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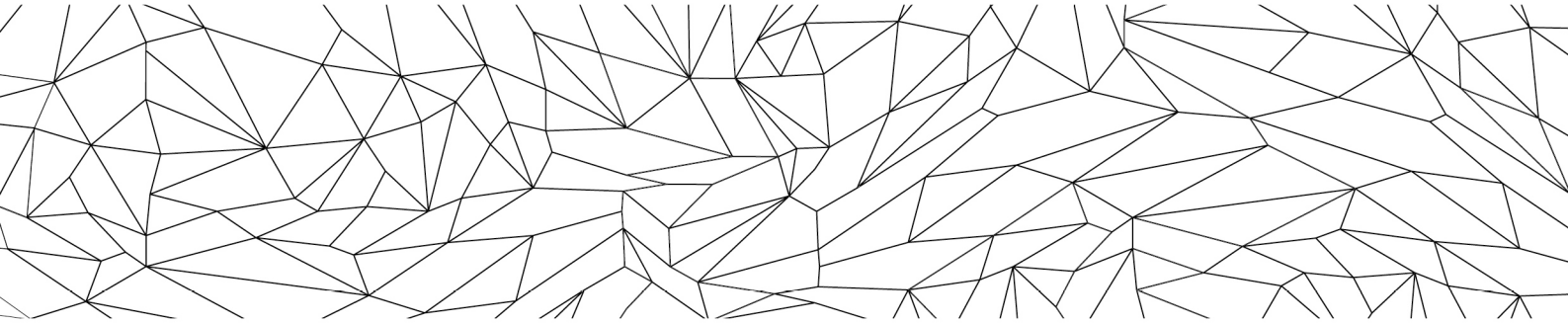

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Yue Teng, Dic Lo

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Department of Economics
SOAS University of London
Thornhaugh Street, Russell Square, London WC1H 0XG, UK
Phone: + 44 (0)20 7898 4730
Fax: 020 7898 4759
E-mail: economics@soas.ac.uk
http://www.soas.ac.uk/economics/

Determinants of Developing Countries' Export Upgrading: The Role of China and Productive Investment

Yue Teng*

Dic Lo†

Abstract

This paper explores the determinants of developing countries' export upgrading measured by export sophistication. In particular, as a response to the recent debate on China's impact on developing countries' industrialisation, we examine a new hypothesis that the considerable growth in developing countries' trade with China may serve as a source of productive investment for their export upgrading. Dynamic panel estimations based on HS 6-digit export data on 62 developing countries during 1995-2014 show the positive effects of human capital, productive investment, and absolute gains from trade with China measured by income terms of trade *vis-à-vis* China. Mediation analysis finds that the positive effect of trade with China on export upgrading takes effect largely through its enhancing effect on productive investment, which supports our hypothesis. By contrast, China's direct export-downgrading impact is minor. Our findings suggest that, for developing countries, China serves more as a stimulator of capital accumulation for industrial development than a competitor in manufacturing market or a predator of natural resources. This provides an alternative to the widespread argument of China's crowding-out and re-primarisation impact on developing countries. The priority for developing countries is therefore the appropriate use of the gains from trade for productive purposes..

Keywords: export sophistication, developing countries, China, terms of trade, productive investment.

JEL classification: F14, F63, O14, O19, O25.

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* School of Social Sciences, University of Trento and University of Florence. Via Verdi 26, 38122 Trento, Italy. Email: yue.teng@unitn.it

† Department of Economics, SOAS University of London. Russell Square, London WC1H 0XG, UK. Tel: +44 207 898 4532. Email: diclo@soas.ac.uk

1. Introduction

After the global wave of neoliberal economic policy in the 1980s and the 1990s, which is based on the assumption of production homogeneity and trade regime neutrality, industrialisation has been increasingly re-emphasised as a condition for development. Particularly, the sophistication of a country's export basket has been seen as a signal of industrial development and a driver of economic growth (e.g. Hausmann, Hwang, and Rodrik 2007). That said, the export-economic growth nexus is conditional on the sophistication of export basket, and exporting potato chips is different from exporting microchips.

Therefore, understanding the mechanism underlying the improvement of export sophistication, namely export upgrading, is important and relevant. Some studies have shown the positive effects of income level, human capital, investment, and FDI (Hausmann et al. 2007; Cabral and Veiga 2010; Kemeny 2010; Weldemicael 2012; Spatafora, Anand, and Mishra 2012; Zhu and Fu 2013). However, explorations into export upgrading are still insufficient and need to be methodologically improved (Zhu and Fu 2013). In particular, developing countries encounter more difficulties in export upgrading due to limited resource and capability (Harding and Javorcik 2011). Amongst others, underinvestment resulting from political-economic problems is a major constraint (Hausmann and Rodrik 2003; Szirmai 2012; Lo 2016).

Another factor relating to developing countries' export upgrading is China. As a major primary commodity importer and a major manufactured exporter, China's impact on developing countries' industrial development has been highly contentious. Existing studies tend to look at how China's export supply and import demand, reflecting on trade volume, impact on prices and supply in both global and local market. This can be read as China's direct impact on developing countries[1]. Many studies suggest that China has crowded out developing countries' manufacturing and/or re-primarised their economic structure. However, existing studies tend to neglect an indirect channel through which the monetary gains from the considerable growth in trade with China may serve as a source of productive investment for developing countries' industrial production.

This paper aims to connect the literature on export upgrading and the literature on China's impact on developing countries, bringing the 'China' factor to the former and bringing export upgrading to the latter. We examine the determinants of developing countries' export upgrading measured by the indicator of export sophistication, EXPY (Hausmann et al. 2007). A particular interest lies in a new hypothesis that developing countries' growing trade with China can serve as a source of productive investment for their export upgrading. We use System GMM to estimate dynamic panels based

[1] The direct and indirect impact used in this paper is irrelevant to China's direct impact on developing countries (in home market) and indirect impact (in third market) defined in Kaplinsky (2009).

on 6-digit BACI export data for 62 developing countries from 1995 to 2014[2].

We find that accumulating productive investment, improving education, and promoting openness can stimulate export upgrading but institutional quality, reflecting market friendliness, does not matter. Moreover, absolute gains from trade with China, reflecting on improvement in income terms of trade *vis-à-vis* China, also promote developing countries' export upgrading. Importantly, in support of our hypothesis, mediation analysis shows that this export-upgrading effect takes effect largely through the enhancing effect of trade with China on developing countries' productive investment. By contrast, we find a slight export downgrading effect of imports from China only on developing countries that specialise in manufactures. Our findings provide an alternative perspective to understand China's influence on developing countries' industrialisation. We suggest that, for developing countries, China serves more as a stimulator of capital accumulation than a competitor in manufacturing market or a predator of natural resources. Accordingly, the priority for developing countries is the appropriate use of the gains from trade for productive purposes. To this end, we suggest that socio-political agents' motivations of and commitments to development (e.g. developmental state) might be more important than market friendliness for developing countries' industrialisation.

2. Analytical Framework of Export Upgrading

2.1. A Traditional Perspective

Traditional trade theories use a 'fundamentals' view to explain a country's export composition based on its fundamentals (Hausmann et al. 2007). In the early supply-side trade theories (e.g. the Ricardian model and the Heckscher-Ohlin model), fundamentals refer to comparative advantages in productivity or abundance of endowments. A country should export products that intensively use its most abundant or efficient factors of production. Accordingly, countries with abundant natural or labour resources should export primary commodities or labour-intensive products. The concept of fundamentals can be extended to institutions, human capital, and technology[3]. Unlike natural and labour resources, technology and skills may not be completely pre-determined and may be endogenously created or imported through international trade and FDI. Moreover, better institutions have been seen as a comparative advantage (Levchenko 2007). Because productively or

[2] Emerging countries (e.g. Brazil, Colombia, India, and South Africa), which are defined based on the 2013 UNIDO country classification, are excluded from the group of developing countries.

[3] New trade theories (e.g. the Linder model and the Krugman model) explain export composition based on preference (e.g. consumers' love of variety) and production (e.g. economies of scale). However, because these theories are targeted at trade between similar countries, they explain export composition conditional on the relation between trade partners rather than conditional on a country's endowments and capabilities. This goes beyond the scope of this paper.

technologically more sophisticated products tend to be more institutionally dependent ('institution-intensive' goods), institution is in theory a determinant of the sophistication of a country's export basket.

2.2. An Alternative Perspective

The fundamentals-based trade theories leave limited space for policy-driven export upgrading. Changes in export specialisation are considered largely as the passive result of changes in endowment (Hausmann and Klinger 2006). In contrast, classical development economics and development sociology argue that socio-political agents, especially the state, can selectively promote, through industrial policy, particular dynamic sectors to stimulate industrialisation in general and upgrade export structure in particular. This implies that a country can defy, rather than following, its pre-determined fundamentals. At the core of the 'defying comparative advantage' are socio-political agents' motivations of and commitments to industrialisation and development, especially in the form of capital accumulation. According to the capability theory of production, a country's export structure reflects its productive capabilities, which are defined as skills, knowledge, and experience embedded in entities (Andreoni 2011). The transformation of productive capabilities into real production activities is conditional upon material production capacity (e.g. means of production). Accumulating productive investment enhances material production capacity and then stimulates the transformation of productive capabilities into new production activities. On the contrary, underinvestment impedes a country's production upgrading.

By definition, productive investment falls within the category of physical capital, which is, according to traditional trade theories, defined as part of a country's endowments. However, we incline to treat productive investment as a proxy for socio-political agents' commitments to industrialisation rather than a pre-determined endowment. Lo (2016) highlights that the insufficiency of productive investment in developing countries, especially the failure in translating gains from beneficial terms of trade into productive investment, results from the lack of socio-political agents' motivations to industrialise and develop. This reflects the 'broader political-economic problems' in developing countries (Lo 2016). Importantly, the term of 'broader political-economic problems' is not equivalent to the mainstream terminology of institutions, which has tended to be used to reflect the quality of the state's role in guaranteeing the functioning of the market and in promoting private sectors. Therefore, institutions in mainstream terms, as an indication of a country's market friendliness, are not necessarily relevant to socio-political agents' commitments to industrialisation (e.g. developmental state).

Industrialisation is a socially-determined process that is rooted in specific socio-

political context (Kitching 1982; Kiely 1998). The constraints of socio-political context on agents' motivations of industrialisation, in which export upgrading is a core component, can be interpreted as the 'broader political-economic problems', which take effect largely through their constraints on productive investment. Therefore, the examination of the determinants of industrialisation should take into account, in addition to generic, technical factors (e.g. technology and human capital), those context-embedded factors. Given the difficulty in quantitatively measuring context-embedded factors, productive investment serves as a good proxy. Importantly, productive investment also reflects the state's attitude towards industrial policy, which, despite being often targeted at the sectoral or firm level, reflects on country-level capital intensity of production (Lectard and Rougier 2018).

2.3. China and Developing Countries' Export Upgrading

Over the recent two decades, China has become an increasingly important trade partner for developing countries. Table 1 shows that, except for developing countries specialising in manufactures (MANUs), all groups of developing countries have had considerable increase in the share of China in total exports and imports[4]. The first channel through which trade with China impacts on developing countries lies in the composition of China's exports and imports. Despite great productive capabilities in medium and high technology-intensive manufactures, China still has advantages in labour-intensive manufactures (Baliamoune-Lutz 2011). Low-end manufactures from China may crowd out developing countries' manufacturers in both their home markets and third markets. This crowding-out impact has been widely found for Sub-Saharan Africa and Latin America (e.g. Kaplinsky, McCormick, and Morris 2007; Moreira 2007; Kaplinsky and Morris 2008; Power 2008; Freund and Ozden 2009; Giovannetti and Sanfilippo 2009; Fu, Kaplinsky, and Zhang 2012). For another thing, China's resource-intensive modernisation has substantially increased its demand for primary commodities and raised the global prices. This commodity boom may act as a push factor to lead some developing countries to increasingly specialise in primary commodities, namely re-primarisation, and then experience export downgrading.

[4] AGRIs, MINEs, FUELs, and MANUs refer to major (developing) exporting countries of agricultural products, non-fuel minerals, mineral fuels, and manufactures, respectively. The classification is detailed in Section 3.2.

Table 1. China's share in developing countries' trade: 1995 versus 2014 (%)

Developing Countries by Export Specialisation	China's Share in Exports		China's Share in Imports	
	1995	2014	1995	2014
AGRIs	2.6	11.8	3.9	15.8
MINEs	5.2	23.1	5.6	19.2
FUELs	2.9	20.5	2.1	17.6
MANUs	0.8	5.7	2.8	14

Source: Authors' calculation based on the BACI database.

Another channel takes place through developing countries' monetary gains from their trade with China. China's fast-growing demand for primary commodities and supply of cheap manufactures have led to rising export prices but decreasing import prices for many developing countries that specialise in primary commodities, resulting in improvement in these countries' income terms of trade *vis-à-vis* China[5]. This improvement indicates absolute gains from trade with China, which potentially serve as a source of productive investment for export upgrading. Actually, even developing countries that specialise in manufactures, which tend not to benefit from commodity boom and may compete with China in low-end manufactures, have still improved their income terms of trade *vis-à-vis* China, as shown in Table 2. However, the appropriate use of resource revenues is more important than simply obtaining them. Whether resource revenues can be appropriately used largely depends on the role of the state (Paus 2009). This role in turn is constrained by the 'broader political-economic problems'. Gallagher and Porzecanski (2009) shows that, despite 'good' institutions, Latin America has failed in channelling resource revenues into industrial development.

Table 2. Trends of developing countries' income terms of trade *vis-à-vis* China (ITOT): 1995-2014

Country Group	*r*	$Adj\ R^2$	DW Statistics
AGRIs	0.17***	0.92	1.94
MINEs	0.17***	0.96	1.81
FUELs	0.21***	0.86	1.76
MANUs	0.13***	0.97	1.71

Trend rate (*r*) is estimated by the trend equation: ln(*ITOT*)=*a*+*rt*+*u*. *** p<0.01, ** p<0.05, * p<0.1.

[5] Income terms of trade is defined as net barter terms of trade multiplied by export volume index.

3. Measurement and Country Classification

3.1. Measuring Export Upgrading

We measure export upgrading by the indicator of EXPY (Hausmann et al. 2007). The underlying rationale is that a country's export sophistication can be revealed by the associated income level of its exported products. A particular product embodies a certain level of technology, human capital, management, and other production-related factors, and these factors reflect on the income level of countries that export this product[6]. Accordingly, EXPY can be read as a trade-based indirect measure of country-level productive capabilities, and development can be seen as a process of accumulating new productive capabilities (Andreoni 2011).

The export sophistication (EXPY) of country *i* in year *t* is defined as the mean of the associated income values (PRODY) of all its exported products, weighted by the share of the export value of each individual product *k* ($x_{i,t}^{k}$) in its total exports ($X_{i,t}$):

$$EXPY_{i,t} = \sum_k \left\{ {x_{i,t}^{k}}/{X_{i,t}} \right\} PRODY_k \qquad (1)$$

where $PRODY_k = {PRODY_{k,t}}/{t}$ and $PRODY_{k,t} = \sum_i \left\{ \left({x_{i,t}^{k}}/{X_{i,t}} \right) \Big/ \sum_i \left({x_{i,t}^{k}}/{X_{i,t}} \right) \times Y_{i,t} \right\}$ (2)

The associated income of product *k* in year *t* ($PRODY_{k,t}$) is defined as the mean of each exporting country's GDP per capita ($Y_{i,t}$) weighted by its normalised revealed comparative advantage in this product. Importantly, each product's annual PRODY values ($PRODY_{k,t}$) during a given period are averaged to generate a single static PRODY ($PRODY_k$), which enters the formula of annual EXPY ($EXPY_{i,t}$). This ensures that any change in EXPY is due to change in a country's export structure, instead of change in GDP per capita of other exporting countries. The calculation uses the HS 92 6-digit BACI export data and GDP per capita (PPP, in 2011 constant International Dollars) from the World Development Indicators (WDI).

There are three major criticisms of PRODY, but we believe that they should not be major problems for our case. First, combining information on GDP per capita and that on each country's revealed comparative advantage generates a circularity that 'rich countries export rich-country products' (Hidalgo and Hausmann 2009). However, because we aim to examine the determinants of EXPY rather than the

[6] An exception is mineral fuel, which has numerically high associated income level, because some rich but non-developed countries (e.g. the Gulf countries) take a major share in the world exports. However, mineral fuel production does not reflect economy-wide technological and productive capabilities, partly because it does not have sufficient linkages with the rest of the economy.

impact of EXPY on GDP per capita, the circularity tends not to matter. Second, PRODY may overestimate developing countries' export sophistication, because it does not reflect the difference in quality (unit value) within product category. However, since the difference in unit value mainly manifests itself in the comparison between developed and developing countries, this problem tends not to matter for our developing countries-only case. Needless to say, it is impossible to appropriately choose the extent to which the difference in unit values should be adjusted, due to the unmeasurable non-technological dimensions of unit value (e.g. market power and barriers to entry). Finally, PRODY cannot fully identify trade in value added, which leads to an overestimation of the actual export sophistication of some developing countries that assemble technologically sophisticated intermediate inputs from developed countries. This bias can only be solved by using data on production process rather than data on final products[7]. However, this is not a major problem, because, amongst the countries in our sample, only a few exceptions (e.g. Vietnam, the Philippines, and Lebanon) have actively participated in trade in tasks.

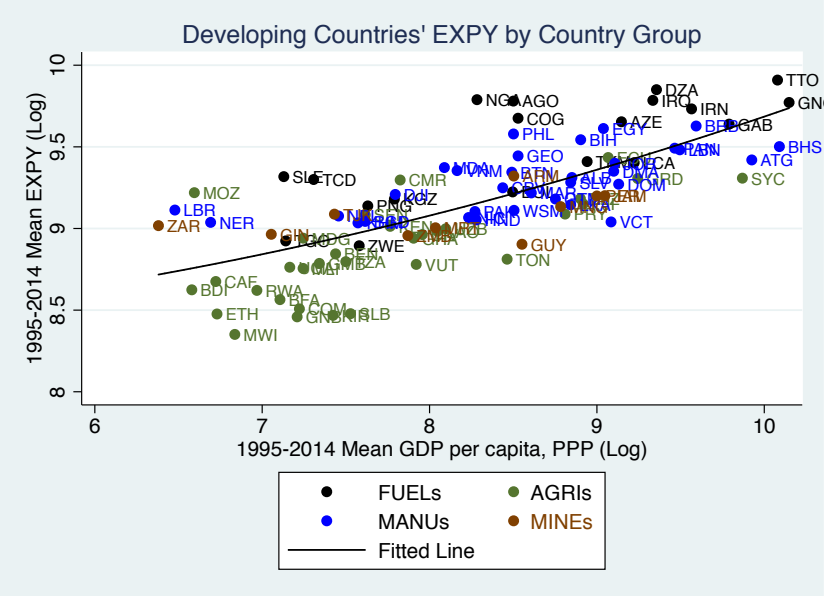
3.2. Country Classification

We define developing countries as Other Developing Economies (ODEs) and Least Developed Countries (LDCs) in the 2013 UNIDO country grouping (Upadhyaya 2013)[8]. These countries are further classified into major exporting countries of agricultural products (AGRIs, SITC 0+1+2+4-27-28), of manufactures (MANUs, SITC 5+6+7+8-667-68), of non-fuel minerals (MINEs, SITC 27+28+667+68+971), and of mineral fuels (FUELs, SITC 3). A country is defined as major exporter of a particular product category if this product category accounts for on average no less than 40% in this country's total exports in 1995, 2005, and 2014. A country may be a major exporter of two product categories, such as Moldova (AGRIs and MANUs). In the country sample, four countries do not have any product categories that account for no less than 40% of total exports (i.e. Bolivia[9], Kyrgyzstan, Papua New Guinea, and Togo). Appendix A lists countries by export specialisation. Figure 1 shows that, within the developing world, countries specialising in mineral fuels (FUELs) tend to have the highest export sophistication, while those specialising in agricultural products (AGRIs) are at the bottom. FUELs countries are excluded from the econometric analysis, because their numerically high export sophistication does not indicate economy-wide technological and productive capabilities as discussed in footnote 6. Moreover, countries with population less than one million are dropped.

[7] Actually, EXPY can, to some extent, identify the discrepancy between the location of R&D and that of production, because it takes into account the income level of other exporting countries.
[8] The 2013 UNIDO country grouping divides the world into Industrialised Economies (IEs), Emerging Industrial Economies (EIEs), Other Developing Economies (ODEs), and Least Developed Countries (LDCs), based on manufacturing value added per capita.
[9] Bolivia is an important exporting country of non-fuel minerals and natural gas, but neither product category continuously takes no less than 40% in total exports between 1995 and 2014.

Eventually, our data cover 62 developing countries.

Figure 1. Developing countries' export sophistication by export specialisation group



Source: Authors' calculation based on the BACI data.

4. Methodology

4.1. The Empirical Model of Export Upgrading

Based on various strands of trade and development theories, the determinants of developing countries' export upgrading can be generally modelled as[10]:

$$EXPY_{i,t} = \beta EXPY_{i,t-1} + Geography_i'\delta + \tau Specialisation_i + \theta Population_{i,t} + \varphi Human\ Capital_{i,t} + \rho Institutions_{i,t} + \omega Productive\ Investment_{i,t} + \lambda FDI_{i,t} + Trade_{i,t}'\eta + \mu_i + \gamma_t + \varepsilon_{i,t} \quad (3)$$

μ_i, γ_t, and $\varepsilon_{i,t}$ refer to country fixed effects, year fixed effects, and idiosyncratic errors, respectively. Following previous studies, we include the lagged export sophistication $EXPY_{i,t-1}$, because export upgrading is a path-dependent process conditional upon past export sophistication. $Geography_i'$ is a vector of geographical variables, namely *Landlock* (dummy) and *Remoteness*. The latter is defined, following Wei (1999), as a country's mean distance to all other countries weighted by each country's share in the total world trade[11]. $Specialisation_i$ is a dummy for a country's export specialisation and resource endowment (*AGRIs*, *MANUs* or *MINEs*).

[10] Appendix B gives descriptive statistics for main variables for the 62-country panel.

[11] $Remoteness_{i,t} = \sum_{j \neq i} w_{j,t} \times ln[Distance(i,j)]$, $w_{j,t} = {Trade_{j,t}}/{\sum_{k \neq j} Trade_{k,t}}$ (4). *Distance* refers to the distance between the most populous cities of two countries.

Since several countries do not belong to any specialisation group, including three country dummies does not lead to the dummy trap. $Population_{i,t}$ controls for country size and labour endowment. $Human\ Capital_{i,t}$ measures a country's mean years of schooling. $Institutions_{i,t}$ represents institutional quality in mainstream terms (market friendliness), which is proxied by the average of three variables from the Worldwide Governance Indicators (i.e. rule of law, control of corruption, and regulatory quality). $Productive\ Investment_{i,t}$ is proxied by gross capital formation per worker, indirectly measuring the 'broader political-economic problems'. $FDI_{i,t}$ measures FDI inflow as a share in GDP. $Trade'_{i,t}$ is a vector of trade variables, including trade openness (*Openness*), the share of medium-technology manufactures in total imports (*Manufactured Imports*) as a proxy for imported machinery and equipment, the share of China in total exports and imports (*Exports to CHN* and *Imports from CHN*), and income terms of trade *vis-à-vis* China (*ITOT*) as a proxy for absolute gains from trade with China. *Openness* is derived, following Wei (1999), as the residual between a country's observed trade share in GDP and the fitted share (natural openness) based on geography, population, language, and income[12].

FDI is treated as an endogenous variable, because factors that promote export upgrading may also attract FDI inflow. However, it is difficult to find exogenous variables that are sufficiently correlated with FDI inflow but do not impact on export sophistication unless through FDI. Zhu and Fu (2013) use latitude and longitude, namely geographical location, to instrument FDI inflow, and Weldemicael (2012) instruments FDI inflow by international capital control. However, these two variables are actually direct determinants of export sophistication. We bypass this difficulty in finding external instruments by using System GMM with internal instruments. *Human Capital* is not treated as endogenous variable, because the impact of exports on education takes effect with a time lag rather than simultaneously (Galor and Mountford 2008; Blanchard and Olney 2017). Moreover, following Zhu and Fu (2013), GDP per capita is not considered as an explanatory variable, because GDP per capita is an outcome of other variables (e.g. human capital, FDI, and institutions) rather than an input variable and does not have own explanatory power. Including GDP per capita will lead to a spurious result.

We will first examine China's direct impact on developing countries' export upgrading through the volume of trade with China. China's differential impacts on different groups of developing countries are examined by including interaction terms between the dummy on export specialisation and the variable of trade with China. Because the number of observations in each country group is not large enough for valid

[12] To derive the residual openness of country *i* in year *t*, the following equation is estimated:

$$Trade_{i,t}/_{GDP_{i,t}} = \beta_1 Remoteness_{i,t} + \beta_2 ln(Population_{i,t}) + \beta_3 ln(GDP\ p.c._{i,t}) + \beta_4 Eng_i + \beta_5 FRN_i + \beta_6 SPN_i + \beta_7 Island_i + \beta_8 Landlock_i + \varepsilon_i + \mu_{i,t} \quad (5)$$

ENG_i, FRN_i, and SPN_i specify whether country *i*'s official language is English, French or Spanish. $Island_i$ and $Landlock_i$ are dummies for island and landlocked countries, respectively. This model extends the original model of Wei (1999) by adding GDP per capita and using panel data.

System GMM estimation, we cannot use split-sample regression. Next, we will examine China's indirect impact on developing countries' export upgrading through their income terms of trade *vis-à-vis* China. Importantly, we use mediation analysis to explore whether trade with China impacts on export upgrading via its impact on productive investment. Since consecutive data on institutional quality are available only from 2002, all regressions for 1995-2014 will be repeated for 2002-2014 with the institution variable. The period of 2002-2014 is important in itself, because China's demand for primary commodities and supply of manufactures have rapidly grown since the early 2000s. Moreover, a robustness check that use lagged explanatory variables will be implemented, in order to allow for lagged effects and further avoid endogeneity.

4.2. Empirical Strategy

Introducing lagged export sophistication as explanatory variable leads to the dynamic panel bias (Nickell 1981). Following the recent export sophistication studies such as Kemeny (2010), Weldemicael (2012), Zhu and Fu (2013), and Lectard and Rougier (2018), we address the bias and endogeneity by System GMM (Arellano and Bover 1995; Blundell and Bond 1998). System GMM augments the earlier Difference GMM (Arellano and Bond 1991) by combining level and differenced equations as an equation system, leading to more robust, consistent, and efficient estimations. It is particularly suitable for small-*T* and large-*N* dynamic panel with individual fixed effects (Roodman 2006). In the differenced equation, the lagged first-differenced dependent variable is instrumented by the lagged level dependent variables. In the level equation, the lagged level dependent variable is instrumented by the lagged first-differenced dependent variables. Other pre-determined and endogenous variables are instrumented alike. Since all instruments are generated from the model itself, they are the so-called 'internal instruments'.

For valid Hansen overidentification test and Difference-in-Hansen test of the validity of instruments, the number of instruments is controlled to be smaller than that of cross sections through collapsing the instrument set into a single column for all time points (Roodman 2009). Moreover, Windmeijer finite-sample corrected standard errors (Windmeijer 2005) and two-step estimation are used for improving asymptotical efficiency and avoiding heteroskedasticity. All regressions include year dummies, which strengthen the estimation robustness and control for linear time trend and common shocks (e.g. the global trade slowdown and the 2007-2008 crisis). Finally, panel unit root test shows that the data are stationary.

5. Results

Table 3 shows the first set of regressions on China's direct impact. *Lagged EXPY* is highly significant, indicating the path dependence of export upgrading. Neglecting this lagged dependent variable will compound the effect of other variables with the path-dependence effect. *Landlock* and *Remoteness* tend to have negative impact, while *Population* tends to have positive impact. *Human Capital* and *Productive Investment* have positive effect at the 1% significance level in all specifications. A one-standard-deviation increase in *Human Capital* raises *EXPY* by around 6.7% for 1995-2014 and 7.5% for 2002-2014. A one-standard-deviation increase in *Productive Investment* increases *EXPY* by around 7.4% for 1995-2014 and 9.8% for 2002-2014. An increase in *Openness* by one standard deviation increases *EXPY* by approximately 1.7% for 1995-2014 and 2.7% for 2002-2014. *FDI* and *Institutions* are not statistically significant in any specifications.

How has trade with China directly impacted on *EXPY*? Columns 1 and 2 show that *Imports from CHN* and *Exports to CHN* barely have significant effects on developing countries as a whole. Columns 3-6 examine whether China's impact varies across country groups. *Imports from CHN* may increase *EXPY* in AGRIs countries, as shown by the relatively large positive coefficients of the interaction term (*AGRIs*×*ImpCHN*). The coefficients of *Imports from CHN* in Columns 3 and 4, which represent the impact of *Imports from CHN* on MANUs and MINEs countries, are insignificant, because, as shown below, *Imports from CHN* has opposite impacts on these two country groups. *Imports from CHN* reduces *EXPY* in MANUs countries but increases it in other countries, because the negative coefficients of the interaction term (*MANUs*×*ImpCHN*, -0.00547 and -0.00530) significantly outnumber the positive coefficients of *Imports from CHN* (0.00296 and 0.00339). The export-downgrading impact of imports from China (mainly manufactures) on MANUs countries may indicate a kind of crowding-out or re-primarisation. *Exports to CHN* does not show interaction effect, except for MANUs countries, which have significantly positive interaction term (*MANUs*×*ExpCHN*) but insignificant main effect. Regardless of statistical significance, China's direct impact is, however, quite small. For instance, a one-standard-deviation increase in *Imports from CHN* reduces MANUs countries' *EXPY* by 2.2% for 1995-2014 and 1.7% for 2002-2014. The small magnitude of impact suggests that China's crowding-out or re-primarisation impact on developing countries, if any, tends to be minor.

Table 3. System GMM: China's direct impact

Dependent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EXPY	1995-2014	2002-2014	1995-2014	2002-2014	1995-2014	2002-2014	1995-2014	2002-2014
Lagged EXPY	0.363***	0.262**	0.352***	0.252**	0.337***	0.270**	0.360***	0.258**
	(0.0823)	(0.115)	(0.0852)	(0.115)	(0.0804)	(0.115)	(0.0949)	(0.113)
Landlock	-0.0473*	-0.0932**	-0.0557**	-0.0879**	-0.0467	-0.0749*	-0.0549*	-0.0907**
	(0.0272)	(0.0383)	(0.0277)	(0.0342)	(0.0329)	(0.0407)	(0.0311)	(0.0370)
Population	0.0262*	0.0238	0.0283*	0.0273	0.0329**	0.0298	0.0429***	0.0383*
	(0.0150)	(0.0195)	(0.0157)	(0.0195)	(0.0163)	(0.0235)	(0.0160)	(0.0198)
Remoteness	-0.000340	-0.000461	-0.00048*	-0.00053*	-0.00062**	-0.000325	-0.000414	-0.00060**
	(0.00027)	(0.00030)	(0.00029)	(0.00028)	(0.00031)	(0.00027)	(0.00030)	(0.00030)
Human Capital	0.0218***	0.0253***	0.0213***	0.0247***	0.0257***	0.0253***	0.0259***	0.0287***
	(0.00521)	(0.00695)	(0.00528)	(0.00654)	(0.00492)	(0.00646)	(0.00560)	(0.00718)
Institutions		-0.0221		-0.0368		-0.0213		-0.0297
		(0.0322)		(0.0356)		(0.0344)		(0.0358)
Productive Investment	0.0482***	0.0692***	0.0526***	0.0730***	0.0553***	0.0771***	0.0632***	0.0797***
	(0.0133)	(0.0201)	(0.0147)	(0.0207)	(0.0129)	(0.0197)	(0.0152)	(0.0219)
Openness	0.122**	0.210***	0.133**	0.214***	0.137**	0.222***	0.140***	0.194**
	(0.0491)	(0.0751)	(0.0531)	(0.0763)	(0.0570)	(0.0825)	(0.0525)	(0.0778)
Manufactured Imports	0.000233	-0.000317	-0.000980	-0.00151	-0.00151	-0.000380	-0.00381*	-0.00285
	(0.00189)	(0.00243)	(0.00186)	(0.00246)	(0.00189)	(0.00306)	(0.00214)	(0.00278)
Imports from CHN	0.00152	0.00162	-0.00102	-0.000221	0.00296***	0.00339**	0.00170	0.00135
	(0.00142)	(0.00175)	(0.00145)	(0.00153)	(0.00109)	(0.00143)	(0.00143)	(0.00171)
AGRIs×ImpCHN			0.00491***	0.00425*				
			(0.00190)	(0.00245)				
MANUs×ImpCHN					-0.00547**	-0.00530*		
					(0.00268)	(0.00308)		
MINEs×ImpCHN							-0.000871	0.00186
							(0.00205)	(0.00264)
Exports to CHN	-0.00144*	-0.00115	-0.000447	-0.000563	-0.00100	-0.00173	-0.00342*	-0.00388
	(0.00086)	(0.00106)	(0.00077)	(0.00097)	(0.00077)	(0.00114)	(0.00207)	(0.00269)
AGRIs×ExpCHN			-0.00284	-0.00339				
			(0.00221)	(0.00274)				
MANUs×ExpCHN					0.00620*	0.00925*		
					(0.00376)	(0.00553)		
MINEs×ExpCHN							0.00298	0.00324
							(0.00217)	(0.00287)
FDI	0.000946	-0.000461	0.00118	-0.000194	0.00147	-0.000542	0.00107	0.000147

	(0.00238)	(0.00291)	(0.00216)	(0.00249)	(0.00229)	(0.00347)	(0.00220)	(0.00244)
AGRIs	-0.0631*	-0.0749**	-0.131***	-0.101**				
	(0.0326)	(0.0372)	(0.0392)	(0.0426)				
MANUs	0.0715**	0.0185			0.114***	0.0961**		
	(0.0343)	(0.0416)			(0.0386)	(0.0477)		
MINEs	0.0511	-0.0259					0.0303	-0.0548
	(0.0402)	(0.0453)					(0.0444)	(0.0486)
Constant	5.497***	6.620***	5.960***	6.932***	5.532***	6.248***	5.704***	6.601***
	(0.939)	(1.121)	(1.004)	(1.180)	(0.840)	(1.075)	(1.079)	(1.118)
Observations	1018	687	1018	687	1018	687	1018	687
Groups	59	59	59	59	59	59	59	59
Instruments	37	31	37	31	37	31	37	31
AR(1)	0.00147	0.00271	0.00152	0.00285	0.00131	0.00167	0.00160	0.00277
AR(2)	0.820	0.403	0.882	0.430	0.831	0.426	0.813	0.397
Hansen Test (p)	0.950	0.471	0.945	0.526	0.983	0.424	0.926	0.545
Diff.-in-Hansen	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Wald chi2 (p)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Two-step System GMM: Windmeijer finite-sample corrected standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Next, we examine China's indirect impact through developing countries' monetary gains from trade with China. This entails a two-step causality chain: (1) from gains from trade with China (income terms of trade *vis-à-vis* China, *ITOT*) to productive investment (*Productive Investment*) and (2) from productive investment to export upgrading (*EXPY*), in addition to any direct, independent contribution of gains from trade with China to export upgrading. In other words, productive investment may act as a mediator that channels (part of) the gains from trade with China to export upgrading. Assuming *ITOT* as the explanatory variable, *Productive Investment* as the mediator variable, and *EXPY* as the outcome variable, following Baron and Kenny (1986), *Productive Investment* acts as the mediator between *ITOT* and *EXPY*, if:

(1). its variations are significantly explained by *ITOT* (Regression 1);

(2). without *Productive Investment*, *ITOT* significantly explains the variation of *EXPY* (Regression 2);

(3). after controlling for *Productive Investment*, the effect of *ITOT* on *EXPY* becomes insignificant or weaker (Regression 3).

Table 4 shows results for Regression 1. Explanatory variables are drawn from the literature on gross capital formation. *ITOT* has highly significant positive effect on *Productive Investment*, which supports condition (1).

Table 4. Mediator test: income terms of trade and productive investment

Dependent Variable	(1)	(2)	(3)	(4)
Productive Investment	1995-2014	1995-2014	2002-2014	2002-2014
GDP p.c. Growth Rate	0.00833**	0.00596	0.00872*	0.00697
	(0.00353)	(0.00480)	(0.00463)	(0.00580)
FDI Inflow	0.0175***	0.0141**	0.0154**	0.0140**
	(0.00570)	(0.00597)	(0.00610)	(0.00631)
External Debt	0.000148	-9.46e-06	2.86e-05	3.53e-05
	(0.000257)	(0.000193)	(0.000180)	(0.000186)
Exchange Rate	-2.94e-05	-3.79e-05	-3.49e-05	-2.47e-05
	(2.88e-05)	(2.39e-05)	(2.90e-05)	(3.64e-05)
Interest Rate		-0.00171		-0.00268
		(0.00227)		(0.00274)
ITOT	0.0467***	0.0468***	0.0563***	0.0520**
	(0.0127)	(0.0149)	(0.0189)	(0.0209)
*Financial Development**	0.0133***	0.0126***	0.0121***	0.0115***
	(0.00155)	(0.00175)	(0.00186)	(0.00225)
Gross Saving % of GDP	0.0177***	0.0138**	0.0122**	0.0109*
	(0.00575)	(0.00569)	(0.00600)	(0.00606)
Constant	4.908***	5.096***	4.953***	5.093***
	(0.121)	(0.163)	(0.188)	(0.221)
Observations	868	664	610	508
Number of Countries	53	48	53	47
Adjusted *R*-squared	0.517	0.447	0.410	0.349

Fixed-effects regression: robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

**Financial Development* is measured by domestic credit to private sector as % of GDP.

Table 5 shows Regression 2 in Columns 1 and 3 and Regression 3 in Columns 2 and 4. In Columns 1 and 3, a one-standard-deviation increase in *ITOT* raises *EXPY* by 3.8% and 5.1% at the 1% significance level for 1995-2014 and 2002-2014, respectively. Having controlled for *Productive Investment*, *ITOT* becomes marginally insignificant (*p*-value=0.102) in Column 2 and its significance decreases from the 1% level in Column 3 to the 5% level in Column 4. Meanwhile, the coefficients decrease from 0.0113 to 0.00659 and from 0.0179 to 0.0129 for the two periods, respectively. Thus, conditions (2) and (3) hold, supporting the mediation effect of *Productive Investment* between *ITOT* and *EXPY*. Interestingly, the impact of *ITOT* on *EXPY* is stronger during the period of 2002-2014, which coincides with China's commodity boom and its strong performance in manufactured exports since the early 2000s. The potential differential impacts of *ITOT* across country groups is examined by

interacting *ITOT* and the export specialisation dummy. Since no interaction effects are found, the results are not shown but available upon request.

Table 5. System GMM (mediation analysis): China's indirect impact

Dependent Variable	(1)	(2)	(3)	(4)
EXPY	1995-2014	1995-2014	2002-2014	2002-2014
Lagged EXPY	0.335***	0.344***	0.263**	0.260**
	(0.0788)	(0.0787)	(0.103)	(0.108)
Landlock	-0.0766**	-0.0384	-0.106**	-0.0818*
	(0.0306)	(0.0301)	(0.0451)	(0.0426)
Population	-0.000924	0.0227	-0.0105	0.00907
	(0.0139)	(0.0159)	(0.0184)	(0.0197)
Remoteness	-0.000172	-0.000253	-0.000161	-0.000346
	(0.000312)	(0.000302)	(0.000357)	(0.000319)
Human Capital	0.0291***	0.0234***	0.0310***	0.0256***
	(0.00533)	(0.00487)	(0.00791)	(0.00714)
Institutions			0.0275	-0.0258
			(0.0368)	(0.0340)
Productive Investment		0.0510***		0.0617***
		(0.0113)		(0.0183)
ITOT	0.0113***	0.00659	0.0179***	0.0129**
	(0.00393)	(0.00404)	(0.00652)	(0.00585)
Openness	0.0662	0.125**	0.0979	0.184**
	(0.0629)	(0.0497)	(0.0769)	(0.0773)
Manufactured Imports	0.000875	-0.00106	-0.0000663	-0.00190
	(0.00177)	(0.00181)	(0.00235)	(0.00229)
FDI	0.00120	0.00161	0.00108	-0.000634
	(0.00205)	(0.00229)	(0.00302)	(0.00282)
AGRIs	-0.0565*	-0.0521	-0.0691*	-0.0719**
	(0.0304)	(0.0321)	(0.0362)	(0.0346)
MANUs	0.123***	0.0720**	0.0904**	0.0266
	(0.0326)	(0.0318)	(0.0423)	(0.0348)
MINEs	0.00423	0.00236	-0.0417	-0.0659
	(0.0353)	(0.0327)	(0.0433)	(0.0412)
Constant	6.031***	5.528***	6.843***	6.633***
	(0.935)	(0.948)	(1.189)	(1.106)
Observations	1003	976	665	654
Groups	57	56	57	56
Instruments	35	36	29	30
AR(1)	0.000715	0.00166	0.00203	0.00255
AR(2)	0.904	0.906	0.481	0.470

Hansen Test (p)	0.956	0.967	0.676	0.633
Diff.-in-Hansen	Pass	Pass	Pass	Pass
Wald chi2 (p)	0.000	0.000	0.000	0.000

Two-step System GMM: Windmeijer finite-sample corrected standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 6 shows robustness check with lag structure. *FDI*, *Manufactured Imports*, *Openness*, *Productive Investment*, and *ITOT* are lagged by one year, but this lag structure does not generate qualitative changes in results. We have also examined whether engagement in global value chain increases export sophistication by including in the model the share of foreign value added in exports (UNCTAD-Eora GVC data), but there is no statistically significant result. This may be because that most countries in our sample tend not to be active in trade in task. Due to significant loss of observations, we have chosen not to include the GVC variable in our final model. Moreover, there is a concern about the reverse causality that the increase in export sophistication, indicating greater capability to participate in trade in task, may lead to more trade with China. However, this should not be a problem, because, except Vietnam and the Philippines, countries in the sample have quite small share of China in their foreign value added in exports.

Table 6. System GMM with lag structure: China's indirect impact

Dependent Variable	(1)	(2)	(3)	(4)
EXPY	1995-2014	1995-2014	2002-2014	2002-2014
Lagged EXPY	0.426***	0.447***	0.346***	0.304***
	(0.0820)	(0.0795)	(0.110)	(0.0714)
Landlock	-0.0274	-0.0445	-0.0221	-0.0791**
	(0.0508)	(0.0308)	(0.0851)	(0.0358)
Population	-0.0571*	0.0140	-0.0844*	0.0126
	(0.0292)	(0.0158)	(0.0432)	(0.0165)
Remoteness	0.000377	-0.000181	0.000166	-0.000327
	(0.000456)	(0.000262)	(0.000590)	(0.000300)
Human Capital	0.0127*	0.0183***	0.0179*	0.0226***
	(0.00749)	(0.00437)	(0.0102)	(0.00535)
Institutions			-0.0281	-0.0227
			(0.0646)	(0.0310)
Lagged Prod. Invest.		0.0409***		0.0583***
		(0.0111)		(0.0173)
Lagged ITOT	0.0567**	0.00559	0.0820**	0.00980*
	(0.0243)	(0.00380)	(0.0345)	(0.00545)
Lagged Openness	0.000556	0.100**	-0.0156	0.145**
	(0.0899)	(0.0457)	(0.135)	(0.0699)
Lagged Manu. Imp.	-0.00157	-0.0000140	-0.00355	-0.000912

	(0.00328)	(0.00161)	(0.00539)	(0.00214)
Lagged FDI	0.00163	-0.000202	0.00117	0.000129
	(0.00245)	(0.00177)	(0.00273)	(0.00141)
AGRIs	0.00823	-0.0480	0.0114	-0.0681**
	(0.0634)	(0.0294)	(0.0864)	(0.0327)
MANUs	0.185***	0.0530*	0.208*	0.0181
	(0.0651)	(0.0287)	(0.107)	(0.0342)
MINEs	-0.0403	-0.00702	-0.0924	-0.0546
	(0.0750)	(0.0324)	(0.0986)	(0.0363)
Constant	4.860***	4.698***	6.132***	6.192***
	(1.049)	(0.916)	(1.541)	(0.842)
Observations	973	973	653	653
Number of Groups	56	56	56	56
Number of Instruments	35	36	29	30
AR(1)	0.000513	0.000649	0.00173	0.000505
AR(2)	0.921	0.994	0.652	0.469
Hansen Test (p)	0.307	0.286	0.316	0.614
Diff.-in-Hansen	Pass	Pass	Pass	Pass
Wald chi2 (p)	0.000	0.000	0.000	0.000

Two-step System GMM: Windmeijer finite-sample corrected standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

6. Conclusion

Historical experience of economic catch-ups, especially the case of late industrialisers, has demonstrated the role of export upgrading as a pre-condition of development. Thus, it is of importance and relevance to understand the mechanism underlying the upgrading of developing countries' export basket. However, empirical explorations into this issue have been insufficient. Moreover, the rise of China as an increasingly important trade partner for developing countries has made it a new factor that influences their export upgrading. This paper examines the determinants of developing countries' export upgrading from 1995 to 2014 with a particular interest in the role of trade with China and productive investment.

We find that, amongst general factors, access to sea, human capital, productive investment, and trade openness are significant determinants of developing countries' export upgrading. Some developing countries are doomed to be at a disadvantageous position of export upgrading due to landlocked location, a 'curse of geography'. However, improving human capital, accumulating productive investment, and promoting trade openness can stimulate export upgrading. The robust positive effect of productive investment supports the argument that underinvestment leads to

developing countries' poor manufacturing performance (Lo 2016). Therefore, we highlight the importance of developmentally-oriented socio-political agents (e.g. developmental state and proactive entrepreneurs) that are willing and able to accumulate capital for export upgrading and industrial development. Moreover, promoting trade openness is not necessarily related to trade regime neutrality and laissez-faire trade policy. Rather, the experience of the Asian Tigers provides an alternative example of export-led model in which the developmental state plays a decisive role.

The finding that trade with China promotes developing countries' export upgrading through its enhancing effect on productive investment provides a new perspective to understand the impact of China on developing countries. As an alternative to the widespread argument that China has crowded out or re-primarised developing countries, we suggest that, for developing countries, China serves more as a stimulator of capital accumulation for industrial development than a competitor in manufacturing market or a predator of natural resources. However, once again, socio-political agents' appropriate use of the gains from trade is actually more important than simply obtaining them.

The absence of institutional quality in mainstream terms (market friendliness) as a statistically significant contributor to developing countries' export upgrading might not be read as a surprise. It implies that market-friendly institutional arrangement might not necessarily promote industrial development in developing countries. Historical experience has demonstrated that industrialisation tended to be intrinsically an up-bottom, profit- or interest-driven revolution initiated by the elites such as entrepreneurs and politicians (Moore 1966; Kiely 1998). In this sense, these agents' motivations and interests have a more important role to play in industrialisation than the so-called 'market-friendly institutions'. This conforms to the centrality of strong, developmentally-oriented elites in the developmentalist model of industrialisation and development (Leftwich 1995).

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Appendix A. Countries by Export Specialisation

Table A1. Countries by export specialisation

AGRIs	MINEs	MANUs	FUELs
Benin	Armenia	Albania	Algeria
Burkina Faso	D. R. Congo	Bangladesh	Angola
Burundi	Guinea	Bosnia and Herzegovina	Azerbaijan
Central African Republic	Jamaica	Cambodia	Cameroon
Cote d'Ivoire	Mauritania	Dominican Republic	Chad
Ethiopia	Mongolia	Egypt	Congo
Gambia	Peru	El Salvador	Ecuador
Ghana	Sierra Leone	Eritrea	Equatorial Guinea
Guatemala	Tajikistan	Georgia	Gabon
Guinea-Bissau	Zambia	Guatemala	Iran
Kenya		Haiti	Iraq
Laos		Honduras	Libya
Madagascar		Jordan	Nigeria
Malawi		Lebanon	Syria
Mali		Liberia	Trinidad and Tobago
Mauritania		Moldova	Turkmenistan
Moldova		Morocco	Yemen
Mozambique		Nepal	
Myanmar		Nicaragua	
Nicaragua		Niger	
Paraguay		Pakistan	
Rwanda		Panama	
Senegal		The Philippines	
Tanzania		Sri Lanka	
Uganda		Vietnam	
Uzbekistan			
Zimbabwe			

Source: Authors' elaboration.

Appendix B. Descriptive Statistics

Table B1. Descriptive statistics (62-country panel, 1995-2014)

Variable	Mean	Std.	Source
EXPY (ln)	9.04	0.34	BACI*
Remoteness	1727.79	49.81	CEPII*
Population (ln)	16.2	1.11	WDI
Human Capital (years)	5.44	2.84	UNDP
Institutions	-0.66	0.43	WGI
Productive Investment (ln)	5.86	1.34	WDI
ITOT (ln)	9.97	3.36	BACI*
Manufactured Imports (% of total imports)	62.43	10.64	WDI
FDI (% of GDP)	4.09	7.14	WDI
Imports from CHN (% of total imports)	9.21	8.66	BACI*
Exports to CHN (% of total exports)	5.44	11.08	BACI*
Openness	0.01	0.13	UNCTAD*

Source: Authors' elaboration.

*Authors' own calculation based on the data.