Real exchange rates and manufacturing in China

Ping HUA

Université Clermont Auvergne, CNRS, IRD, CERDI, F-63000 Clermont-Ferrand, France

Ping.hua@uca.fr

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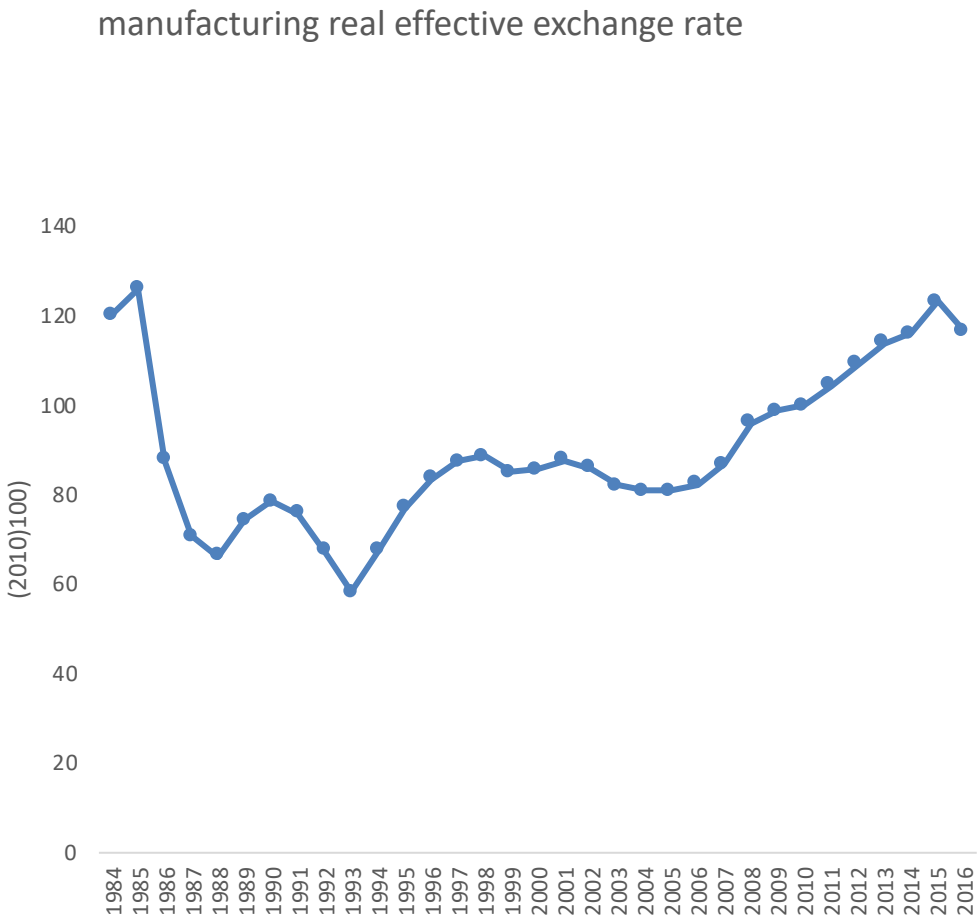
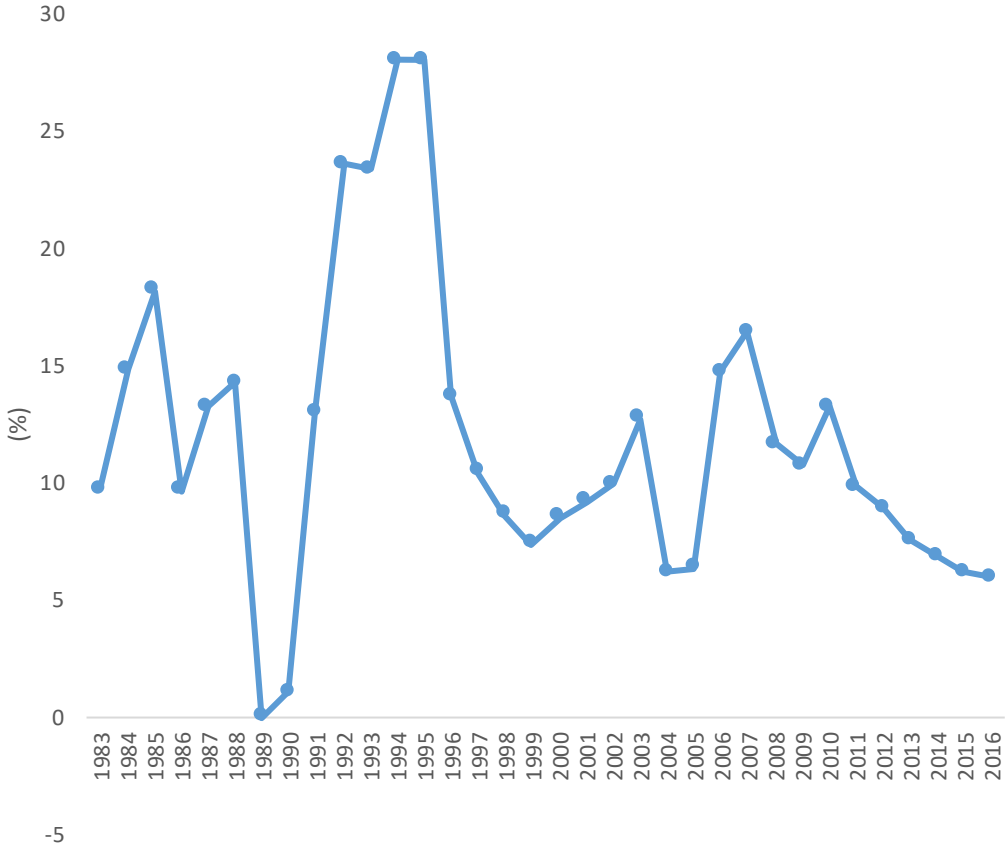
Departure points

- Exchange rate policies have been one of the most active macroeconomic policies taken by the Chinese government since 1978
- marked by a period of strong depreciation of real effective exchange rate of the RMB (an decrease in the figure) from 1984 to 1993 (51%)
- and a period of appreciation and stabilization from 1994 to 2016 (42%).
- NB. An increase of REER means a real appreciation of the RMB



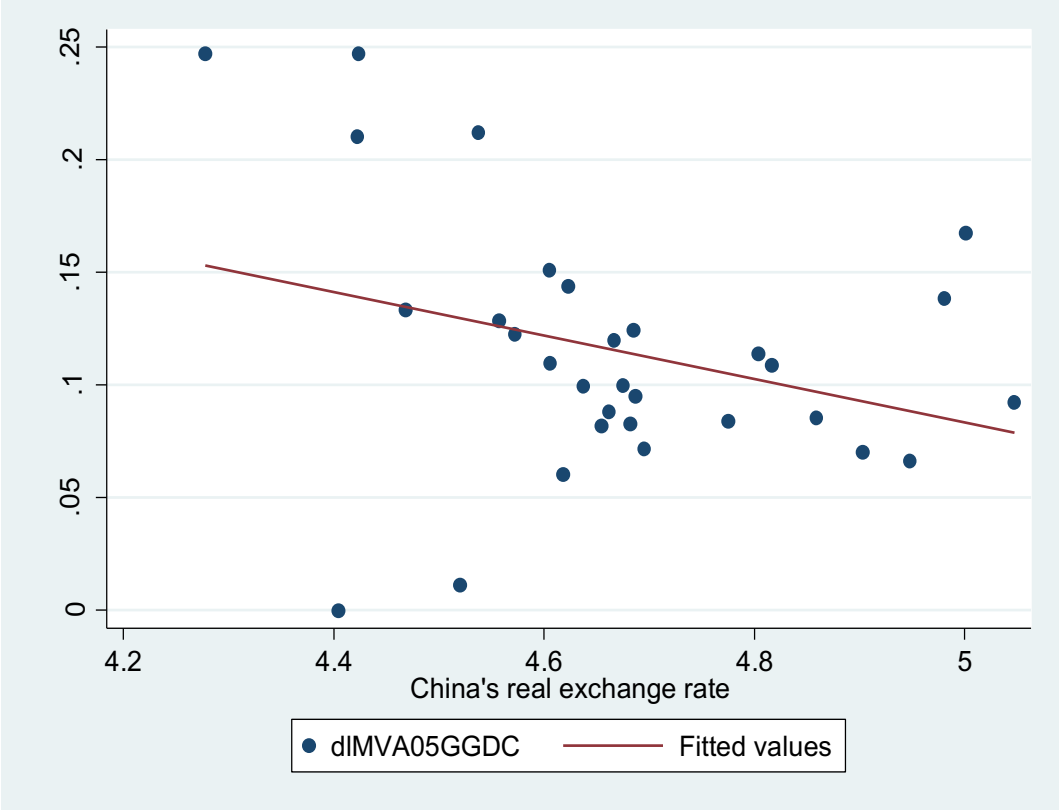
Departure points

- Real manufacturing value added (MVA) increased at an annual average growth rate of 17% over the period from 1984 to 1993 (except 1989 and 1990), higher than that over the period from 1994 to 2016 (10%).
- MVA growth rate is decreasing since 1994, and arrived at the lowest level in 2016 (5,9%) (except 1989 and 1999).



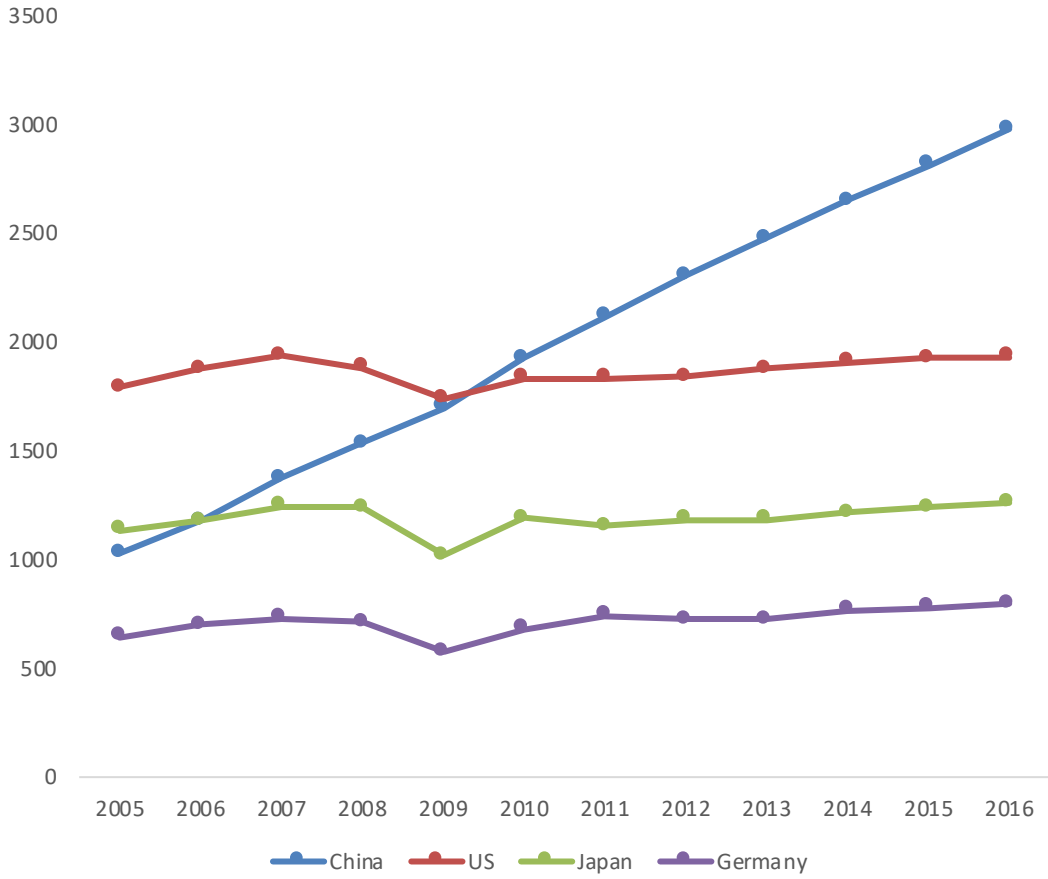
Departure points

- A negative relationship between RMB appreciation and real growth rate of manufacturing value added
- This corresponds to traditional argument of international economics: a real depreciation favors manufacturing and inversely for appreciation



Departure points

- On the other size, 10% per year on average over the period 1994 to 2016 is not so bad for a such long period.
- China became the second biggest world manufacturer in terms of MVA in 2006 and the first one in 2009.
- Some theoretical arguments suppose that real appreciation may exert positive effect on manufacturing.



Objectives

- to explain why theoretically real appreciation of exchange rates may exert two opposite effects (negative and positive), and thus its total effect is theoretically uncertain. An empirical investigation is thus necessary.
- to propose a “real exchange rate” augmented model of manufacturing determinants
- To apply the model into the Chinese manufacturing

Plan

- 1. Theoretical arguments on manufacturing impact of real appreciation,

- Why it is bad for manufacturing ?

- Why it may be good for manufacturing ?

- 2. A manufacturing model
- 3. empirical results of Chinese manufacturing
- 4. conclusion: political and economic implications

2. Theoretical arguments: why real appreciation is bad for manufacturing?

- Bad for the size of tradable sector

→ Real appreciation causes deterioration in international competitiveness of domestic enterprises relative to their foreign competitors and leads to a reduction in exports and an increase in imports.

→ This deterioration reduces the profits of the export sector. It decreases industrial self-financing for private and foreign enterprises and their will to invest in the industrial sector, and more generally in the tradable goods sector.

→ If the tradable goods sector is the most efficient and innovative sector, real appreciation may affect manufacturing industry negatively, in addition to its impact on exports-led firms.

2. Theoretical arguments: why real appreciation is bad for manufacturing?

- Bad for employment

→ A real exchange rate appreciation decreases the cost of imported inputs relative to real wages, deteriorates the international competitiveness of domestic firms and exerts pressure on efficiency improvement.

→ This negative effect extends even beyond the tradable sector in China because of the importance of services as an intermediate input in export production (Chen & Dao, 2011).

2. Theoretical arguments: why real appreciation is good for manufacturing?

- Positive effect on capital intensity

→ Real appreciation decreases the cost of imported machines and equipment relative to wages, thus favours capital-intensive manufacturing industry and push labour-intensive industry to be more capital intensity if it wants to stay competitive.

→ Ex, Chinese manufacturing enterprises use more and more robots in the production to avoid the increasing labor costs. According to BBC, Apple and Samsung supplier Foxconn in China has reportedly replaced 60 000 factory workers with robots (Wakefield, 2016). Only one factory has "reduced employee strength from 110 000 to 50 000 thanks to the introduction of robots", according to the South China Morning Post (30 may, 2016).

2. Theoretical arguments: why real appreciation is good for manufacturing?

Positive effect on efficiency

- A real exchange rate appreciation increases the real remuneration of workers expressed in tradable goods.

→This increase causes efficiency improvements by workers in a country where the wages of unskilled workers relative to living life are still low. A labor remuneration that is too low might make workers unhealthy and reduce their capacity for work. The motivation of workers has an effect on efficiency, known as “X-efficiency” (Leibenstein 1957, 1966).

→ This slows down brain drain, stimulates Chinese students came back and allows hunting brain to satisfy the needs of enterprises to employ qualified workers and to develop high technology products, leading thus efficiency improvement. In 2017, 480 000 Chinese students came back the highest level according to Education Ministry. China benefits more qualified workers

2. Theoretical arguments: why real appreciation is good for manufacturing?

Positive Impact on technical efficiency

→ Managers only benefit from a part of the profit induced by a better management since a part of the profit goes to the owners of the enterprise. In the case of monopoly, managers do not choose to maximize the profit, but to seek other profitable opportunities such as the power and satisfaction gained from having more employees (Baldwin, 1995). As Marshall said, the better profit of a monopoly is a quiet life.

→ Under strong pressure of foreign competitors, the managers will choose a higher effort by eliminating excess labour or possibly by introducing labour-saving techniques. They do so not only because this behaviour may increase the profit in the short run, but also because the decrease of costs dissuades competitors from entering into the market and thus avoids a fall in the price. Due to this strategy, there is an additional benefit, which may push management effort near to its optimum.

2. Theoretical arguments: why real appreciation is good for manufacturing?

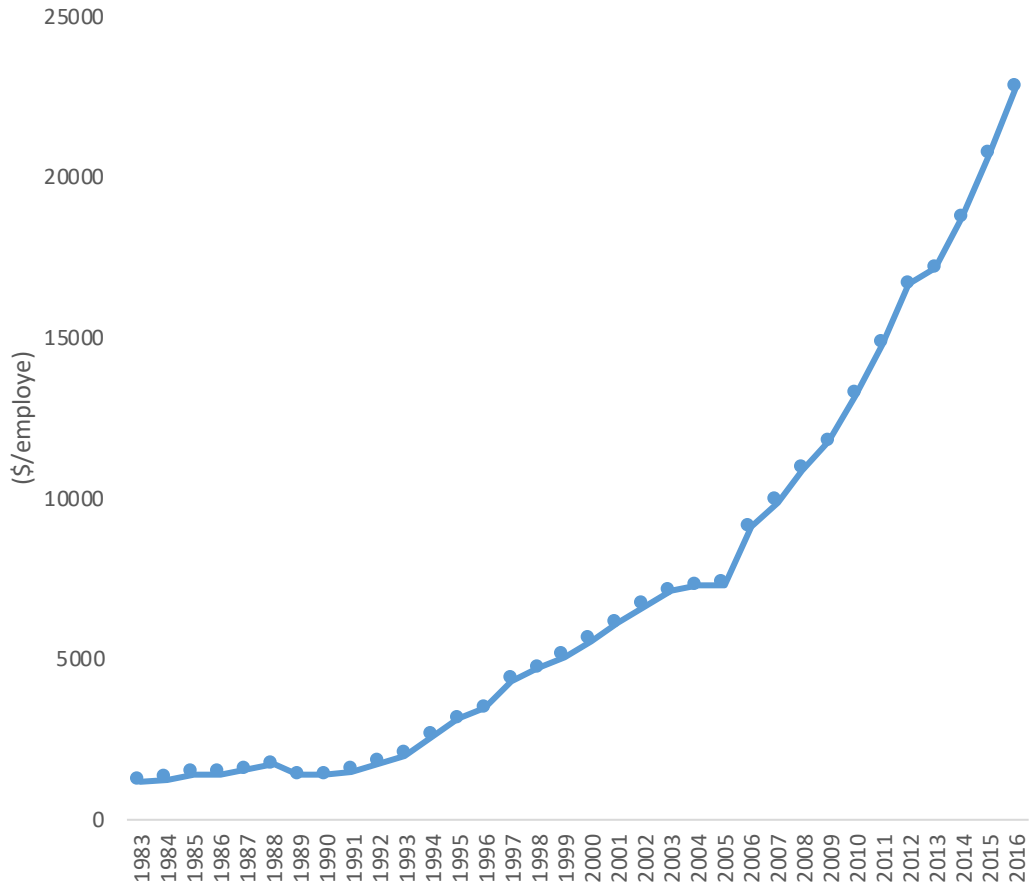
- Schumpeterian “creative destruction”

→ In a more general manner, in any market structure, the intensification of foreign competition due to currency real appreciation is favourable to the productivity of manufactured firms as some of them are obliged to close their poorer performing factories, or even to close down completely; in favors of the enterprises which perform better, innovate and create new products.

→ Under the pressure of the renminbi appreciation since 1994, Chinese firms have been more and more exposed to foreign competition, and a large number of firms were obliged to reform their management, to group together (industry cluster) or to close down. It is reported that more than 4000 enterprises were closed in 2014 in Dongguan, a key manufacturing city in southern China's Guangdong province (Salvacion, 2015).

Chinese manufacturing labour productivity

- MVA labor productivity increased from 1 182 $/employee in 1983 to 22 752 $/employee in 2016 (more than 19 times).
- It increased at an average growth rate of 9.7% in the period of real appreciation against 3.6% during the period of depreciation
- a kind of virtuous circle: the real appreciation boosts the growth of MVA labour productivity while, according to the Balassa-Samuelson effect, productivity growth tends to push up the real appreciation.



Two opposite effects of real appreciation on manufacturing

Negative ones on the size of tradable sector

- *Traditional negative effect through*

-exports volume, FDI, size of private enterprises etc.

- resource allocation effect

- Manufacturing employment

Positive ones on productivity improvement

- *Capital intensity effect*
- *efficiency" effect*
- "technical efficiency"effect (Krugman, 1989)
- *Effect of Schumpeterian "creative destruction" (*Schumpeter, 1942)
- *Innovation-led productivity improvement (*Alfaro et al., 2018)

Table 1: Expected impacts of real exchange rate appreciation on manufacturing

Direct impacts	Via « work effort » of workers and managers			$\Rightarrow^{+}$
Indirect impacts via transmission channels	Impact of real exchange rate appreciation on intermediary variables **(a)**		Impact of intermediary variables on manufacturing (b)	Impact of exchange rate on manufacturing (c)=(a)*(b)
	Size of tradable sector	$\Rightarrow$ Exports	$\Rightarrow^{+}$	$\Rightarrow$
		$\Rightarrow$ FDI	$\Rightarrow^{+}$	$\Rightarrow$
		$\Rightarrow$ Private ratio	$\Rightarrow^{+}$	$\Rightarrow$
	Inputs	$\Rightarrow$ employment	$\Rightarrow^{+}$	$\Rightarrow$
		$\Rightarrow^{+}$ Capital intensity	$\Rightarrow^{+}$	$\Rightarrow^{+}$
Net impact of real exchange rate				$\Rightarrow^{?}$

3. An econometric model of the impacts of real exchange rate on manufacturing

$$\ln MVA_t = a_0 + a_1 \ln RER_t + a_2 \ln X_t + a_3 \ln FDI_t + a_4 \ln PRIV_t + a_5 \ln K/L_t + a_6 \ln L_t + \varepsilon_t \quad (1)$$

$$\ln X_t = b_0 + b_1 \ln RER_t + \varepsilon_{t1} \quad (2)$$

$$\ln FDI_t = c_0 + c_1 \ln RER_t + \varepsilon_{t3} \quad (3)$$

$$\ln PRIV_t = d_0 + d_1 \ln RER_t + \varepsilon_{t4} \quad (4)$$

$$\ln KL_t = e_0 + e_1 \ln RER_t + \varepsilon_{i5} \quad (5)$$

$$\ln EM_t = f_0 + f_1 \ln RER_t + \varepsilon_{it7} \quad (6)$$

3. An econometric model of the impacts of real exchange rate on manufacturing

- As all the intermediate variables are added into the equation 1, the coefficient of the real exchange rate measures only the effects that are not captured by the intermediary variables and notably the direct effects on work effort. Its expected sign is positive.
- Equations 2 to 6 allow checking if the intermediary variables are effectively channels through which real exchange rate affects on manufacturing

3. Econometric estimation

- Econometric estimation are unfortunately limited by data availability on MVA
- The data on China's real manufacturing value added are obtained from *GGDC 10-Sector Database* published by the Groningen Growth and Development Center (Timmer et al. 2014) and completed by United Nation Statistics Division (UNSD), but only at total manufacturing level
- In February 2018, WIOD published MVA for 18 manufacturing sectors over the period from 2000 to 2014
- A macro manufacturing real effective exchange rate indices as the ratio of the consumer price index of China to the average consumer price index of its 10 main exports partners of manufactured goods, all prices being converted into the same currency.

3. Econometric estimations

- The studied variables are not stationary at absolute level I (0), but are integrated at first difference I (1).
- The results of Johanson cointegration test show that they are cointergrated I (0) as well as the estimation residuals are
- An error correction model (ECM) is used to distinguish short-run from long-run behaviour, to test if the error correction term is statistically significant and to check the speed of adjustment to the long-run equilibrium.

Table 4. Effects of real exchange rate on manufacturing value added: 1984-2016

	1	2	3	4	5	6
	Long-run regression	Long-run regression	Short-run regression	Short-run regression	ECM	ECM
Ln(Real effective exchange rate)	0.32*** (3.69)	0.29*** (3.98)	0.20** (2.02)	0.17* (1.95)	0.31*** (3.06)	0.24*** (3.40)
Ln(Capital intensity in manufacturing)	0.51*** (6.54)	0.41*** (5.07)	0.46*** (5.05)	0.37*** (5.00)	0.47*** (6.72)	0.37*** (6.45)
Ln(Employment in manufacturing)	0.61*** (3.05)	0.55*** (3.09)	0.40** (2.74)	0.36** (2.46)	0.43*** (3.20)	0.36** (2.80)
Ln(Real exports of manufactured goods)	0.22** (2.34)		0.16** (2.23)		0.15** (2.30)	
Ln(Real ordinary exports of manufactured goods)		0.16*** (3.57)		0.17*** (3.31)		0.13** (2.44)
Ln(Real FDI in manufacturing)	0.02 (0.28)	0.11* (1.74)	0.12 (1.52)	0.16* (1.87)	0.11* (1.69)	0.15** (2.38)
Ln(Private share in total manufacturing)	0.32*** (5.16)	0.29*** (5.22)	0.22*** (3.03)	0.19*** (3.25)	0.22*** (3.18)	0.22*** (3.40)
EC coefficient$_{t-1}$					-0.50* (-1.94)	-0.60** (-2.09)
Constant	4.01 (1.22)	3.21 (1.07)	-0.004 (-0.21)	0.005 (0.32)	-0.01 (-0.35)	0.01 (0.65)
Number of observations	30	30	30	30	30	30
ADF unit root test for residual	I(0)**	I(0)***				
Johansen cointegration tests	1	1				

Note: 1. Variables are at absolute level for long-run regressions (columns 1 and 2), and at first difference level for short-run regressions and error correction estimation (columns 3, 4, 5, 6).

-*, ** and *** indicate significance at the 10%, 5% and 1% levels of confidence, respectively.

Table 5: Estimation of the channelling variables of the real exchange rate to manufacturing value added: 1984-2014

	7	8	9	10	11	6
Long-run regressions	Export of manufactured goods	Ordinary export of manufactured goods	Manufacturing FDI	Private share in manufacturing	Manufacturing Capital intensity	Manufacturing employment
Real effective exchange rate	-0.54*** (-4.04)	-0.35*** (-3.42)	-1.58*** (-5.97)	-0.81*** (-3.67)	0.31*** (3.00)	-0.56*** (-6.08)
Trend	0.17*** (61.3)	0.16*** (53.5)	0.17*** (30.5)	0.11*** (14.3)	0.10*** (43.1)	0.01*** (3.58)
Constant	25*** (41.7)	24.3*** (47.5)	28.2*** (22.6)	3.40*** (2.85)	7.46*** (14.8)	20.9*** (52.9)
Short-run regressions	12	13	14	15	16	6
Real effective exchange rate	-0.55*** (-3.09)	-0.05*** (-3.23)	-0.44* (-1.74)	-0.10 (-0.42)	0.005 (0.04)	-0.21* (-1.93)
Constant	0.15*** (8.53)	0.12*** (5.33)	0.18*** (7.04)	0.11*** (4.55)	0.11*** (9.35)	0.01 (0.96)
Number of observations	30	30	30	30	30	30

Table 2: Direct and indirect effects of real exchange rate appreciation on manufacturing

Effects		Coefficients	Long-run	Short-run
Direct effects		a_1	0.29	0.17
tradable sector	ordinary exports	a_2b_1	-0.06	-0.01
	FDI	a_3c_1	-0.17	-0.07
	private sector	a_4d_1	-0.23	-0.02
Inputs	employment	a_5e_1	-0.31	-0.08
	capital intensity	a_6f_1	0.13	NS
net effects		$(a_1 + a_2b_1 + a_3c_1 + a_4d_1 + a_5e_1 + a_6f_1)$	-0.35	-0.01

3. Econometric estimations

- Real appreciation of the renminbi exerts
- positive effects on manufacturing value added by improving the work efficiency of workers and staffs, keeping the best performing enterprises via a kind of Schumpeterian “creative destruction” and favouring capital intensive production and innovation
- negative effects via its transmission channels such exports, FDI, private importance in manufacturing sector and employment,
- leading finally a net negative effect.
- The real appreciation of the renminbi of 43% during the period 2004-2016 has led a decrease of 15% of manufacturing value added.

3. Econometric estimations

For robustness tests, a manufacturing product real effective exchange rate of the renminbi is calculated as the weighted product of 188 product real effective exchange rates in function of their importance in the total exports of 188 products at HS4 level, which are the most important products exported by China.

Each product real effective exchange rate is calculated as the product of consumer price of China and the weighted consumer price of the ten most important exporters of the product in world market.

So, partners are very different : Macro REER with USA as the first partner, while for Micro product REER, USA is only the first partner for 23 products among 188 products.

Effects of micro product real exchange rate on manufacturing value added: 1994-2016

	1b	2b	3b	4b	5b	6b
	Long-run	Long-run	Short-run	Short-run	ECM	ECM
Ln(Real effective exchange rate)	0.60*** (4.33)	0.48** (2.11)	0.42* (1.77)	0.35* (1.95)	0.57*** (3.59)	0.52*** (3.03)
Ln(Capital intensity in manufacturing)	0.35*** (4.23)	0.38*** (3.46)	0.36 (1.36)	0.31 (1.11)	0.44** (2.49)	0.47** (2.43)
Ln(Employment in manufacturing)	0.60*** (4.33)	0.65*** (3.97)	0.49* (1.82)	0.46* (1.79)	0.59*** (3.33)	0.28** (3.35)
Ln(Real exports of manufactured goods)	0.34** (4.52)		0.25** (2.52)		0.30** (4.61)	
Ln(Real ordinary exports of manufactured goods)		0.25*** (3.18)		0.17* (1.95)		0.21** (3.58)
Ln(Real FDI in manufacturing)	-0.02 (-0.42)	0.02 (0.35)	-0.02 (0.18)	0.02 (0.22)	-0.04 (-0.66)	-0.04 (-0.53)
Ln(Private share in total manufacturing)	0.14** (2.31)	0.25*** (4.30))	0.18* (1.63)	0.21 (1.72)	0.18** (2.52)	0.28*** (3.35)
EC coefficient$_{t-1}$					-1.12*** (-4.29)	-1.02** (-4.11)
Constant	0.47 (0.17)	0.71 (0.21)	0.11 (0.31)	0.02 (0.59)	-0.01 (-0.35)	0.01 (0.65)
Number of observations	21	21	31	31	31	31
ADF unit root test for residual	I(0)**	I(0)***				
Johansen cointegration tests	1	1				

3. Econometric estimations

For robustness tests, a manufacturing sector real effective exchange rates of the renminbi is also calculated for each of 18 manufacturing sectors according to ISIC revision 4, as the ratio of the consumer price index of China to the average consumer price index of its 18 exports partners of manufactured goods, all prices being converted into the same currency.

We have introduced only exports of manufactured goods in estimation because the data on FDI and private importance are not available

The estimation is on panel data for 18 manufacturing sectors and over 2006 to 2014, a period marked by real appreciation.

Impact of renminbi real appreciation on 18 industrial sectors over 2006-2014 period

	MVA	MVA	ln(Exports of manufactured goods)	ln(capital intensity)	Ln(manufacturing employment)
Ln(Real effective exchange rate)$_{-1}$		2.14* (1.87)	-1.76*** (-3.27)	0.61** (2.01)	-0.68** (-1.93)
Ln(Exports of manufactured goods)$_{-1}$	0.21* (1.86)	0.21* (1.93)			
Ln(Capital intensity)$_{-1}$	1.64*** (7.93)	1.49*** (6.82)			
Ln(manufacturing employment)$_{-1}$	2.14*** (12.8)	2.05*** (11.8)			
Number of observations	144	144	144	144	144
Number of groups	18	18	18	18	18

4. Conclusion: economic and political implications

- China should gradually revalue the renminbi in function of productivity improvement to avoid the serious deceleration of manufacturing industry when its negative impacts are higher than the positive ones.
- This allows China's manufacturing upgrading from low cost labour-intensive industry to capital-intensive one based on innovation and technologies and moving China from low value chain up to high value chain to realize the objective of "Made-in-China 2025 strategy."
- China's manufacturing upgrading strategy put developed countries under strong pressure, leading China-US trade confit for example.
- So, the challenge for China to realize productivity improvement-led industrialization is much higher than that of labour-intensive-led one. China has no choice to upgrade manufacturing to avoid middle income trap and to become high income country.