006, the substantial drop in the domestic content of electronics manufacturing accounts for almost two-thirds of the aggregate change in domestic content.

The dominance of within-industry effects in accounting for the trends observed is confirmed from decompositions using different time periods. In almost all of time periods, the drastic drop in the domestic content of electronics explains more than half of the changes in domestic content. The only exception occurs from 1995 to 2001, as a result of higher within changes in the DCE intensity from the textile and transport sectors.

5.3. The mechanism behind declining domestic content of exports: the shocks of 1982 and 1994

According to Figure 2, the aggregate trend in the domestic content of exports from maquila firms is conditioned by two discrete breaks in crisis years. The events in 1982 and 1994 imposed new medium-term standards for the evolution of the DCE in the years to come. After 1982, the DCE was between 20% and 15%, whereas after 1994 the aggregate trend was between 15% and 10%.

Two main factors explain the mechanism behind the drastic DCE breaks after 1982 and 1994. The first one is that those two years coincide with a sharp depreciation of the Mexican peso. A sharply lower value of the Mexican peso implies an upward valuation effect on imported intermediate inputs, thus lowering the share of domestic value added relative to foreign value added in exports.[15] The second factor is that 1982 and 1994 also coincide with two major trade policy shifts. Mexico formally abandons the ISI strategy by the end of 1982, and joins NAFTA by the beginning of 1994. The interaction between those two factors help us understand why discrete breaks in crisis years imposed medium-term standards for the evolution of the DCE.

According to Wilson (1992), the maquiladora decree from 1983 represents a historical policy shift. Here, maquiladora production officially moves from being a temporary program (and an anomaly in the prevailing ISI strategy) to be one of the key elements in the export-oriented strategy from the Mexican government. With the devaluation from the Mexican peso in 1982 (which made Maquiladoras wages more attractive than Asian wages) and higher official encouragement, the Maquiladora industry boomed during the 1980s to become one of the largest sources of foreign exchange after petroleum and before tourism (Wilson 1992). Mexico's accession to GATT further reinforced this trend.

The signing of NAFTA guaranteed preferential access from maquila output to the US market. A maquiladora could import from anywhere in the world intermediate inputs to produce a final good for exports, without paying import duties or value-added tax. If the maquila firms used sufficient intermediate goods from the US, Canada, or Mexico to meet NAFTA rules of origin, its output could be considered of NAFTA origin and thus it could also enter free of duty the US market. In line with Angulo Parra (1998), with zero tariffs, a maquila firm could enjoy no duties in their imports and productive process all the way from Malaysia to Chicago. The devaluation of the Mexican peso by 1994 had similar effects on wages and on the valuation of imported goods like the ones described for 1982. The 1994 DCE break seems to have been reinforced by stiff competition from Chinese producers and the 2001 US crisis.

6. Concluding remarks

This paper combined a specific IOT for maquiladora industries with detailed longitudinal data on output and inputs. We find substantial differences in the domestic value-added content of maquiladora exports across industries and over time. The domestic content is typically higher in labor-intensive goods, such as textiles, compared to more capital-intensive industries such as transport and electronic goods manufacturing. Over time, productivity and the share of skilled workers in maquiladoras improved only modestly. A long-run decline in aggregate domestic value added embodied in maquila exports is identified (from 27% in 1981 to 13% in 2006). Currency devaluations and major policy shifts both in 1982 and 1994 imposed new medium-term standards for the evolution of the domestic content in the years to come. During 1982–1993, the aggregate domestic content of exports was between 20% and 15%, whereas in 1994–2006 the aggregate trend was between 15% and 10%. The decline during the entire time-period appears largely accounted for by the falling domestic content in electronics manufacturing.

This paper is the first to study long-term trends in the domestic content of Mexico's maquila exports. So far, most analysis of domestic content and technology upgrading within maquiladoras are limited to case studies. We provide a macro perspective to these case studies. A clear limitation in this approach is that we are unable to causally link industrial policy to the domestic content of exports. Typically, detailed micro studies are better able to isolate effects of particular policies. However, our findings show the overall picture, which suggests that even if some micro studies may find that industry-specific policies have been successful (Jordaan 2011), in the aggregate, upgrading is not visible as productivity levels and the use of skilled workers in maquila industries hardly improved. Also, we do not find a systematic tendency of increased domestic sourcing of inputs.

Although our analysis is for Mexico's maquiladoras, we believe the analysis presented here has wider appeal. Many other Central-American countries, but also developing Asian and African countries, have export processing firms and low domestic content (Koopman, Wang, and Wei 2014). Which nations and firms have successfully upgraded in global value chains and why? Future research may seek to extent this type of long-term analysis of industrial upgrading to other developing countries and get a tighter grip on policies that lead to technological upgrading.

Notes

1. Most imports are from the United States, and over 99.7% of sales are in the United States (Utar and Torres Ruiz 2013).
2. See also Johnson and Noguera (2012) who separate the value-added content of Mexico's maquila and non-maquila exports for the year 2004.
3. At the same time, as a result of Mexico's increasing outward orientation, other export-promoting programs for non-maquila firms were implemented. In 1985, the 'Programas de Importación Temporal para Producir Articulos de Exportación' (PITEX) came into effect with the intention of permitting firms in the domestic manufacturing of Mexico to import intermediate inputs and machinery free of duty as long as 30% of their total sales were exported. The difference between the firms under PITEX and the maquiladora program lies in the fact that the industries under the latter program were exempted to a bigger amount of taxes. Similarly, unlike maquiladoras, PITEX firms were mainly located in the interior of Mexico as most of their production was destined for domestic consumption (de la Cruz et al. 2011).
4. As of 2001, only North American inputs were exempted from tariffs. This scenario implied that, by 2001, maquila firms had to pay import duties on the non-NAFTA components upon entering to Mexico. In order not to lose competitiveness, policy-makers implemented a new program called 'Sectoral Programmes' (PROSECs) that provided tax exemption to the import of a specific percentage of inputs not produced in North America across selected industries.

5. Our analysis starts in 1981 as we were unable to obtain industry-level data further back. The maquiladora program started in the 1960s, but it boomed during the increasing outward orientation of Mexico during the late 1980s (Feenstra and Hanson 1996). Hence, the time period analyzed in this paper covers the most relevant period in the history of the maquiladora program.
6. The sector 'business services' includes activities such as professional services, leisure services and other services (INEGI, 2010a).
7. Before 1995, maquila firms paid little (or any) income and asset taxes because they were not operating as profit centers, and often leased machinery and equipment (Rice 1998). After 1995, as a result of the boom in production triggered by NAFTA, the Mexican government no longer regarded maquila firms as cost centers but as profit centers. Thus, in the following years, maquiladoras were required to report arm's-length profits or to meet a safe harbor for tax purposes (PWC, 2013). In general, the main implication behind this policy shift was that maquilas were now supposed to pay income taxes on the basis of their profits just like any other manufacturing firm in Mexico (Gambrill 2002).
8. Note this implies the VS measure as proposed by Hummels et al. (2001) that includes pure double-counted terms.
9. The circumflex indicates a diagonal matrix, in this case with the vector **x** on the main diagonal.
10. See INEGI (2010b) for a discussion why Mexico did not publish any input–output tables between 1987 and 2008.
11. The Generalized RAS procedure (Junius and Oosterhaven 2003) is generally used to update or regionalize a given matrix. The underlying idea behind the (G)RAS procedure is to iteratively adjust an old matrix **A**, with the row sums w_0 and column sums $\boldsymbol{v}_0$, to a 'new' matrix (**X**) that satisfies the given set of rows sums $\boldsymbol{w}$ and column sums $\boldsymbol{v}$. An important assumption from the (G)RAS method is that every row and every column from a matrix to be balanced has at least one positive element (Temurshoev, Bouwmeester, and Miller 2013). With minimum loss of information, the (G)RAS-procedure will produce the new (target) matrix (**X**) with the required row and column sums. The main advantage of this (G)RAS-procedure is that, unlike the original RAS procedure (Stone 1961; Stone and Brown 1962), it allows for the existence of positive and negative values.
12. Our approach, however, is not uncommon in the literature. See e.g. Johnson and Noguera (2014) who estimate global input–output tables for four decades based on a limited set of benchmark tables. See Temurshoev, Webb, and Yamano (2011) for an assessment of the reliability of projections.
13. Our two different benchmarks years triggered different DCE results for the service sector from 1981 to 1984. These different results are the main source behind the initial differences in the aggregate trend between the 1980 and 2003 benchmarks. Particularly, using the 1980 benchmark, we obtain negative DCE in the service sector in 1981. This negative result explains the smaller DCE aggregate trend in 1981 when compared to respective result for that same year using the 2003 benchmark. After 1982, the DCE in services becomes positive but still smaller than the results triggered by the 2003 benchmark. From1985 onwards, the results for DCE in services are rather similar between the two benchmarks. The rest of the manufacturing sectors show no major difference from 1981 to 1993 as a result of using either benchmark year.
14. de la Cruz et al. (2011, 2013) find similar differences across sectors.
15. Other effects may arise as a result of currency devaluations. For example, credit constraints or increased uncertainty may affect domestic sources, and changes in industry composition of exports may also affect these outcomes. If industries with lower domestic value-added content expand, the overall effect is a decrease in domestic content of aggregate maquila exports.

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