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Vietnam's ascendancy in the electronics trade and the role of inward Foreign Direct Investment

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Abstract

A new regression-based Revealed Comparative Advantage index is used to analyze Vietnam's exports. Vietnam now has the highest comparative advantage in electronics in the world. It suggests that Vietnam may be a new follower in the "flying geese" style and reinforces the Kojima (2000) view that sufficient inward FDI can change comparative advantage. With detailed FDI and local data, we estimate that this change was brought about by a massive surge of inward FDI amounting to 6% of GDP. Lastly, we opine that while the comparative advantage in footwear may decline, that in electronics may be here to stay.

Keywords: comparative advantage, exports, inward FDI, revealed comparative advantage, Vietnam

I. Introduction

For more than two decades, Vietnam has integrated deeply and widely into the global economy. After acquiring membership in the Association of Southeast Asian Nations (ASEAN) in 1995 and the World Trade Organization (WTO) in 2005, Vietnam signed numerous bilateral and multilateral commitments with various partners including the mega-trade agreement CP-TPP of 11 countries. This trade liberalization process has brought a significant increase in the

contribution of exports to Vietnam's Gross Domestic Product (GDP). By 2019, merchandise exports were as large as Vietnam's entire GDP (Source: World Bank).

While a large share of this trade is processing exports, with imported inputs coming from China and elsewhere, the export growth is real and is raising the incomes and reducing poverty in record levels. Since 2005, in which we start our sample, GDP per capita has risen 295% in nominal terms to $2,715 in 2019 (Source: World Bank). Poverty has fallen from nearly 21% in 2010 to just under 7% in 2018. (Source: World Bank. 'Headcount poverty headcount ratio at national poverty lines'.) While domestic industries and innate comparative advantage contributes to these exports, a large and perhaps growing share is due to huge investments into Vietnam by foreign multinationals, who are using Vietnam as an export-platform to high-income markets.[1] Most notably, massive investment in the footwear industry by Nike (in 1995) and later by Adidas (in 2010) contributed to an upsurge in exports from Vietnam in that sector. More recently, South Korean giants LG and Samsung have poured billions of dollars into production and, importantly, research & development facilities, in the electronics sector in Vietnam. This, in turn, has resulted in huge increases in the exports of electronics from Vietnam to the world (see Figure 1 below.) Electronics exports are more than one-third of all Vietnamese exports and that share is rising.

[1] This effect will be more pronounced if the low-cost host country is a member of an FTA with access to another large, high-cost market, while the FDI host country is a non-member. Despite the US's withdrawal from the TPP pact, this was, no doubt, one large factor in LG and Samsung's calculations. Korea is not a member of TPP. Vietnam is. For a theoretical model of export platform FDI of this type, see Ekholm, Forslid and Markusen (2003).

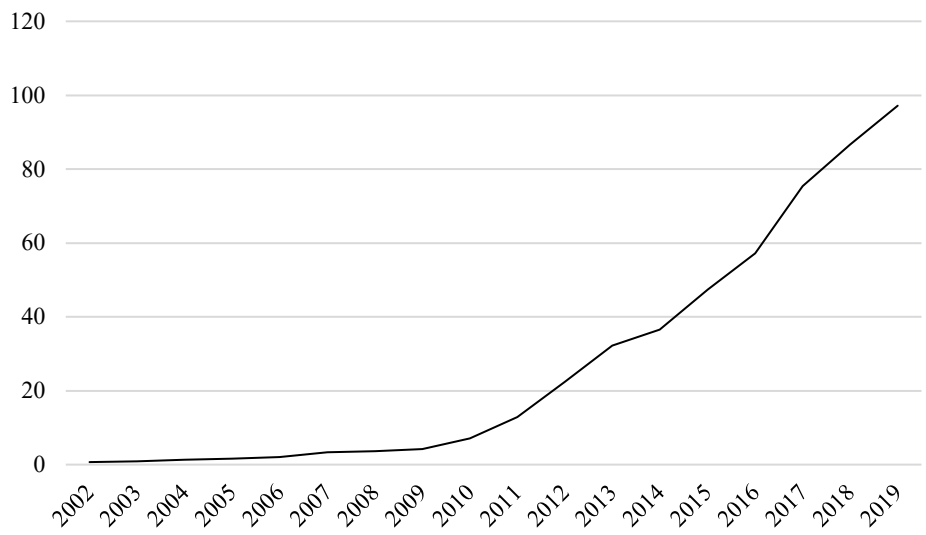

Figure 1. Vietnam's Exports of Electronics, HS 85 (Billions of US$).

Source: UN COMTRADE.

While it is clear from a quick glance at the trade data and the popular press that multinationals played a large role in these newfound exports, many questions remain.[2] **One question** is whether or not Vietnam's electronics industry is *truly* taking off relative to neighbors in Asia and the world, more generally. To answer this, we create original, econometrically-estimated measures of revealed comparative advantage (RCA) for a wide range of industries in Vietnam and 24 other countries in ASEAN and the world over the past 14 years (2005-2018). We confirm both Vietnam's ascendancy in electronics, but also the decline in comparative advantage in this sector elsewhere in Asia. Indeed, we find that Vietnam has the highest RCA in electronics in the world.

The second is a two-part question. Is this new world leader status primarily driven by only two firms, LG and Samsung? And if so, just how *much* new, greenfield investment has it

[2] "Tech firms flock to Vietnam," *Wall Street Journal* by James Hookway Sept. 27th, 2013 online at https://www.wsj.com/articles/no-headline-available-1380253320; last accessed September 2020.

taken for Vietnam to become a world leader (economic size-adjusted) in electronics? Using unique local-level government data together with other detailed FDI data, we arrive at our answer. The answer to the first part of the question is 'yes' and the answer to second part is '6% of GDP'. That is to say, the new greenfield investment, mostly by LG and Samsung, over the period of a few years was equivalent to approximately 6% of Vietnam's GDP. Almost entirely due to this investment, Vietnam has transformed from a country with no comparative advantage in electronics, to the having the highest comparative advantage in the world.

A third question is whether or not the electronics Foreign Direct Investment (FDI) (by LG and Samsung, but also to a lesser degree from Japan, Malaysia, the US and Taiwan) will continue in the near future, or whether such a surge in inward FDI is of a more 'footloose' nature.[3] The history of Nike and other footwear firms is a pattern of constant movement of production from one low-wage country to the next, as wages rise in the host nation (Japan, then to Korea, then to China, etc.). Secondly, and perhaps more importantly, Nike does not typically invest in *fixed assets* in the host country, but rather subcontracts to local or other multinational firms.[4] Thus, though it may be too early to tell, we may reasonably predict that while Vietnam is now a powerhouse in footwear exporting, it may not last. However, in contrast, there is massive investment in physical assets by LG, Samsung and others in Vietnam, and some of these assets

[3] Note: The top 10 countries investing in electronics in Vietnam during 2003-2017 were: South Korea, Japan, Malaysia, United States, Taiwan, Singapore, Thailand, United Kingdom, China and France. (Source: www.unctad.org)

[4] See chapter 4 in Otsubo (2016).

are even engaged in R&D activity.[5] As such, the comparative advantage in electronics may be sustained in the foreseeable future.

The answers to the above questions yield important lessons for other countries who may be eager to move up the development ladder via greater inflows in hi-tech FDI.

II. Literature review

Revealed Comparative Advantage

Ricardo demonstrated in 1817 that a country has a comparative advantage in a product if its *relative* production cost is lower than that of other countries.[6] The country will then specialize and export this product and import the other(s). Theoretically, the pre-trade relative price (or cost) of products is the determinant of comparative advantage. Thus, if we can observe autarky prices, we can determine comparative advantage. In reality, autarky prices are unobservable. Hence, economists have developed a proxy of comparative advantage by using *ex-post* observed trade data. Balassa (1965) introduced the so-called 'revealed comparative advantage index', or later simply called the Balassa Index (BI). It is well-known and often used as a descriptive statistic in international trade.[7]

Simply put, the Balassa Index is the ratio of two ratios. In Japan's RCA in automobiles, for example, the numerator would be the share of auto exports by Japan of all Japanese exports.

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[5] See the November 30, 2017 article by Atsushi Tomiyama in the Nikkei Asian Review "Samsung readies Vietnam R&D center for appliances." Accessed on August 17, 2020 here: https://asia.nikkei.com/Business/Electronics/Samsung-readies-Vietnam-R-D-center-for-appliances

[6] Haberler (1930) was the first to re-frame Ricardo's Comparative Advantage into that of a question of lower opportunity costs. See Bernhofen's (2005) explanation.

[7] While Balassa made this measure well-known, it was preceded by a similar method by Liesner (1958).

The denominator would be auto exports by *all* countries as a share of total world exports (i.e. all goods by all countries). As a rough representation of reality, let us say autos are 20% of Japanese exports and world auto exports are 10% of all goods exported globally. In this case, the Japanese auto RCA would be 2. Anything greater than one is suggestive that Japan has a *revealed* comparative advantage in that good, as compared to other nations.

While easy to calculate from trade data, there are serious weaknesses with the Balassa Index. These are many and well-known. For example, the Balassa Index has a non-symmetric and non-normal distribution. While the mean is generally around 1, it can be as low as, say, 0.2, or as high as 15. The mean for any given country-product (say Japan's autos) is very unstable and can vary quite a bit from year to year. (See Hinloopen and van Marrewijk, 2001.) The many flaws of the BI and its variations have been known for some time, indeed, since its inception. To deal with the problems of the Balassa Index, a number of solutions have been proposed (again, refer to Hinloopen and van Marrewijk, 2001). These methods, however, solved only some of the statistical problems, and usually in an *ad hoc* fashion.

There is also still the fundamental problem that the *ex-ante* nature of Ricardian comparative advantage is not captured in these indices that used *ex-post*, observed trade flows. Since all the previous studies on Vietnam used the Balassa Index or some variation, they suffer from the same shortcomings. (See Le (2010); Phan and Jeong (2012); Huynh and Nguyen (2017) *inter alia*).

Recent Empirical Advances

As such, this paper will use the recent method developed by Costinot, Donaldson and Konmujer (2012) and adapted by Leromaine and Orefice (2013) who used econometric regressions to isolate the exporter-product specific factors from the importer-product and country-pair specific

factors. Hence, the new RCA strips away confounding effects, and, in theory, leaves us with the relative productivities for each country-product pair which better capture the true nature of the Ricardian idea.

As briefly mentioned above, the new RCA has much better statistical characteristics (normal, symmetric distribution; mean of almost exactly one; much smaller variance) and superior ordinal ranking properties when compared to the Balassa Index (Leromain and Orefice, 2013). Another strength of the Costinot et al. measures is that they are derived from an underlying trade model. It can be derived from an Eaton and Kortum (2002) trade model, but also other standard models. Throughout this paper, the terms 'RCA' and 'new RCA' will refer to the RCA index developed by Costinot et al. (2012) and the original estimates of those RCAs by the authors and not the Balassa Index measures.

Whereas Costinot et al. (2012) and Leromain et al. (2013) mainly focused on G20 countries, in this paper, Vietnam is studied as the primary object in a comparison to either leading exporters at the global level or similar economies in ASEAN. Hence, not only the G20 group, but also the emerging ASEAN countries are included. The final sample includes 25 exporters: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Italy, Japan, Republic of Korea, Mexico, Russia Federation, South Africa, Turkey, UK, US, Saudi Arabia, Spain, Netherlands, Thailand, Indonesia, Malaysia, the Philippines and Vietnam. These exports are regressed on 95 commodities to 70 destination countries.[8]

[8] To construct these new RCA for a single country-product, one needs to run regressions (see below) not only on the trade flows of the country in question (Vietnam), but for all other countries and products as well. Ideally, one would use 180 or so exporters rather than just the 25 used here and elsewhere. However, even with 25 exporters, this pushes STATA's software capacity the maximum.

Our dataset consists of trade flows of commodities at the 2-digit level and uses the Harmonized System 2002 Classification (HS). The annual export values are from 2005 to 2018 and are taken from the United Nations Commodity Trade Database (COMTRADE). The category of industries corresponding to 2-digit codes are described in Table 1 based on the HS 2002 Classification by Section.

Table 1. Industry Description

Industry	Section in HS 2002	Description	HS-2 code
Animal Product	I	Live animals; Animal products	01-05
Vegetable Product	II, III	Vegetable products; Animal or vegetable fats, oil and waxes	06-15
Foodstuffs	IV	Prepared foodstuffs; Beverages and tobacco	16-24
Minerals	V	Salt; Sulphur; Earths and stone; Plastering materials, lime and cement; Ores, slag and ash; Mineral fuels, mineral oils	25-27
Chemicals	VI	Chemicals and allied industries	28-38
Plastics	VII	Plastics and Rubbers	39-40
Leather	VIII	Raw Hides; Skins; Leather and Furs	41-43
Wood	IX, X	Wood and products of cork, straw and wood; Paper and paperboard	44-49
Textiles	XI	Textiles and textile articles	50-63
Footwear/Headgear	XII	Footwear; Headgear; Umbrellas; Prepared feathers	64-67
Stone/Glass	XIII, XIV	Articles of stone, plaster, cement, asbestos, mica, ceramic, glass, pearls, precious metals	68-71
Metals	XV	Base metals and articles of base metal	72-83
Machinery	XVI	Nuclear reactors, boilers, machinery and mechanical appliances	84
Electrical	XVI	Electrical machinery and equipment; Television image, sound recorders and reproducers	85
Transportation	XVII	Vehicles, aircraft, vessels and associated transport equipment	86-89
Misc. Mfg.	XVIII, XIX, XX	Optical equipment; Arms and ammunition; Miscellaneous manufactured articles	90-96

III. Methodology

A New Econometric-based Measurement of RCA

In implementing the Costinot et al. (2012) method, trade flows will be a good representation of exporter-product technology advantages if the country-pair specific and importer-product specific factors are controlled for. To control for this, Costinot et al. (2012) derived an econometric-based index from a world (m-countries producing and exporting n-goods) trade model assuming a single factor of production (labor). Ultimately, they can express trade flows between exporter *i* to importer *j* in commodity *k* by the following:

$$ln(x_{ijk}) = \delta_{ij} + \delta_{jk} + \theta ln\,(z_{ik}) + \varepsilon_{ijk} \qquad (1)$$

in which x_{ijk} is the bilateral trade value from exporter *i* to importer *j* in commodity *k*, wherein δ_{ij} is the country-pair fixed effect and δ_{jk} is the importer-product fixed effect. The term expressing the technological differences, $\theta ln\,(z_{ik})$, is assumed to be an exporter-product specific δ_{ik}

$$\delta_{ik} \approx \theta ln\,(z_{ik}) \qquad (2)$$

The technological differences depend on two parameters. Firstly, the fundamental productivity z_{ik} of exporter *i* in commodity *k* is *ex ante* unknown and interpreted as the technological coefficient of the Ricardo model. Hence, the Ricardian spirit is retained, and cross-country factors affecting the trade pattern such as climate, institutions, infrastructure and factor endowments are, in principle, captured. Secondly, the dispersion of productivity variable θ represents the intra-industry productivity heterogeneity across varieties with an industry. The value of this parameter has been estimated through econometric methods in Costinot et al. (2012)

to be θ=6.53 using firm-level data in manufacturing. Other authors have found this parameter to generally be in this range. For our work, we follow Costinot et al. (2012) and assume θ is a constant value of 6.53 across all industries. While this is a big assumption, it is, alas, unavoidable. Having said that, assuming the theta was a bit higher or lower would not change our conclusions and the relative nature and ranking of our derived RCAs.

The procedure to generate the RCAs is as follows:

Step 1: Estimate the exporter-product effect δ_{ik} by estimating equation (3)

$$ln(x_{ijk}) = \delta_{ij} + \delta_{jk} + \delta_{ik} + \varepsilon_{ijk} \quad (3)$$

Step 2: Calculate the fundamental productivity based on δ_{ik} and θ, in which θ = 6.53

$$z_{ik} = e^{\delta_{ik}/\theta} \quad (4)$$

Step 3: Compute the RCA by a weighted index of the average of z_{ik} coefficients across all *m* exporting countries and *n* commodities (*m* = 25 and *n* = 95 in this paper)

$$RCA_{ik} = \frac{z_{ik}z_{mn}}{z_{in}z_{mk}} \quad (5)$$

in which, z_{mn} is the average of all z_{ik} across all commodities and countries, z_{in} is the average of z_{ik} for the exporter *i* across all commodities and z_{mk} is the average of z_{ik} for the commodity k across all exporting countries. Equation (5) can be reformulated as: $RCA_{ik} = \frac{z_{ik}/z_{in}}{z_{mk}/z_{mn}}$ where the numerator indicates the ratio of productivity of country *i* for commodity *k* divided by the average of that for all commodities. The denominator denotes the ratio of average productivity in all countries for commodity *k* compared to the average of those for all commodities. If the numerator is greater than the denominator, production in commodity *k* in country *i* is relatively

more efficient than production in commodity k in the other countries. Therefore, if RCA_{ik} takes a value of greater than 1, country i has a comparative advantage in commodity k. On the other hand, country i has a comparative disadvantage in commodity k when RCA_{ik} is less than 1.

The interpretation that an RCA of 'greater than unity implies comparative advantage' is also made in the original 1965 Balassa Index (BI). However, it is important to remember that the interpretation in this new measure is based on a comparison of productivities across products and countries 'stripped', if you will, of the confounding factors. In Balassa, the decision to say that 'greater than unity implies comparative advantage', while reasonable, is entirely arbitrary. With the BI, it is rare, but not unheard of, to have a net *importer* of a product have a BI of greater than unity! (See Bowen, Hollander and Viaene, 2012.) As we will see in the next section, these econometrically-derived RCAs have very reasonable values (no outliers) and are very consistent across countries and over time.

IV. Results

Here, we present our new estimates of RCAs.

Regression-based RCAs for Vietnam

The values of RCA for all 25 countries in 2018 are reported in Table 2. The most interesting finding, which has not been reported in previous studies, is that Vietnam has the highest comparative advantage in the electrical industry at the global level in 2018 (as has maintained that for some time). In the past, this top position in the industry belonged to Japan and Korea.[9]

[9] Reminder: when we say 'top position', we, of course, mean this in the comparative advantage sense, not an absolute sense. Total electronics exports from China, for example, are still far greater than that of Vietnam`s.

Table 2. RCA Index for 25 countries at the industry level in 2018

Industry	Animal Product	Vegetable Product	Foodstuffs	Minerals	Chemicals	Plastics	Leather	Wood	Textiles	Footwear/ Headgear	Stone/ Glass	Metals	Machinery	Electrical	Transport	Misc. Manuf.
ARG	1.31	1.23	1.19	0.97	0.86	0.60	1.30	0.90	0.95	0.83	0.71	0.74	0.64	0.51	0.85	0.72
AUS	1.25	1.09	0.94	1.11	0.97	0.81	1.09	0.88	1.01	0.95	0.96	1.00	0.92	0.93	1.02	0.97
BRA	1.09	1.10	1.16	1.23	0.93	1.00	1.23	1.09	0.91	0.88	1.09	0.94	1.02	0.85	0.88	0.81
CAN	1.13	1.02	0.95	0.99	0.97	0.93	1.08	1.15	0.90	1.04	0.94	0.98	1.04	0.98	1.11	1.06
CHN	0.74	0.79	0.79	0.75	0.95	1.04	1.14	1.16	1.56	1.72	1.26	0.99	1.00	1.12	1.00	1.20
FRA	1.00	0.94	1.05	0.91	1.08	1.00	1.13	1.10	1.17	1.07	1.11	0.94	0.95	0.99	1.19	1.07
DEU	0.90	0.84	0.98	0.73	1.09	1.02	1.01	1.12	1.14	1.06	1.14	1.03	1.01	1.00	1.10	1.09
IND	0.69	1.11	0.83	0.92	1.00	1.06	1.17	1.07	1.53	1.02	1.28	0.97	0.90	0.93	0.88	0.90
IDN	0.79	1.05	1.09	0.80	0.87	1.18	0.94	1.27	1.24	1.42	1.04	0.90	0.84	0.98	0.80	1.13
ITA	0.82	0.90	1.00	0.76	0.96	0.97	1.41	1.09	1.40	1.23	1.27	0.95	1.02	0.92	1.01	1.12
JPN	0.76	0.72	0.78	0.83	1.08	1.27	0.71	0.98	1.21	0.93	1.22	1.09	1.26	1.17	1.13	1.18
MYS	0.68	0.85	0.97	0.88	0.99	1.29	0.91	1.03	1.04	0.99	1.06	1.11	1.06	1.24	0.90	1.10
MEX	0.98	1.04	1.05	1.03	0.96	0.95	1.06	0.84	0.96	0.85	0.99	1.06	1.02	1.07	1.03	0.86
NLD	1.07	0.99	1.12	0.85	1.07	0.95	0.92	0.98	0.98	1.02	0.88	0.93	0.97	0.98	0.93	0.97
PHL	0.84	1.07	1.21	0.73	0.97	0.99	1.06	1.20	1.17	1.23	0.99	0.88	1.06	1.15	0.89	1.16
KOR	0.59	0.65	0.82	0.79	1.06	1.38	0.93	0.86	1.36	1.05	1.08	1.14	1.17	1.27	1.13	1.12
RUS	0.88	1.02	0.94	1.50	1.01	1.09	0.94	1.20	0.83	0.74	1.03	1.00	0.91	0.91	1.17	0.88
SAU	0.89	0.85	0.89	1.04	1.11	1.26	0.97	1.22	1.15	1.00	1.11	1.08	0.84	0.72	1.12	0.95
ZAF	0.79	1.05	0.91	1.26	0.98	0.86	1.12	1.11	0.91	0.98	0.95	1.07	0.92	0.84	1.11	0.88
ESP	1.00	0.99	1.01	0.83	1.01	0.99	1.11	1.14	1.19	1.07	1.19	0.93	0.90	0.92	0.98	1.03
THA	0.78	0.99	1.17	0.64	0.90	1.39	1.07	0.96	1.28	1.16	1.35	0.93	1.19	1.17	0.98	1.04
TUR	0.76	0.92	0.99	0.97	0.88	1.06	1.17	0.91	1.51	0.96	1.29	0.94	0.91	0.91	0.91	0.98
GBR	0.92	0.81	0.98	0.82	1.06	0.97	1.05	1.10	1.25	1.12	1.15	1.03	1.01	0.97	1.13	1.10
USA	0.94	0.94	0.91	0.92	1.05	0.99	0.96	1.17	1.04	0.99	1.09	0.97	0.96	0.99	1.20	1.13

See table in Appendix 1 for list of country abbreviations.

Additionally, annual RCA values of Vietnam from 2005 to 2018 are provided at the industry level in Table 3. First, we can see that Footwear and Headgear is also a leading Vietnamese industry. Next, we see that several of Vietnam's low-technology industries have a slight comparative advantage, such as Textiles, Wood and Vegetable Products. Sectors with an even weaker comparative advantage are, for example, Plastics and Leather. On the other hand,

Vietnam has a clear comparative disadvantage in Chemicals and Transport. The turning point upwards for electronics seems to be in 2011. Also, there have been improvements in Metal and Machinery industries where the comparative advantage is approaching the tipping point of an RCA of 1. In contrast, Mining, Animal and Vegetable products gradually seem to be losing their advantage.

Table 3. RCA index for Vietnam at the industry level during 2005-2018

Industry	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Animal Product	1.08	1.07	0.98	1.05	1.08	0.96	1.02	1.01	0.94	0.98	0.97	0.89	0.97	0.92
Vegetable Product	1.31	1.2	1.16	1.19	1.15	1.1	1.13	1.09	1.09	1.06	1.12	1.00	1.10	1.09
Foodstuffs	0.98	1.01	1.03	0.98	1.02	0.95	0.99	0.98	0.96	0.99	0.99	0.93	1.03	1.03
Minerals	1.02	0.99	0.95	0.96	0.83	0.83	0.93	0.97	0.83	0.89	0.83	0.69	0.86	0.77
Chemicals	0.82	0.82	0.77	0.82	0.8	0.73	0.81	0.88	0.77	0.81	0.84	0.87	0.94	0.81
Plastics	1.07	1.14	1.08	1.01	1.05	0.98	1.04	1.07	1	1.04	1.11	1.07	1.13	1.14
Leather	1.1	1.02	1.04	1.13	1.18	1.07	1.07	1.09	1.09	1.1	1.17	1.03	1.18	1.26
Wood	1.17	1.13	0.93	1.05	1.07	1.03	1.06	1.14	0.99	1.1	1.28	1.03	1.09	1.11
Textiles	1.2	1.18	1.17	1.13	1.2	1.06	1.13	1.15	1.1	1.15	1.21	1.11	1.18	1.43
Footwear/ Headgear	1.5	1.57	1.42	1.4	1.43	1.36	1.37	1.4	1.35	1.45	1.51	1.38	1.41	1.59
Stone/ Glass	1.04	1.02	0.99	0.97	1.01	0.91	0.95	1	0.93	1.01	1.05	0.97	1.04	1.12
Metals	0.91	0.89	0.86	0.89	0.91	0.85	0.95	1.01	0.91	0.96	0.99	0.89	0.94	0.93
Machinery	0.74	0.79	0.79	0.76	0.83	0.75	0.85	0.98	0.91	0.97	1.01	0.93	1.01	0.97
Electrical	0.85	0.93	0.91	0.82	0.93	0.89	1.06	1.26	1.17	1.33	1.45	1.37	1.43	1.37
Transport	0.85	0.81	0.83	0.77	0.8	0.8	0.83	0.88	0.76	0.82	0.82	0.76	0.84	0.82
Misc. Manuf.	1.03	1.04	1.01	0.97	1.05	0.95	1.04	1.09	1.02	1.07	1.11	1.04	1.12	1.14

This rapid increase in Vietnam's electronics industry appears to be another example of the so-called 'flying geese' model, widely known in East Asia and first put forth by Akamatsu in 1935 and 1937 and the translated into English in 1961 and 1962. Kojima (2000) expanded on this theme and posited that an industrial transfer starts, often through FDI, from a country like Japan as the leader in Asia to 'follower' geese including NIEs - Newly industrializing economies (South Korea, Taiwan, Singapore and Hong Kong), ASEAN4 (Malaysia, Indonesia, Thailand, Philippines) and China. Kojima (2000) also predicted that the flying geese would spread further to the new ASEAN members (Vietnam, Cambodia, Laos, and Myanmar), India, Pakistan and

even North Korea. Hence, consistent with this prediction, Vietnam appears to be a new leader in the electrical industry.[10]

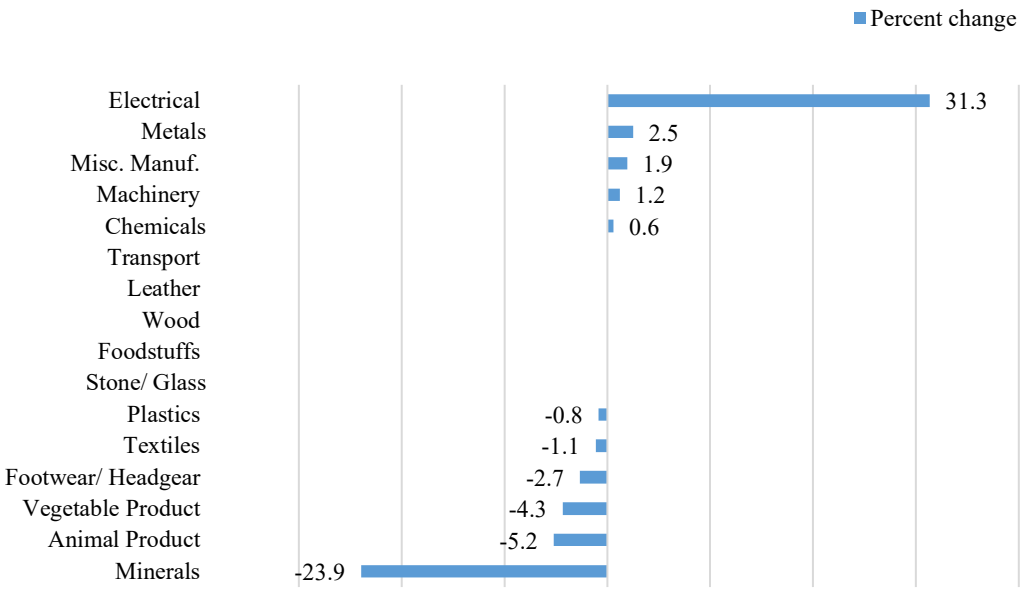

Figure 2. Changes in Vietnam's export share, 2005 - 2018

Source: Own calculation using data from UN COMTRADE

Vietnam's structural transformation can perhaps better be seen in Figure 2 above. Here, we see the dramatic increase in the growth of exports as a share of total exports in electronics and in some other sectors to a far lesser extent. We can also see which export sectors are shrinking, mineral exports being the most notable.

[10] Two of several empirical observations of the flying geese pattern are described below. A structural upgrading of textiles and related industries across Korea-Thailand-Malaysia-Indonesia from 1960 to 1990 was observed by Kosai and Tran (1994). Another example in machinery trade from 1975-1992 between Japan and other Asian countries (NIEs, ASEAN4 and China) was observed by Shinohara (1996).

In Table 4, we show the ranking of our RCA measures for select commodities and compared to most of the world (our selection of countries covers over 90% of world exports.) We see that 'Footwear' and 'Fish', and quite a few other sectors are at the top, but now Vietnam's RCA in electronics is also number one as well.

Table 4. Top 20 products in Vietnam and its global ranking in 2018

HS Code	Product Description	RCA	Global Ranking
50	Silk	2.41	7
46	Manufactures of straw, of esparto or of other plaiting materials	2.18	1
64	Footwear, gaiters and the like; parts of such articles	2.15	1
9	Coffee, tea and spices	1.90	1
62	Articles of apparel and clothing accessories, not knitted or crocheted	1.84	1
3	Fish, crustaceans and other aquatic invertebrates	1.72	1
42	Articles of leather; saddlery and harness	1.72	1
61	Articles of apparel and clothing accessories, knitted or crocheted	1.68	1
16	Preparations of meat, of fish or of crustaceans	1.53	3
65	Headgear and parts thereof	1.52	1
55	Man-made staple fibers	1.47	6
63	Other made up textile articles; sets; worn clothing and worn textile article ...	1.44	3
60	Knitted or crocheted fabrics	1.42	4
94	Furniture; bedding, mattresses, cushions and similar stuffed furnishing	1.41	1
54	Man-made filaments	1.40	7
66	Umbrellas, sun umbrellas, walking sticks, seat sticks, whips, riding-crops	1.38	3
8	Edible fruit and nuts; peel of citrus fruit or melons	1.38	3
85	Electrical machinery and equipment and parts thereof; sound recorders, etc.	1.37	1
58	Special woven fabrics; tufted textile fabrics; lace, tapestries; trimmings; ...	1.34	7
67	Prepared feathers and down and articles made of feathers or of down	1.31	4

Vietnam Breaking Away from the ASEAN pack

Next, we contrast Vietnam's rising RCA in electronics to that of some of largest ASEAN neighbors in Figure 3. As our estimated RCAs have a fairly tight range, we started the vertical axis at 0.70 to highlight the differences. It is clear that Vietnam has taken off in electronics, while its neighbors have not.

According to data from UNCTAD, FDI flows into 2019 to Vietnam were $16 billion as compared to Indonesia's $20 billion and Thailand's $4 billion. However, while there is some electronics investment in these and other ASEAN countries, it is tiny as compared to Vietnam.

Most FDI into Indonesia is in 'renewable energy, mining, chemical, real estate, and metals'.[11] In Thailand, nearly half of the inward FDI is in manufacturing, some of which is in ICT sector.[12] However, inward FDI has fallen (it was $10 billion in 2018) and more generally has been quite erratic since the coup d'état and change in government in 2014.

Malaysia has long been involved in ICT supply chains. Intel made its first investment there in 1972 and had invested nearly $4 billion in Malaysia by 2010.[13] Overall, Malaysia has had a fairly steady inflow of $7-$9 billion a year, but real estate, finance and insurance are the main recipient sectors. Manufacturing accounts for about 17% and electronics manufacturing alone about 5%.[14] Firms such as Dell and ON Semiconductors also have a presence in Malaysia and Malaysia has seen an uptick in investment plans from the US in the wake of the US-China trade war.[15] Despite Covid-19 concerns and the global slowdown, which may put most of those plans on hold, Malaysia will likely continue to be a popular FDI host to wafer fabrication and other semiconductor-related industries in the foreseeable future.

The Philippines received about $4 billion a year in total FDI. There has been a downward trend since a peak of $10 billion in 2017. Nearly half of this is in manufacturing, but virtually none of it is in electronics production. (See Aldaba and Aldaba, 2010.) There is a thriving ICT sector in the Philippines, much of it financed by foreign firms, but this is mostly in 'call centers,

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[11] See a recent article by the Asian Development Bank at https://www.adb.org/news/op-ed/foreign-direct-investment-not-coming-indonesia-really-edimon-ginting .

[12] For more detailed data see the Bank of Thailand website as https://www.bot.or.th

[13] "Intel in Malaysia for the long haul" June 14, 2010 accessed Sept 17, 2020 at thestar.com.my

[14] For more detailed data see the Department of Statistics Malaysia website at https://www.dosm.gov.my/

[15] Das, Krishna "U.S. investment in Malaysia up sharply as trade row with China drags" on Sept 4, 2019, on Reuters.com; last accessed Sept 17, 2020.

computer processing, software development and multimedia content creation' (Dezan Shira and Associates, 2018)

Compare the above figures to the staggering fact (see section 4 below) that Samsung alone invested $17 billion in Vietnam in the last decade or so. In summary, it appears that Vietnam's position as a favoured recipient of electronics FDI in the ASEAN region is assured for the near future.

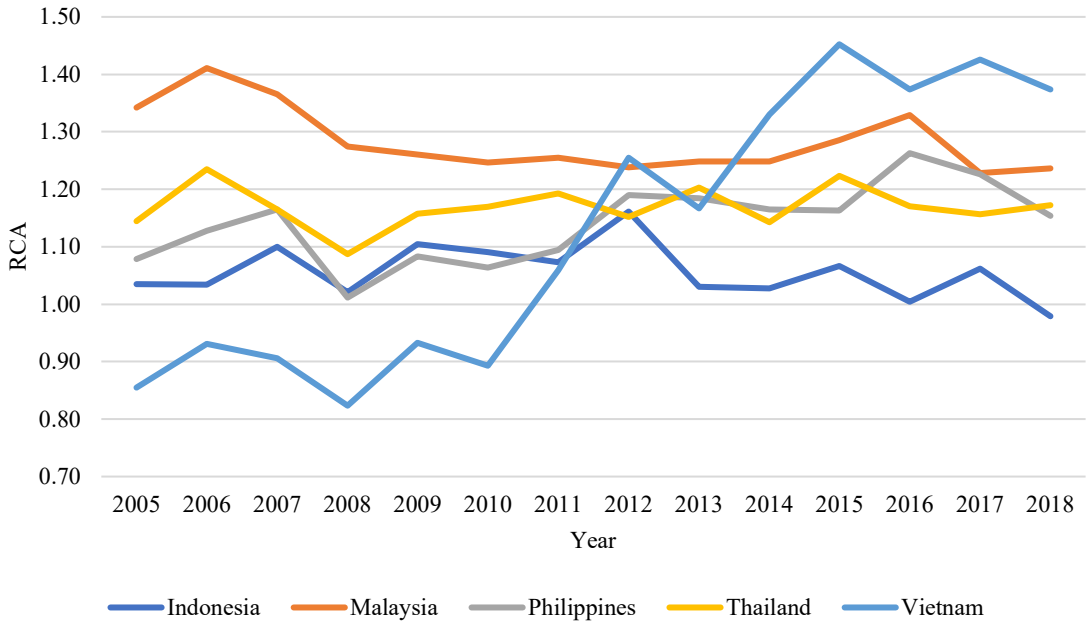

Figure 3. RCA in Electrical in 5 ASEAN countries

Electronics Comparative Advantage Slowly Moving out of Northeast Asia

In Figure 4, we show that Vietnam rise in its Electronics' RCA is paralleled with either a flat or declining RCA in the three traditional East Asian giants in electronics, namely Japan, Korea and China.

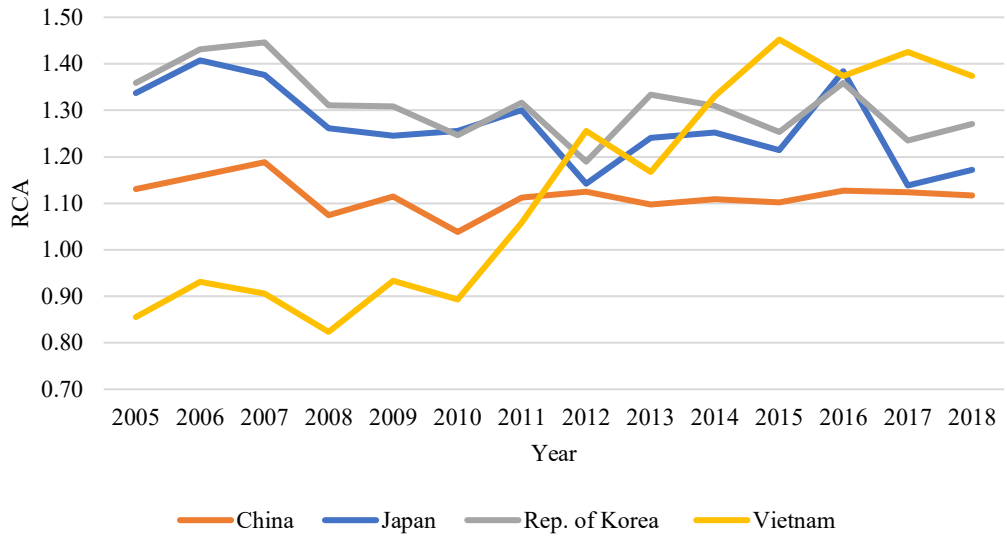

Figure 4. Electrical RCA in 4 selected countries

In the next section, we identify why and confirm from exactly where this new trajectory of exports of electronics is coming.

V. Discussion

Origins of New Electronics Exports: Evidence from Vietnamese Government Data

While it may be apparent that Vietnam's huge and sustained surge in electronics in exports is due to the relatively recent presence of inward FDI, one cannot confirm that by looking at trade data or firms' annual reports. That is to say, trade data alone cannot tell us whether all those new exports are being made by Samsung, or, though unlikely, some domestically-owned Vietnamese firm. Detailed data both on production by foreign and local firms is needed.

By assembling detailed data from the government of Vietnam, we have confirmed the overwhelming contributions made by foreign firms. Table 5 below has been constructed from data available (in Vietnamese, but also in English) in the "Customs Handbook on International

Merchandise Trade Statistics of Vietnam 2015".[16] The findings in Table 5 below were further confirmed by data at the provincial level. LG's operations are located mainly in the tiny province Bac Ninh, just northeast of Hanoi. Examining data from the statistics office of Bac Ninh province, we corroborated the fact that virtually all industrial electronics products were produced by 'FDI enterprises'.[17]

Specifically, we collected data on the main electronics groups in HS 85, namely: 'Computers, electrical products, spare-parts and components thereof; Telephones, mobile phones and part thereof; and Still image, video cameras and parts thereof'. The export values are presented in Table 5. The government data presents total exports out of Vietnam of these (and many other) products, but also breaks out the amount exported by 'FDI enterprises' alone.

Exports by FDI enterprises (mainly by Samsung and LG) range from **98% to 100%** of total exports. This confirms that FDI has nearly single-handedly transformed Vietnam from a country with no comparative advantage (recall Figure 2 where RCA in 2005 was 0.85 but jumped to 1.37 in 2018) in electronics, to one of the world's leading exporters (size-adjusted).

As nearly all of the production at plants such as those in Bac Ninh is destined for exports, it is clear that this is export-platform FDI, at least for the time-being. But how can we nest this phenomenon in the theories of comparative advantage and FDI?

Ricardo's original comparative advantage is viewed as coming from some natural advantage (perhaps climate and soils conducive to wine such as Portugal's) or some other

[16] The entire handbook, in pdf form, was found at www.customs.gov.vn

[17] This data was accessed in October 2018 at the Bacninh Statistics Department website http://bacninh.gov.vn/ in a book called "Niên giám thống kê Bắt Ninh 2015" (which means "Bacninh statistical yearbook 2015"). They have since taken that book offline, but it is available in hard copy in the Statistics Library of Vietnam in Hanoi.

technology (British textile mills in the 19th century.) It is clear here that the transformation is due to the importation of technology or 'know-how' by foreign FDI. At the same time, most of the production is assembly (rather than, say, design) and so we can also ascribe a Heckscher-Ohlin view that firms are locating in Vietnam to take advantage of cheaper and relatively abundant semi-skilled labour as wages for that same labor rise in China, Korea and elsewhere. Again, it remains to be seen whether this newfound comparative advantage will take root in Vietnam or, instead, be more footloose, as has traditionally been the case in global footwear production. As mentioned in the introduction, because giants like LG and Samsung are bringing in fixed assets and even building R&D facilities, our prediction is that it will be the former.

Table 5. Exports by three main commodity groups in HS85 products

1. Computers, electrical products, spare parts and components thereof				
	2014		***2015***	
	Total exports	FDI enterprises	Total exports	FDI enterprises
Value (Bil.US$)	11.43	11.3	15.61	15.32
Annual change (%)	7.9	8.4	36.3	35.49
Share in total exports (%)	100	98.9	100	98.13
2. Telephones, mobile phones and parts thereof				
	2014		***2015***	
	Total exports	FDI enterprises	Total exports	FDI enterprises
Value (Bil.US$)	23.6	23.5	30.166	30.09
Annual change (%)	11.1	11.4	27.8	28.03
Share in total exports (%)	100	99.6	100	99.75
3. Still image, video cameras and parts thereof				
	2014		***2015***	
	Total exports	FDI enterprises	Total exports	FDI enterprises
Value (Bil.US$)	2.22	2.178	3.025	3
Annual change (%)	36.8	36	36.3	38
Share in total exports (%)	100	98.1	100	99.36

Note: Total exports means the number of exports by all kinds of ownership including state, non-state and FDI enterprises.

Source: General Department of Vietnam Customs

As mentioned earlier, this phenomenon may be likened to that espoused by Kojima (2000) and Ekholm, Forslid and Markusen (2003). Vietnam's abundance of low-wage, yet

relatively educated labor is ideal for the assembly of electronics in Vietnam. Thus, Vietnam becomes (and China slowly ceases to be) an exporter to third countries as well as to the home country (here, Korea) through FDI and the know-how brought in by Samsung and LG. As transportation costs for intermediate inputs from the FDI source (home) country fall, this process is accelerated. This basic shift in the location of comparative advantage is also leveraged with Vietnam's stable rule of law, and the promise of improved access to the US, Canada and elsewhere through TPP.[18] This may be an example of what Kojima (2000) called 'Pro-trade oriented FDI' and which is independently modelled explicitly as 'export-platform FDI' in Ekholm *et al.* (2003).

The Nature and Magnitude of Foreign Direct Investment Inflows in Electronics

What magnitude of FDI inflows in electronics were necessary to bring about this dramatic rise in Vietnam's comparative advantage in little more than a decade? A generally positive relationship between the promotion of FDI in certain sectors and an increase in that sector's comparative advantage has been found in at least one recent study. (See Harding and Javorcik, 2011).[19] However, the nature and magnitude of such promotion efforts and incentives is unknown. More

[18] Both Vietnam and the US joined the broadened TPP discussions in 2008 (the US in January 2008). LG and Samsung made massive investments and Samsung its first mobile phone factory in Bac Ninh (Vietnam) in 2007. Of course, LG and Samsung had made earlier, smaller investments in Vietnam in 2003. These were likely influenced by the normalization of trade relationships between the US and Vietnam in December of 2001. Vietnamese exports to the US skyrocketed following this agreement. Much later, the US signed the TPP agreement in February 2016. Although the US withdrew from the TPP in January 2017, at the time, Samsung and others made these investments clearly expecting a stronger and growing relationship with the US.

[19] The Harding and Javorcik paper, published in 2011, naturally used the older, classic, Balassa Index for its measure of RCAs.

importantly, how *much* increased FDI was necessary to bring about such an increase is also unknown. Here, we have constructed a very precise estimate of exactly that in this paper with the judicious combination of several sources of FDI activity in Vietnam.

Over the period from 2003 to 2017, $311 billion of new (greenfield) FDI has come into Vietnam purportedly creating some 1.3 million jobs. This includes direct investment in manufacturing, but also construction, mining, etc. Of this figure, $136 billion worth of this investment was in 'Manufacturing Activity' alone. This is as opposed to 'Construction, Business Services, Infrastructure' and other forms of FDI activity. Over 937,000 persons were to be employed in these activities. Of this $136 billion, $27 billion was invested in 'ICT' manufacturing activity alone and approximately 237,000 persons were employed. This works out to over $100,000 of investment in the ICT manufacturing activities per worker employed in those plants. Of this $27 billion, $14.5 billion, or half, was from South Korean firms alone.[20] Of this, $14.5 billion, $13 billion came from Samsung and LG.[21] From other journalistic sources, these figures have been confirmed and updated.[22]

Vietnam's entire nominal GDP was $224 billion in 2017 (Source: World Bank). Thus, the cumulative investment by Samsung and LG in new manufacturing plants in ICT alone was nearly *6% of GDP*. In summary, investments by only two firms, in little over a decade, amounted to 6% of the nation's entire GDP and increased Vietnam's RCA in electronics from 0.85 to

[20] From Tractus (2019).

[21] This data in this paragraph is taken from Parsons, Doytch and Feliciano (2020).

[22] 'Samsung invested about $17 billion in Vietnam, making it the country's largest overseas investor.' (Waring (March 2, 2020). This implies that another $4 billion has flowed in from Samsung in the last three years. Rumors that Samsung would move smartphone production out of Vietnam and into India have, thus far, been not been borne out. See Waring, "Samsung stands by Vietnam factories" Aug 19, 2020.

1.37.[23] Recall that this is new FDI stock and GDP is an annual flow. Presumably, the returns and sustained production and exports from these new investments will continue for many years to come.

How much is the LG and Samsung investment as a share of Vietnam's pre-existing stock of capital? Estimates of Vietnam's total capital stock in 2017 was approximately $1.7 trillion (in constant 2011 US dollars).[24] As such, *nearly 20%* of all existing capital stock in Vietnam came from new inward FDI since 2003. Recent investments by Samsung and LG have added roughly 1% to the entire capital stock in Vietnam.

We clearly see that comparative advantage *can* change with a massive infusion of FDI. And this change can be fast, though not instantaneous. Investment started to take off in 2003, and then expanded with two major projects by Samsung and LG in 2007 and 2008. We do not see an uptick in Vietnam's RCA until 2011, when it jumps 15% higher than in its relatively steady value of around 0.9 from 2003 to 2010. It jumps again in 2012. This increase in RCA (brought out by a surge in new exports from Vietnam by LG and Samsung) was no doubt delayed by the Global Financial Crisis in 2007/2008 and the ensuing Great Trade Collapse. So, it could be said that massive inward FDI may take around three years to see a noticeable effect on RCAs. This is a certainly a very rapid shift in the location of comparative advantage (dubbed the 'kaleidoscope effect' by Bhagwati, 1998) if a certain firm is committed to certain export goals in specific sectors. Note also that despite the amount of inward investment in other sectors across Vietnam, only electronics has seen the sharp uptick in comparative advantage.

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[23] While some of these investment projects have been added to in the years following, for the most part, this 6% figure is the sum of several huge lumps of investment over a period of years. That is to say, it is not 6% of GDP *every* year.

[24] Source: Feenstra, Inklaar and Timmer (2015).

While we are not privy to whatever tax breaks and other auxiliary support the government of Vietnam promised to these and other firms to attract such FDI, it is fairly clear that attracting such massive investments would be the envy of many other countries in the region and the world.[25] Yet it also points to how *much* investment is needed to make such a radical change in export structure. Whether or not the tax breaks and other concessions given are worth this boon for the host country is another matter. But it does give us a benchmark with which to compare with other countries in future work.

For some historical perspective, consider that Intel invested $1.3 billion in electronics in Vietnam in a two-year period in 2006-7. But the RCA for electronics remained essentially unchanged even in 2010 (see Table 3). At first, the facilities were used for simpler assembly and testing of semiconductor components.[26] In 2014, Intel started making CPUs in Vietnam. Nowadays, Intel's export revenue from Vietnam is about $1 billion per year. (Tractus, 2019). While $1 billion per year is impressive, Vietnam exported nearly $57 billion dollars of electronics exports in 2016 (Tractus, 2019). Approximately 50% of these electronics exports are telephones. 98% of these phones are produced by Samsung. (Tractus, 2019). So, this is clearly unprecedented, but how long will it last?

Is Vietnam's position in electronics sustainable?

Will this leadership position be sustained, or will this superior RCA decline as LG, Samsung and

[25] Most, if not all countries in the region, are taking very pro-active efforts to attract FDI. See 'Invest India' investindia.gov.in, or Thailand (https://thaiembdc.org/invest-in-thailand/ and Invest Indonesia (investindonesia.go.id), the Philippines (boi.gov.ph) just to name a few.

[26] Dezan Shira and Associates (June 4, 2015).

others move on to lower wage countries as Vietnam's wages rise? Vietnam's current luck may change, of course, but there are two reasons why this surge may just stick. First, as mentioned earlier, ICT firms such as LG are invested in *fixed assets*. This is very different from the subcontracting model of Nike and other footwear companies. Second, these ICT firms are investing in *R&D facilities* in Vietnam. Samsung employs 2,200 R&D staff in the country and began construction of a $220 billion R&D facility in Hanoi focusing on 5G network technologies (Waring, March 2, 2020). Japan's Renesas also built R&D facilities in Hanoi. Renesas is one of the largest producers of semiconductors for automobiles (Source: Tractus, 2019).

Again, contrast this with the footwear industry, where no R&D is taking place in Vietnam. Indeed, the large rents that are made in the footwear industry are derived from the brand power that firms like Nike and Adidas have *and the brand names that they take with them* when production moves. With both production and R&D in ICT occurring in the country, the possibility that this comparative advantage may stick is far greater.[27] It may be too much to predict that Vietnam will generate its own version of the next 'LG' or 'Huawei' smartphone, as its domestic market is still small in GDP terms.[28] However, one can envisage Vietnam finding a permanent place in the international value chains in electronics, and gradually moving up it.

Another set of factors makes Vietnam a preferred venue for electronics giants such as LG, Intel, and the like. Vietnam has the advantage of proximity to China, Japan and South Korea

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[27] There is a large domestic footwear industry in Vietnam that no doubt benefitted from the spillovers from the presence of Nike and Adidas. However, no Vietnamese brand has yet emerged in the world market.

[28] Vietnam's population is currently almost 100 million and is predicted to reach 106 million in 2030. By comparison South Korean has a population of 51 million. But South Korea's GDP per capita is over $30,000 while Vietnam's is about $2,000. (Source: World Bank.)

and it is a member of ASEAN. Both of those facts reduce the barriers of movement in both parts and personnel between the headquarters and their subsidiaries. These are factors that are consistently found to influence location decisions. But as mentioned above, Vietnam does not yet have the appeal as a huge market, something India, a rival host for FDI, certainly has. As India will clearly play a larger role in hosting FDI from electronics giants from around the world, it is imperative that Vietnam make the most of the current position it has.

VI. Conclusion

In this paper we accomplished three major goals with respect to Vietnam's recent emergence as a leading electronics exporter. First, through our original, econometrically-estimated measures of Revealed Comparative Advantage, we have confirmed that Vietnam now has the highest comparative advantage in the world and is far above its ASEAN neighbors. Likewise, RCAs in traditional electronic powerhouses Japan, Korea and China are flat or falling. Second, we identified, through the use of local government data, that nearly all (98-100%) of this newfound comparative advantage is from foreign enterprises based in Vietnam. The majority of this investment is by LG and Samsung. Third, we determined that that amount of inward investment necessary to produce this large increase in its comparative advantage amounted to roughly 6% of Vietnam's GDP over the period of a decade.

Although we only examined the case of Vietnam and electronics, we feel there are important lessons for other countries that aspire to become exporters in so-called higher-value goods and achieve greater integration into the global value chains in electronics. The main lesson is that it is possible, but it takes a massive amount of new (greenfield) FDI in manufacturing of the product. However, foreign firms presumably will only be willing to make such large, far-sighted investments if the host country's government is stable overall and predictable in its

behavior towards foreign firms. Good infrastructure and steady electricity supply are also, no doubt, necessary requirements. Vietnam has become more attractive as a host for FDI from recently improved access and trade ties with the US (the US pull-out of TPP notwithstanding), and the EU (an EU-Vietnam trade agreement went into force in August 2020). Currently, Vietnam is also benefitting from current US-China frictions, as well as rising labor costs in China.

While the jobs created, influx in capital, and potential spillover effects to local firms from inward FDI (see Sjoholm, 1999) will almost certainly bring net benefits to Vietnam, countries must be wary of giving too much away in the form of excessive tax breaks, infrastructure subsidies and the like.[29] Lastly, such a huge inflow of funds may be a breeding ground for corruption, lax environmental standards, weak labor enforcement, political intervention by foreign firms, etc. While welcome the incoming FDI, emerging countries must remain vigilant in these areas.

We have argued in this paper that this FDI in electronics is not the 'footloose' type and may be here to stay and spur domestic electronics firms. However, as mentioned in the previous section, Vietnam is a medium size country, but still with very low purchasing power. One potential threat to Vietnam's current position is, of course, India. As mentioned in footnote 22, more and more firms are considering moves to India. India has a much larger pool of low-wage workers, many of whom have a good education and as such, India has more than enough 'absorptive capacity'. India also has its own vibrant, home-grown ICT industries. And, of course,

[29] See a report by the OECD (2003) which describes the various policies in which host countries government can implement in efforts to secure more inward FDI. The report also explains the costs and benefits of each of the various policies, some of which can be quite wasteful either to the recipient country and/or to world welfare overall.

it has a huge, yet still on average poor, domestic market. India has just started negotiations with the EU on a possible trade agreement. The US has also discussed the possibility, though the barriers to overcome seem large. India is already receiving $50 billion in FDI each year. Historically, most of that has been from the EU, but now the US and Japan are top source countries. It remains to be seen if firms like Samsung and LG and will continue to see Vietnam as one of their first choices. In the World Bank's Doing Business 2020 report, India surpassed Vietnam. Previously, India was 77th, but it has now jumped to 63rd, ahead of Vietnam at 60th. The government needs to continue to make Vietnam attractive for foreign businesses (safety for expats, less red tape, good infrastructure, higher transparency and less corruption in doing business, etc.). Also, Vietnam needs to leverage the position it has now in order to sustain or even enhance its export competitiveness in electronics by enhancing successful 'learning by doing' and other efforts to capture any potential spillovers from the inward FDI. Otherwise, there is still the chance that this may be a 'kaleidoscope comparative advantage' after all.

For future research, it would be very useful to identify similar experiences in other countries to confirm whether our 6% figure is a reasonable reference for other countries and industries. With the new methodology for estimating comparative advantage more accurately, as well as the increased availability of detailed FDI data, there is great potential here.

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Appendix 1

List of 25 Exporting Countries and their Abbreviations

ARG = Argentina; AUS = Australia; BRA = Brazil; CAN = Canada, CHN = China;

DEU = Germany; ESP = Spain; FRA = France; GBR = United Kingdom; IDN = Indonesia;

IND = India; ITA = Italy; JPN = Japan; KOR = Republic of Korea; MEX = Mexico;

MYS = Malaysia; NLD = Netherlands; PHL = the Philippines; RUS = Russia Federation;

SAU = Saudi Arabia; THA = Thailand; TUR = Turkey; USA = United States; VNM = Vietnam;

ZAF = South Africa.

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