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The Currency of the People's Republic of China and Production Fragmentation

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Abstract

This paper examines how an appreciation of the currency of the People's Republic of China (PRC)—renminbi—affects the country's exports in the context of production fragmentation, using a panel data set of the PRC's trade for 1992/93–2008/09. It constructs two exchange rates for renminbi: one is a bilateral real exchange rate and the other is a real effective exchange rate against East Asian component suppliers. It is found that appreciation of the renminbi would somewhat offset a reduction in the volume of the PRC's exports induced by lower importing costs of components. Hence, evidence casts further doubts on the efficacy of further unilateral reform of the renminbi exchange rate regime on correcting trade imbalances.

JEL Classification: F14, F23, F31

Contents

1. INTRODUCTION

The People's Republic of China (PRC) has recently overtaken Germany to become the world's largest exporter, having increased its share of world exports to almost 10%, up from around 3% in 1999. This rise of the PRC as a trading powerhouse has created concerns in world policy circles. Industrial countries are concerned about the growing size of the PRC's trade surplus with them, and it is the subject of intense debate, particularly among United States (US) policy makers. It is claimed that the PRC's currency (renminbi) has been kept at a deliberately low level in order to give a competitive edge to the PRC's exports in the world market.[1] The concerns of developing countries are based on "the PRC fear", that fierce export market competition with the PRC will eventually crowd out their export opportunities and growth prospects. Hence, the recent announcement of a move into a more flexible exchange rate regime for renminbi against the US dollar by the central bank of the PRC is a pressing global issue.

In this policy context, this paper examines the PRC's export elasticity to exchange rate changes from a viewpoint of the PRC being a base for assembling operations of exporting final products. There has been a proliferation of studies examining the implications of the PRC's export responses to changes in exchange rates (Marquez and Schindler 2007; Ahmed 2009; Cheng, Chinn, and Fujii 2010; Thorbecke and Smith 2010; and Thorbecke 2011). Most of these studies estimate the export elasticity of real exchange rate changes based on the imperfect substitution model between foreign and domestic goods using time-series data using the PRC's custom trade data. It is found that changes in renminbi rates alone have a minor impact on the PRC's exports. However, the degree of export price elasticity increases once exchange rate changes in currencies of East Asian economies that supply parts and components to the PRC are taken into account. This makes sense, since most of the value-added in the PRC's exports comes from East Asian economies.

This paper further extends the literature in the following ways. First, we construct two components of exchange rate changes for renminbi: one is a bilateral real exchange rate of the renminbi, and the other is real effective exchange rates of renminbi against East Asian component suppliers. Using these two components of renminbi exchange rate indices leads to a more nuanced and richer understating of the PRC's export elasticity to exchange rate changes. Second, most existing studies use highly aggregated and time-series PRC trade data. This paper constructs a panel of bilateral PRC exports to Organisation for Economic Co-operation and Development (OECD) countries for 1992/93–2008/09 at the 2-digit industry level. It will be shown that the degree of export elasticity to exchange rate changes will be higher in the relatively capital- and technology-intensive industries which form the bulk of imported parts and components coming from East Asian economies.

2. DEBATE ON RENMINBI AND TRADE ELASTICITY

With rapid technological progress and increased cost pressures in the home country, multinational enterprises (MNEs) increasingly set up assembling centers in locations where they source intermediate inputs and parts and components from various economies and assemble them into final goods for export. As a result, MNEs have created extensive production networks, particularly in East Asia. In this process the PRC plays a pivotal role as an assembling center for a wide range of manufacturing products by importing parts and components from other East Asian economies (Athukorala 2009). A standard analysis on the effects of exchange rates on exports is no longer appropriate for analyzing export elasticity

[1] Frankel and Wei (2007) and others examine under- or overvaluation of the renminbi from the equilibrium exchange rate.

to exchange rate movements when imports are sourced from one set of countries and final assembled goods are exported to another set of countries. An appreciation of real exchange rates usually makes foreign export goods more expensive while making the imported input more affordable. This eventually reduces the sensitivity of exchange rate changes on export responses, as compared to the normal adjustment case. Hence, the net effect on export response is an interesting empirical question to be examined.

Based on this idea, a number of investigators have examined the PRC's export elasticity to changes in renminbi exchange rates (Marquez and Schindler 2007; Ahmed 2009; Cheng, Chinn, and Fujii 2010; Thorbecke and Smith 2010; and Thorbecke 2011). These studies use the trade data separated into processed and ordinary trade published by the PRC Customs Statistics.[2] Processing trade includes imports that enter the country duty-free and will be incorporated into exported goods, and export based on processing imports. This distinction in the PRC's exports is crucial since a driving force behind PRC export growth in the past three decades has been processing exports. Thorbecke (2011) constructs an integrated exchange rate, combining effective exchange rate (RER) for renminbi and RERs of nine economies that supply components to the PRC (Germany; Japan; Republic of Korea; Malaysia; the Philippines; Singapore; Taipei,China; Thailand; and the US). The major finding is that the larger impact of exchange rate changes on the PRC's processed exports was found once allowance was made for exchange rates for East Asian economies supplying parts and components to the PRC. The basic idea underlying the integrated exchange rate is that the bulk of the value added in the PRC's processing exports is drawn from those economies supplying components to the PRC.

While these studies provide a useful starting point, it is still unclear how changes in exchange rates affect the PRC's exports. For example, Thorbecke (2011) uses real effective exchange rates (RERs) from the International Financial Statistics (IFS) of the International Monetary Fund for the exchange rates of the PRC and suppliers. However, the IFS's real effective exchange rates make it hard to interpret precisely the relationship between changes in exchange rates and the PRC's exports. It is found that a joint appreciation of renminbi and supplier RERs would decrease the PRC's processed exports much more than an appreciation of the renminbi RER. However, the RER index from the IFS is essentially the trade-weighted average real exchange rate movement of all important trading partners for a supplier. This means that an appreciation of a supplier's RER might be driven by changes in other trading currencies, not only changes against the renminbi. Hence, an interpretation of suppliers' RERs becomes less clear-cut without directly linking them to changes in the renminbi. We will takes this limitation into account in the proposed measure of exchange rate (detailed construction of indices will be explained in section 3).

3. EXPORT PATTERNS OF THE PEOPLE'S REPUBLIC OF CHINA

This section highlights the important features of the PRC's manufacturing exports, in particular focusing on trade in finally assembled products, and parts and components. We utilize published international trade statistics on parts and components identified at the highly disaggregated 5-digit commodity level. Identification of trade in parts and components takes a systematic approach following the commodity classification system provided by the United

[2] The PRC Customs Statistics data contain Harmonised System (HS) 8-digit product level of the PRC's trade flows administered by the Customs Office with information on the type of trade (processing exports using imported intermediate inputs, using locally sourced inputs; normal exports; and imported intermediate inputs for the purpose of exports), trading partner countries, the type of trading firms (whether MNEs, purely local firms, or international joint ventures), the location of exporters and importers in the regions and cities, the values in US dollars, and the quantity in eight different units. Many chapters in Feenstra and Wei (2010) also use the PRC Customs Statistics trade data.

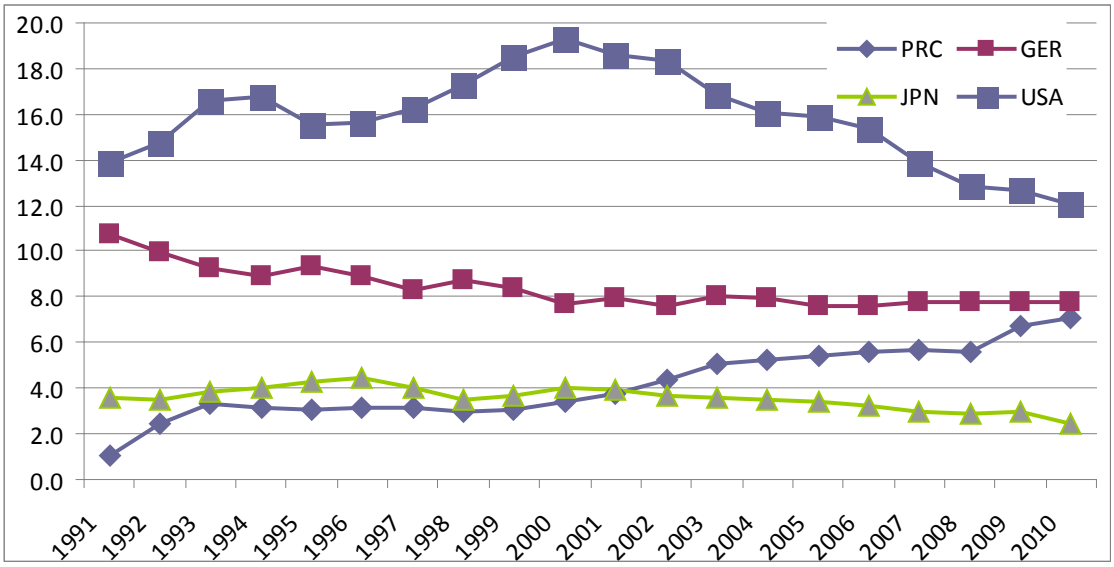
Nation's Broad Economic Category (BEC) (Athukorala and Yamashita 2006; Yamashita 2010, 2011).[3] Among seven major commodity categories under the BEC, industrial supplies (BEC 2), capital goods (BEC 4), and transport equipment (BEC 5) include a subcategory for parts and accessories. We then match those parts and components identified in the BEC classification with the Standard International Trade Classification (SITC) in revision 3. As a result, we identify 264 items belonging to either SITC 7 (machinery and transport equipment) or SITC 8 (miscellaneous manufactured items including clothing, toys, and travel goods).[4] We define finally assembled products which are not specified as components within the machinery sector.

Figure 1A depicts the rise of the PRC in world manufacturing exports. In 1992/93 the PRC's exports only accounted for around 2% of world exports. However, export growth in the PRC took off around the early 2000s when the country joined the World Trade Organization. Since then, the PRC has achieved formidable export expansion, overtaking Germany for the position of the world's largest exporter in 2007/08, accounting for 12% of world manufacturing exports. While the PRC's export share has been growing without any disruptions, the world shares of Japan, the US, and Germany have not grown since 2000. At the same time, the PRC has also been becoming an important importing country (Figure 1B). While the US still has the largest share world manufacturing imports (around 15%–20%), its share has been declining since 2000. At the same time, the PRC's share has been steadily increasing, accounting for close to 9% in 2009, up from 3% in 1992.

Figure1: The Rise of the People's Republic of China in World Manufacturing Exports

(%)

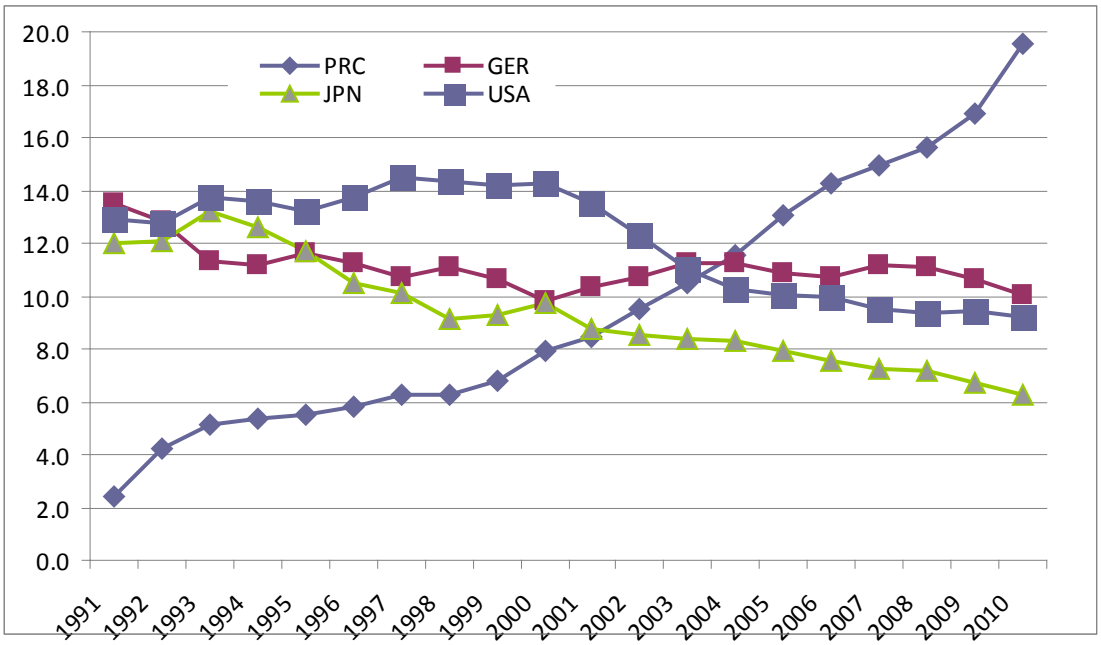
(A) Exports (percentage share in world manufacturing exports)



[3] The BEC classification system is intended to categorize Standard International Trade Classification (SITC)-based trade statistics into a large economic class of items according to economic activity. The original BEC was published in 1971; revision 1 was issued in 1976 and revision 2 in 1986. The BEC was developed in such a way that it would provide the elements which enable the construction of aggregates of trade goods approximately comparable to those for the three basic classes of goods in the 1968 Social National Account. More details of the BEC system are available at http://unstats.un.org/unsd/cr/family2.asp?Cl=10

[4] A complete list of parts and components identified by BEC is available by request.

(B) Imports (percentage share in world manufacturing imports)



Notes: PRC = People of Republic of China); GER = Germany; JPN = Japan; USA = United States of America *Source:* UN Comtrade

The rise of the PRC's presence in world trade also involves a product compositional change in the PRC's manufacturing trade. Data presented in Table 1 clearly suggest a change of export specialization away from relatively labor-intensive products towards more capital- and technology-intensive products. In 1992/93, miscellaneous manufacturing (including clothing, footwear, and toys) accounted for around 50% of the PRC's manufacturing exports, but this has steadily declined to 26% in 2008/09 (Table 1A). Within this decline, the export share of clothing declined substantially, from 24.7% in 1992/93 to 9.2% in 2008/09. However, it should be noted that, while the importance of labor-intensive products has been declining in the PRC's export composition, their presence in the world export market has been increasing. The PRC's export share of clothing (SITC 84) accounted for 13.7% of world exports in 1992/93, increasing to 34.3% in 2008/09; the share of footwear was 35.7% in 2008/09. In addition, travel goods and handbags (SITC 83) contributed 39.1% of the world share in 2008/09 but only accounted for a small share (1.1%) of the PRC's export composition.

In replacing labor-intensive exports, the share of machinery and transport equipment (SITC 7) in the PRC's exports has substantially increased, from 20.0% in 1992/93 to 50.9% in 2008/09. In particular, an increase in information and communication technology products under SITC 75, 76, and 77 is noteworthy. The share of office machines under SITC 75 increased from 2.0% in 1992/93 to 13.4% in 2008/09, telecommunication sound equipment (including mobile phones) increased from 6% to 13%, and electrical machinery appliances rose from 5.9% to 12.5% over the same period. Accordingly, the world share of information and communication technology exports substantially increased (Table 1A). At first sight, the data suggest that the PRC's comparative advantage is changing, away from labor-intensive export specialization into capital- and technology-intensive goods (Rodrik 2006). However, a closer examination reveals that the PRC's comparative advantages are still confined to relatively labor-intensive segments of final assembly activities, importing capital- and technology-intensive parts and components, as demonstrated by Athukorala (2009).

Table 1A: Product Composition of Manufactured Exports of the People's Republic of China, 1992/93–2008/09

		PRC export composition (%)					PRC export world share (%)				
SITC	**Commodity Description**	**1992/93**	**1995/96**	**2000/01**	**2005/06**	**2008/09**	**1992/93**	**1995/96**	**2000/01**	**2005/06**	**2008/09**
5	Chemicals and related products	6.3	7.0	5.5	4.9	5.7	1.4	1.9	2.2	3.6	4.7
6	Manufactured goods classified chiefly by material	22.9	23.7	18.7	18.7	18.0	3.0	4.0	5.3	10.1	12.5
7	Machinery and transport equipment	20.0	26.1	38.4	49.8	50.9	1.1	1.7	3.6	9.9	13.5
71	Power generating machines	1.2	1.2	1.3	1.1	1.7	0.9	1.2	1.9	3.5	6.3
72	Special industrial machinery	1.0	0.9	0.9	1.2	1.7	0.6	0.7	1.3	3.5	5.9
73	Metalworking machinery	0.4	0.3	0.3	0.3	0.4	1.0	1.1	1.7	3.6	7.1
74	General industrial machines	1.9	2.1	2.8	3.7	4.5	0.9	1.4	3.0	7.5	10.6
75	Office machines,	2.0	4.5	9.1	15.1	13.4	0.9	2.4	6.3	24.6	32.7
76	Telecommunication sound equip etc	5.9	6.8	9.4	13.4	12.5	3.4	4.7	7.6	20.8	27.0
77	Electronic machinery parts	5.1	7.2	10.7	10.9	11.6	1.5	2.2	4.4	10.3	14.5
78	Road vehicles	1.7	2.1	2.9	3.0	3.0	0.4	0.6	1.2	2.6	3.7
79	Other transport equipment	0.9	1.0	1.0	1.0	2.1	0.6	1.1	1.5	3.4	8.1
8	Miscellaneous manufactured articles	50.8	43.2	37.4	26.6	25.5	7.6	8.9	11.6	18.0	21.8
81	Prefab buildings	0.7	0.8	1.0	0.8	0.9	3.9	5.7	11.0	18.0	23.1
82	Furniture, bedding, etc.	1.3	1.4	2.1	2.3	2.5	3.1	4.1	8.1	18.8	25.7
83	Travel goods, handbags, etc.	2.3	2.2	1.7	1.0	1.1	15.8	19.3	24.5	32.4	39.1
84	Clothing and accessories	24.7	19.2	15.7	10.4	9.2	13.7	15.5	18.9	28.8	34.3
85	Footwear	6.7	5.4	4.3	2.5	2.3	13.6	15.1	22.4	31.1	35.7
87	Scientific equipment	0.6	0.7	1.1	2.3	2.7	0.7	1.1	2.2	8.7	12.0
88	Photo appliances; clocks	2.8	2.5	1.9	0.9	0.8	4.1	5.1	6.1	7.4	9.8
89	Misc manufactured goods	11.8	11.0	9.6	6.3	6.1	5.7	7.2	9.9	14.1	16.3
	Total manufacturing	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**3.1**	**3.9**	**5.8**	**11.7**	**15.0**

Source: UN Comtrade

Table 1B: Product Composition of Manufactured Imports of the People's Republic of China, 1992/93–2008/09

		PRC import composition (%)					PRC import world share (%)				
SITC	**Commodity Description**	**1992/93**	**1995/96**	**2000/01**	**2005/06**	**2008/09**	**1992/93**	**1995/96**	**2000/01**	**2005/06**	**2008/09**
5	Chemicals and related products	13.4	16.1	16.7	14.8	15.6	3.2	3.7	5.2	7.0	7.5
6	Manufactured goods classified chiefly by material	30.7	27.4	22.5	15.1	14.5	4.4	3.9	5.0	5.6	6.1
7	Machinery and transport equipment	48.3	48.9	53.4	58.2	57.5	3.0	2.9	4.0	8.0	9.2
71	Power generating machines	3.1	2.9	2.8	2.2	2.6	2.9	2.7	3.2	4.8	5.9
72	Special industrial machinery	13.8	12.5	6.3	4.2	3.8	9.7	8.7	7.7	8.9	8.9
73	Metalworking machinery	2.6	3.3	1.8	1.9	1.4	8.0	9.2	8.2	16.1	14.8
74	General industrial machines	5.0	6.7	4.7	4.6	5.1	2.9	3.7	4.0	6.5	7.4
75	Office machines,	1.8	2.9	6.3	6.9	6.1	0.9	1.2	3.3	7.4	8.7
76	Telecommunication sound equip etc	5.7	6.1	6.9	5.8	4.8	3.7	3.8	4.5	6.2	5.9
77	Electronic machinery parts	7.0	9.6	20.3	28.1	28.1	2.3	2.5	6.4	16.6	19.2
78	Road vehicles	5.7	2.2	2.2	2.6	3.7	1.4	0.6	0.7	1.6	2.8
79	Other transport equipment	3.7	2.6	2.2	1.8	1.9	3.7	3.6	3.7	5.7	5.7
8	Miscellaneous manufactured articles	7.5	7.5	7.4	11.9	12.3	1.2	1.3	1.8	5.2	6.1
81	Prefab buildings	0.2	0.2	0.1	0.0	0.1	1.2	1.0	0.6	0.6	1.2
82	Furniture, bedding, etc.	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.3	0.6	1.0
83	Travel goods, handbags, etc.	0.1	0.0	0.0	0.0	0.1	0.4	0.2	0.2	0.7	1.4
84	Clothing and accessories	0.6	0.9	0.7	0.3	0.3	0.4	0.6	0.6	0.6	0.6
85	Footwear	0.5	0.3	0.2	0.1	0.1	1.0	0.7	0.6	0.8	1.1
87	Scientific equipment	1.8	2.0	2.8	8.1	8.2	2.4	2.6	4.5	19.4	21.4
88	Photo appliances; clocks	1.9	1.7	1.7	1.5	1.6	3.1	3.0	4.5	9.4	12.4
89	Misc manufactured goods	2.4	2.3	1.9	1.7	1.8	1.2	1.3	1.5	2.4	2.8
	Total manufacturing	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**3.5**	**3.4**	**4.6**	**8.0**	**9.0**

Source: UN Comtrade

On the import side, the share of miscellaneous manufactured products (including toys, footwear, and clothing) under SITC 8, while growing steadily, remains relatively low compared to exports. However, electrical and transport equipment (SITC 7) accounts for close to 50% of the PRC's manufacturing imports for the entre period—in 1992/93 its share was 48.3% and it grew to 57.5% in 2008/09. The share of electrical machinery appliances (SITC 77) rapidly increased during this period, from 7.0% in 1992/93 to 28.1% in 2008/09.

Table 2 summarizes the percentage share of parts and components in total manufacturing trade for the PRC and other East Asian economies for 1992/93–2008/09. While the component share in total manufacturing exports remains relatively low compared to other East Asian economies, there has been an increase in the component share in total manufacturing imports in the PRC. In 2005/06 the share of components in the PRC's manufacturing exports was around 20%, while in Association of Southeast Asian Nations (ASEAN) countries it was 40%, in the Republic of Korea 33%, and in Taipei,China 46%. On the other hand, the share of components in the PRC's total manufacturing imports dramatically increased, from 19.3% in 1992/93 to 43.8% in 2005/06. This figure is comparable to the average in ASEAN countries and other key East Asian importers. These figures perhaps suggest that the PRC predominantly imports components within manufacturing, and exports final products after undertaking assembly using imported parts and components in domestic factories.

Table 2: Percentage Share of Parts and Components in Total Manufacturing Trade, 1992/93–2008/09

	Export (%)				Import (%)			
Item	**1992/93**	**2000/01**	**2005/06**	**2008/09**	**1992/93**	**2000/01**	**2005/06**	**2008/09**
PRC	5.2	14.2	20.2	15.5	19.3	34.5	43.8	24.1
Hong Kong, China	18.8	27.5	26.5	14.9	16.8	30.0	36.0	21.0
ASEAN6	27.4	38.6	40.2	18.1	34.6	48.8	43.4	24.9
Malaysia	33.4	46.1	48	20.5	42	57.4	53.1	25.4
Philippines	34.4	58.2	66.6	21.6	33.9	55.1	51.1	23.8
Singapore	33.8	43.2	43.5	18.2	38.6	50.4	46.5	25.7
Viet Nam	1.4	9.9	10.2	9.2	8.9	18.5	17.2	15.7
Thailand	21.2	27.2	27.4	18	29.1	43.6	38.2	27.5
Indonesia	3.2	12.4	19.7	15.4	24.0	31.0	32.9	26.4
Japan	26.9	34.1	32.4	24.4	18.5	26.7	25.2	19.2
Korea, Rep. of	19.1	27.4	33.1	18.5	29.2	36.7	31.9	19.4
Taipei,China	21.1	36.9	45.9	19.2	30.5	39.1	37.7	17.6
USA	30.3	35.6	31.2	23.8	24.5	24.1	21.5	17.7
NAFTA	29.6	32.2	29.0	22.8	27.4	27.0	23.7	19.4
EU 15	18.6	20.7	19.6	18	19.1	21.7	19.7	16.6
Low income	2.9	5.4	6.5	7.3	15.3	17.1	16.1	14.9
Low-middle income	8.1	17.5	21.7	15.3	21.6	31.3	34.3	22.1
High income	22.7	26.0	24.0	19.4	21.3	24.2	22.1	17.5
World	20.8	25.1	24.1	18.2	21.7	25.6	23.9	18.2

Notes: ASEAN = Association of Southeast Asian Nations; EU = European Union; NAFTA = North America Free Trade Agreement; PRC = People's Republic of China; USA = United States of America.

Source: UN Comtrade

The share of components in total manufacturing trade sharply dropped during the global financial crisis period in 2008/09 (see Athukorala 2011 for a fuller exposition). The substantial drop in trade volume in 2008/09 was largely caused by a sharp decline in demand for consumer durable goods (information and communication technology products and motor vehicles) in industrial countries. This sharp drop in demand had consequences for component supply chains because of the direct link with demand for final products. For the PRC, the share of components in total manufacturing imports dropped from 43.8% in 2005/06 to 24.1% in 2008/09. In ASEAN countries, on average, the share of components in manufacturing also sharply dropped, to 24.9% in imports and 18.1% in exports in 2008/09.

Table 3(A) summarizes the PRC's export destinations and import-sourcing economies during 1992/93–2008/09. Trading economies are broken down into ASEAN countries; the Republic of Korea and Taipei,China; Japan; the US; and the 15 European Union (EU) countries. The table also separates the PRC's trade patterns into parts and components, and final goods. In machinery and transport equipment (SITC 7), the PRC's component sourcing from ASEAN countries was only 2.2% in 1992/93 but this grew to 13.3% in 2000/01 and 17.2% in 2005/06 (Table 3). The bulk of the PRC's component imports comes from other East Asian economies—the Republic of Korea; Taipei,China; and Japan (excluding Hong Kong, China). In 2005/06, the Republic of Korea and Taipei,China accounted for 30.1% and Japan 18.2% of the PRC's component imports. The share of the US has declined, from 10.7% in 1992/93 to 5.7% in 2005/06, and the share of the EU 15 has dropped from 19.1% in 1992/93 to 9.4% in 2005/06. During the recent crisis period in 2008/09, the share of ASEAN in the PRC's component imports declined substantially, to 8.0% in 2008/09; the share of the Republic of Korea and Taipei,China also dropped.

Table 3: Directions and Sources of the Trade in Components and Final Products of the People's Republic of China, 1992/93–2008/09
(%)

(A) Imports

Part and components in machinery and transport equipments (SITC 7)						Final products in machinery and transport equipments (SITC 7)				
Year	**ASEAN**	**KOR+TAP**	**Japan**	**USA**	**EU 15**	**ASEAN**	**KOR+TAP**	**Japan**	**USA**	**EU 15**
1992/93	2.2	15.0	33.4	10.7	19.1	1.1	15.5	28.5	14.1	25.6
2000/01	13.3	20.3	24.1	9.4	17.2	5.2	15.9	20.6	17.3	26.0
2005/06	17.2	30.1	18.2	5.7	9.4	12.1	14.1	21.5	10.2	24.3
2008/09	8.0	19.7	23.4	6.3	19.0	17.5	23.5	16.2	8.0	15.4
Part and components in miscellaneous manufactured items (SITC 8)						**Final products in miscellaneous manufactured items (SITC 8)**				
Year	**ASEAN**	**KOR+TAP**	**Japan**	**USA**	**EU 15**	**ASEAN**	**KOR+TAP**	**Japan**	**USA**	**EU 15**
1992/93	1.0	22.1	30.5	7.2	5.2	1.4	20.5	25.0	14.9	8.6
2000/01	5.5	16.6	36.1	9.0	13.6	3.1	16.4	20.8	19.4	18.0
2005/06	4.6	31.3	30.0	7.9	8.0	4.0	44.0	16.5	7.4	8.7
2008/09	5.6	25.1	28.0	7.4	13.6	4.2	41.8	15.4	8.0	11.2

(B) Exports

Part and components in machinery and transport equipments (SITC 7)						Final products in machinery and transport equipments (SITC 7)				
Year	**ASEAN**	**KOR+TAP**	**Japan**	**USA**	**EU 15**	**ASEAN**	**KOR+TAP**	**Japan**	**USA**	**EU 15**
1992/93	7.8	6.2	15.8	17.5	13.0	6.2	3.0	8.6	22.3	15.2
2000/01	12.8	7.8	14.9	15.4	12.8	7.0	5.2	11.1	24.4	21.3
2005/06	11.6	9.5	10.1	15.6	13.4	5.2	4.0	8.2	26.4	23.2
2008/09	8.6	7.1	8.8	14.5	16.7	8.6	5.9	5.8	19.9	17.8
Part and components in miscellaneous manufactured items (SITC 8)						**Final products in miscellaneous manufactured items (SITC 8)**				
Year	**ASEAN**	**KOR+TAP**	**Japan**	**USA**	**EU 15**	**ASEAN**	**KOR+TAP**	**Japan**	**USA**	**EU 15**
1992/93	3.9	5.5	13.0	16.8	9.6	1.5	2.3	16.0	27.1	14.5
2000/01	4.6	5.3	19.7	27.4	9.5	2.1	3.5	20.5	27.4	14.2
2005/06	5.9	7.7	25.3	19.4	9.1	2.9	3.5	12.9	26.6	18.2
2008/09	9.1	6.7	13.4	18.4	12.1	4.8	3.2	10.6	24.0	21.4

Notes: ASEAN = Association of Southeast Asian Nations; KOR = Republic of Korea; TAP = Taipei,China; USA = United States of America; EU = European Union

Source: UN Comtrade

In contrast to component imports, the recent crisis had little impact on the PRC's final goods imports from ASEAN countries. The share of ASEAN actually went up, from 12.1% in 2005/06 to 17.5% in 2008/09, while the shares of Japan, the US, and the EU 15 all went down in the same period—the share of Japan declined from 20.6% in 2000/01 to 16.2% in 2008/09, the US dropped from 17.3% in 2000/01 to 8.0% in 2008/09, and the EU 15 went down from 26.0% to 15.4% for the same period.

Table 3(B) looks at the destinations of the PRC's exports in parts and components and final products. Similar to the import pattern, the share of ASEAN countries has substantially increased from the early 1990s—its share went up from 7.8% in 1992/1993 to 12.8% in 2000/2001 and 11.6% in 2005/2006 of the PRC's machinery and transport equipment exports. The US and EU 15 countries account for around 40% of the PRC's final product exports in machinery and transport equipments, and this pattern has not changed for the last 20 years. This indicates that the PRC still finds the market in rich Western countries for its manufacturing exports. In 1992/1993, 22.3% of the PRC's final good exports in machinery and transport equipments went to the US and 15.2% to the EU 15; in 2008/09 the US figure was 19.9% and the EU 15 17.8%.

The PRC's trade in miscellaneous manufactured articles (SITC 8)—mainly toys and clothing—shows a quite different pattern. ASEAN countries account for only a small portion of the PRC's imports and exports in this product category, while imports from the Republic of Korea and Taipei,China dominate—around 40% of the PRC's final goods imports in this product category come from these two East Asian economies. On the export side, the majority of the PRC's products are directed towards Japan, the US, and the EU 15 countries.

In summary, Table 3 clearly suggests that the PRC plays a major role as a final-assembly country. The majority of the PRC's component imports are sourced from East Asian economies including Japan, while final-product exports are directed towards the US and EU 15 countries.

4. EMPIRICAL ANALYSIS

This section undertakes gravity modeling to estimate export elasticity of exchange rate changes. As theoretically and empirically demonstrated in Baldwin and Taglioni (2011), a standard formation of the gravity equation may not be appropriate for explaining trade flows where trade in parts and components are prevalent. As shown in section 3, this is the case for the PRC's trade pattern. In essence, the PRC primarily imports parts and components from other East Asian economies, and then exports assembled products to the US and EU 15 countries. Hence, it is hard to identify the demand and supply forces in modeling of the PRC's exports that includes imported parts and components. A typical gravity equation postulates demand and supply in a bilateral trade relationship, simply represented by gross domestic product (GDP) and GDP per capita of importing and exporting countries. However, GDPs of importing countries might not strictly represent demand for imports because of the presence of parts and components in imports.

Because of this, we focus on the PRC's export of final goods excluding the value of parts and components. The analysis incorporates two exchange rates for renminbi. The first one refers to the real bilateral exchange rates (BERs) between the PRC and its importing economies. The second one is the effective exchange rates (RERs) of renminbi against currencies of component sourcing economies (the variable definition given below). The regression specification takes the following form:

$$\ln CHE_{ijt} = \alpha + Z'_{it}\beta + \phi_1 \ln BER_{it} + \phi_2 \ln RER_{jt} + \varepsilon_{ijt}$$

where i denotes importing economies, j is industry, and t is year. The dependent variable (*CHE*) is the export volume of final products from the PRC to a set of trading partner

countries (US and EU countries). *Z* is a vector of variables (other than exchange rate variables) that determine the volume of the PRC's final goods exports. *BER* denotes real bilateral exchange rates for renminbi against currencies used in importing economies (defined as foreign currency per yuan). Hence, an increase in BER means appreciation of the renminbi. The expected sign for BER is negative. *RER* is renminbi real effective exchange rates computed at the SITC 2-digit level (see below for a formula). The computation closely follows the industry-level computed RER in Goldberg (2004). The symbol *ln* before a variable denotes the natural logarithm; ε is a random variable that is independent and identically distributed (*i.i.d.).* normal with mean zero and variance u_u.

As shown in section 3, the PRC's component imports come mainly from East Asian economies, and the PRC's final product exports are mainly destined for industrial countries in North America and Europe. Hence, in construction of relevant exchange rates, we use renminbi's RER against the currencies of nine East Asian economies (Hong Kong, China; Indonesia; Japan; the Republic of Korea; Malaysia; Philippines; Singapore; Taipei,China; and Thailand) for component suppliers' RER. This will minimize high correlation between BER and RER. Each industry is indexed in *j* at the SITC 2-digit level, and East Asian exporters to the PRC are indexed as *c*. The weight is determined by the share of that economy (*c*) in the PRC's component imports in each industry. The renminbi RER is computed as follows:

$$RER_t^j = \sum_c w_t^{jc} er_t^c, \quad \text{where } w_t^{jc} = \frac{M_t^{jc}}{\sum_c M_t^{jc}}$$

where *M* stands for the PRC's component imports for those East Asian economies and *er* represents the bilateral exchange rates of each of the PRC's component sourcing economies (*c*) against the renminbi. The bilateral real exchange rates are constructed by multiplying a country's nominal exchange rate (defined as a local currency per yuan) by the ratio of the consumer indexes of the PRC against East Asian suppliers. The subscript *t* means that the weight varies through time. A real appreciation of the renminbi's RER against currencies of component providers would essentially lower marginal costs of importing, exerting upward pressures on the PRC's final goods exports.

For a vector of explanatory variables contained in *Z*, a gravity specification is formed by including a constant—GDP of importing economies (to measure market size)—the distance between the PRC and trading economies, and a dummy variable for country pairs that share a common language. All variables except the dummies and the constant are in logarithm.

The data on bilateral trade at the 5-digit commodity level are drawn from the United Nations (UN) Comtrade database. We use annual data series for 1992/93–2008/09. The initial year is set to 1992/93 because from this year more countries started reporting under SITC revision 3, and the end year is 2008/09 as this is the latest data available. This time span also covers the period when the PRC's exchange rates to US dollars became flexible to some extent for the period 2005/06–2008/09. GDP and GDP per capita of the PRC and its trading partners are drawn from the World Bank Development Indicators.

5. RESULTS

We employ the fixed-effect model of the panel data estimation methods because it will address the multilateral resistance terms accounting for cross-country price variations in the gravity modeling (Anderson and van Wincoop 2004, Feenstra 2004, Baier and Bergstrand 2007).[5] Regression results of the fixed-effect model are presented in Table 4, and results for

[5] Of course, one limitation of the fixed-effect estimator for the gravity modeling is that it will automatically drop a time invariant variable (a geographical distance).

the fixed effect with time dummies are presented in Table 5. Columns 1–3 report the regression results including all 2-digit industries of both SITC 7 (machinery and transport equipment) and SITC 8 (miscellaneous manufacturing). As shown in Table 1, SITC 8 includes relatively more labor-intensive goods, such as clothing and footwear. The results for industries within SITC 7 are presented in columns 4–6, and columns 7–9 show results for products under SITC 8. We run separate regressions for two industries because the degree of imported parts and components contained in the PRC's final product exports might differ between industries. We expect higher elasticity of exchange rate changes for machinery and transport equipment (SITC 7) than for SITC 8 because imported parts and components are used. We also introduce renminbi's BER and suppliers-weighted RER in separate regressions because of high correlation between two exchange rate indices.

Table 4: Export Elasticity of Exchange Rate Changes to the Final Products in the People's Republic of China (fixed effect)

	SITC 7 and 8			Machinery and Transport Equipments (SITC 7)			Miscellaneous Manufactured (SITC 8)		
Item	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Importer GDP	0.84	0.98	1.12*	1.05**	1.16	1.39**	0.58	0.69	0.81
	[0.511]	[0.675]	[0.569]	[0.474]	[0.737]	[0.577]	[0.522]	[0.593]	[0.545]
BER	-0.96***	-0.76		-1.24***	-0.82		-0.74**	-0.68	
	[0.319]	[0.481]		[0.327]	[0.545]		[0.330]	[0.409]	
Renminbi RER	0.66***		0.61***	1.15***		1.06***	0.30***		0.28***
	[0.074]		[0.084]	[0.093]		[0.106]	[0.057]		[0.066]
WTO	1.11***	1.62***	1.11***	0.89***	1.80***	0.91***	1.13***	1.36***	1.12***
	[0.133]	[0.223]	[0.160]	[0.131]	[0.248]	[0.161]	[0.139]	[0.196]	[0.158]
Constant	-8.85	-10.33	-15.03	-16.82	-15.99	-24.09	0.26	-1.74	-4.94
	[13.062]	[17.388]	[14.926]	[12.087]	[18.984]	[15.085]	[13.355]	[15.308]	[14.341]
Number of Observations	4,976	4,976	5,101	2,985	2,985	3,062	1,991	1,991	2,039
R-squared	0.643	0.587	0.635	0.689	0.589	0.677	0.658	0.632	0.648

Note: Standard errors in square brackets based on White's heteroskedasticity correction cluster by importing economies for SITC 2-digit industry level are given in brackets with statistical significance (two-tailed test) denoted as *** 1%, ** 5%, and * 10%.

Source: Based on the dataset explained in the main text.

Results in Table 4 show that an appreciation of the renminbi bilateral real exchange rates (BERs) on average would decrease the PRC's final product exports, as expected (column 1). A 1.00% appreciation of the BER would decrease the PRC's final product exports by 0.96%. Considering the fact that the renminbi has been pegged to the US dollar for most of the estimation period, this effect is quite large. An appreciation of the renminbi real effective exchange rate (RER) would increase the PRC's exports, as expected. A 1.00% appreciation of the RER would increase exports by 0.66%. These effects are found to be statistically significant at the 1% level. These findings show that renminbi's appreciation against both importing economies and component suppliers would have offsetting effects on the PRC's exports. However, once the BER and RER are estimated separately in columns 2 and 3 in Table 4, the statistical significance of the BER is lost, although the estimated sign remains negative. Perhaps this is driven by high correlation between the BER and RER (the correlation coefficient is around 0.84). While the estimated coefficient for RERs in column 3 remains similar to the one found in column 1, it retains a 1% statistical significance. This makes sense, since most of the value added in the PRC's final exports comes from those East Asian economies.

We also found, as expected, that export elasticity is greater in machinery and transport equipment (SITC 7) than more relatively labor-intensive industry in SITC 8. A 1.00% appreciation of the RER leads to an increase in PRC exports of 1.15% (column 4), whereas the same effect only shows 0.30% in SITC 8 (column 7). Again, this difference in the estimated magnitude comes from greater use of imported parts and components in electronics and transport equipment.

Table 5 presents results of the fixed-effect model with the year fixed effects. The results changed somewhat, although it is understandable that the year effects drive the time series component of increasing the PRC's exports in the estimation period. Now it is found that the estimated sign for the renminbi RER becomes negative, while that of the BER remains an expected negative. This implies that a 1.0% appreciation of the BER would decrease the PRC's exports by 0.6%, and also a 1.0% appreciation of the RER would decrease exports by 0.1% (column 1). In columns 2 and 3 of Table 5, the estimate coefficients for both the BER and RER remain virtually the same with statistical significance. However, column 4 shows the expected signs for the RER—a 1.0% appreciation of the RER would increase the PRC's exports by 0.3%, which is lower than the move shown in Table 4. Moving into column 7, the estimated coefficient for the RER for more labor-intensive products changes again. These findings show that the effect that exchange rates, especially the RER, have on the PRC's exports is quite sensitive to the specifications.

Table 5: Export Elasticity of Exchange Rate Changes to the People's Republic of China's Final Products with the Year Effect (fixed effect with the year effects)

	SITC 7 and 8			Machinery and Transport Equipments (SITC 7)			Miscellaneous Manufactured (SITC 8)		
Item	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Importer GDP	-0.29	-0.28	-0.35	-0.3	-0.31	-0.35	-0.26	-0.25	-0.34
	[0.352]	[0.351]	[0.416]	[0.405]	[0.408]	[0.469]	[0.333]	[0.334]	[0.396]
BER	-0.60*	-0.60*		-0.48	-0.49		-0.76**	-0.75**	
	[0.339]	[0.335]		[0.402]	[0.408]		[0.278]	[0.266]	
Renminbi RER	-0.10***		-0.10***	0.33***		0.35***	-0.25***		-0.24***
	[0.024]		[0.025]	[0.069]		[0.068]	[0.018]		[0.018]
WTO	3.92***	2.53***	3.86***	2.17***	2.29***	1.30***	2.07***	2.74***	1.75***
	[0.218]	[0.241]	[0.244]	[0.315]	[0.269]	[0.145]	[0.224]	[0.112]	[0.137]
Constant	22.84**	22.55**	25.27**	21.92**	22.69**	23.78*	23.27**	22.45**	26.37**
	[9.306]	[9.302]	[11.056]	[10.412]	[10.519]	[12.408]	[9.195]	[9.242]	[10.557]
Obs.	4,976	4,976	5,101	2,985	2,985	3,062	1,991	1,991	2,039
R-squared	0.760	0.759	0.761	0.761	0.758	0.764	0.842	0.831	0.835

Note: Standard errors in square brackets based on White's heteroskedasticity correction cluster by importing economies for SITC 2-digit industry level are given in brackets with statistical significance (two-tailed test) denoted as: *** 1%, ** 5%, and * 10%.

Source: Based on the dataset explained in the main text

We briefly summarize other variables. As found in other studies, income elasticity of the PRC's exports is found to be almost unit elastic and the income effects are larger in machinery and transport equipment (SITC 7). This is consistent with the finding of Thorbecke and Smith (2010) that income elasticity for technology-intensive products (such as digital cameras and laptop computers) is more elastic than relatively labor-intensive products such as clothing and footwear. However, the income elasticity is also not robustly estimated. In Table 5, income elasticity shows an unexpected negative sign and is hardly statistically significant for all regressions. As found in Thorbecke (2011), the World Trade Organization effect is found to be positive and statistically significant in all regressions.

6. CONCLUSION

Since the early 1990s, the PRC's rise as an exporting powerhouse has attracted much attention from policy makers around the world. Many accuse the PRC of unreasonably maintaining a low renminbi to maintain the international competitiveness of its exports. This paper contributes to this debate by examining the PRC's export elasticity to changes in the renminbi from the perspective of the PRC as a final assembly country in production fragmentation. The PRC's trade specialization is based on export processing, whereby final products are assembled using imported parts and components from East Asian economies and then exported to industrial countries. We have computed two exchange rates for the PRC's exports: one is a bilateral real exchange rate of the renminbi, and the other is a real effective exchange rates of the renminbi against East Asian component suppliers. .

Overall, we found that an appreciation of the renminbi against component suppliers in East Asian economies would offset a reduction of exports caused by the renminbi appreciation. This effect is greater in machinery and transport equipment industries, where reliance on imported parts and components remains high. This finding suggests that a bilateral exchange rate change of renminbi alone will not influence the volume of the PRC's exports or correct some of the growing trade imbalance between the US and the PRC. This paper even shows that there is a possibility that renminbi appreciation would actually increase the PRC's final product exports rather than decrease them. The policy implication is that use of the exchange rate tool is more complex and less predictable for economies that take part in supply chains than for those that export goods mainly containing a high proportion of domestic value added.

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