Export Destination and Export Market Penetration of the People’s Republic of China—Past and Future

RUI MAO AND BIN ZHANG

Growth in the aggregate market penetration rate (MPR) of the People’s Republic of China (PRC) slowed during the period 2002–2014. Closer examination of the destinations and product levels reveals a simultaneous weakening in various markets. Production and trade costs were found to be the main determinants of these changes, while productivity growth and real exchange rate appreciation had either insignificant or limited effects. Predicting trends until 2016, we expect the MPR in almost all destinations and product markets to increase in the optimistic case. However, in a more realistic case, the MPR will likely plateau or fall in most markets. To stabilize exports, the PRC must actively facilitate structural transition in destinations and products. Meanwhile, macro policies to boost domestic demand are also urgently needed to maintain the country’s high economic growth.

Keywords: market penetration rates (MPR), determinants of MPR, prediction of MPR

JEL codes: E66, F13, F14, F17, O53

I. Introduction

The People’s Republic of China (PRC) has implemented a highly successful export-led growth over the past decade. Its total export value increased from $326 billion in 2002 to $2.21 trillion in 2013, implying an average annual growth rate of about 17%. However, the global financial crisis halted export growth. In 2008, export grew by only 16% from the previous year. In 2009, export even shrank by 17%. As this engine sputtered, the PRC’s overall economy lost steam. The country’s gross domestic product (GDP) growth rate was 9.6% in 2008, only about two-thirds of that a year ago. Contribution of net exports was merely 9%, falling by more than half in a year. It further went down to –38.9% in 2009, the first negative contribution

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recorded this century. Consequently, the GDP growth rate reached a new low of 9.2%.

The slowdown of the PRC’s export growth could have resulted from either contracting external demand or a declining market share in external markets. This can be seen from the following equation:

\[
\text{Export growth} = \text{Growth of other countries’ imports} + \text{Growth of market shares in other countries.} \tag{1}
\]

Whereas the contraction of external demand had been mainly a cyclical change caused by the financial crisis, changes in market shares were less volatile and indicative of a downward trend. The PRC’s market shares remained depressed and stumbled for a long time, but external demand picked up shortly after the crisis broke out. In short, the country’s shrinking market shares were not merely a consequence of its falling external demand. In another study, we decomposed the PRC’s export growth to changes in its external demand and market shares based on Equation (1) and found that market shares could explain over 60% of the change in export growth (Zhang 2014). Since a decline in market shares implies a falling status relative to other exporters in the world market, this result implies that our recent observations of the PRC’s export market were not merely cyclical symptoms caused by the global recession, but signs of a waning trend in relative strength.

Of course, market share measured by the market penetration rate (MPR) is only one of several measures of export competitiveness, a term that represents the relative strength of a particular exporter versus a number of other competitors. We also summarize five indices of export competitiveness that have been frequently used in the literature and compare their applicability and limitations. Among them, the MPR not only stands out for its simplicity and robustness to aggregation biases, but also serves as the only measure that can distinguish substantial differences across destinations and product markets at the same time. Moreover, according to Equation (1), the MPR has a direct link with export growth, so it could serve as a desirable measure to understand the change in observed aggregate export data.

As both export competitiveness and its determinants were often examined at the aggregate level in the literature (e.g., Zhang 2001, Eaton and Kortum 2002), this paper fills a gap by providing a closer examination of destinations and product levels in the discussion of the MPR index. Moreover, the destination and product structure of the PRC’s exports have been rapidly changing such that the nature of the transformation has become an increasingly important policy question. Therefore, we adopt the MPR as an indicator of the relative strength of the PRC’s exports.

Focusing on the PRC’s 14 major trading partners, we find that the growth rate of the PRC’s aggregate MPR had been slowing during 2002–2014. As Figure 1 below shows, the aggregate MPR maintained a growth uptrend until mid-2010, and
only then started to decline. However, it gradually regained its pre-crisis level from 2012 to early 2014.

It is worth noting that the PRC’s aggregate MPR did not always move in line with its external demand. In particular, while average demand for the country’s exports sharply fell at the height of the global financial crisis in late 2008 and kept declining until May 2009, aggregate MPR even increased during the period. However, while external demand recovered between mid-2009 and early 2012, aggregate MPR was on a decline. This simple observation suggests that external demand is apparently not the only determinant of the MPR.

At a more detailed level, signs of weakening of the PRC’s MPR have been observed for different destination and product markets. The country’s MPR in Japan has plateaued since mid-2003, while that in the European Union (EU), India, the Russian Federation, and the Republic of Korea has stopped growing since 2008. The measure meanwhile saw a slowdown in the context of the United States (US); Canada; and Taipei, China. Only in the Association of Southeast Asian Nations (ASEAN), Australia, Brazil, Saudi Arabia, and South Africa has the PRC maintained a rising trend in its MPR.

As regards product markets, the PRC’s MPR has stopped growing and has even begun to fall in the markets for food, live animals, beverages, tobacco, oils, and fats; petroleum, coal, and gas; and furniture, clothing, and other products. MPR growth has also slowed and showed signs of plateauing in the markets for chemicals, pharmaceuticals, and plastic products; leather, rubber, metal, and textile manufactures; and machinery and transport equipment.

We find production costs, trade costs, productivity, and the real exchange rate to be the four fundamental causes behind these changes. In our regression results, production and trade costs are significantly and negatively correlated with the MPR.
Before 2009, the PRC’s production costs were rising, but its trade costs were falling. The positive effect of falling trade costs outweighed the negative effect of rising production costs, leading to an increase in the MPR. However, the negative effect of production costs predominated since 2009, as production costs grew constantly while trade costs declined more slowly. After a short period of stalemate, the MPR therefore began to fall. The MPR was able to recover in 2012, thanks to a slowdown in the growth of production costs.

The effect of productivity on the PRC’s MPR is also significantly positive in our regressions, but the impact of late seems limited. Considering that productivity of most sectors in the PRC hardly changed in the past decade, productivity has not been an essential determinant of the MPR. On the whole, the effect of the real exchange rate on the MPR is not significant, although it is important in some markets.

Finally, we predict the PRC’s MPR in various destinations and product markets according to trends in the four determinants. Our results reveal that if the optimistic scenario occurs where pre-crisis upward yearly trends are maintained, then the MPR will increase in all destination markets except Japan, and in four out of six product markets except for petroleum, coal, and gas; and food, live animals, beverages, tobacco, oils, and fats. Otherwise, the said measure of competitiveness will either reach a plateau or fall in most destinations, except ASEAN and the Republic of Korea, and in terms of products, in the market for leather, rubber, metal, and textile manufactures.

II. The Market Penetration Rate and Other Measurements of Export Competitiveness

A. Five Frequently Used Indices

The MPR is an index that is frequently used in the literature to measure export competitiveness. Equation (1) demonstrates that it is a desirable measure to understand observed export data owing to the direct link between the two. Compared to other indices of export competitiveness often used, the MPR is preferred because of its simplicity and robustness to aggregation biases as well as its capability to allow for distinctions in destinations and product markets.

To see this, we compare the MPR with four other well-known measures of export competitiveness: (i) international market share, (ii) revealed comparative advantage, (iii) the trade specification coefficient, and (iv) revealed competitive advantage. Table 1 summarizes the results.

International market share is defined as \( \frac{X_{ik}}{X_{wk}} \), where \( X_{ik} \) is country \( i \)'s exports of good \( k \), and \( X_{wk} \) is the world's total exports of good \( k \); that is, it represents country \( i \)'s share in the global export market of good \( k \). When \( k \) refers to all goods, it
Table 1. Measurements of Export Competitiveness

| Measurement                      | Calculation                                      | Application                          | Features                                      |
|----------------------------------|--------------------------------------------------|--------------------------------------|-----------------------------------------------|
| Market share                     | $X_{ik}/X_{wk}$                                  | Between countries/products           | Easy, but cannot distinguish destinations     |
| MPR                              | $X_{ijk}/M_{jk}$                                 | Between countries/products           | Needs importer information                    |
| Revealed comparative advantage   | $(X_{ik}/X_{ik})/(X_{wk}/X_{w})$                  | Between countries/products           | Excludes scale effects, but biased to 1        |
| Trade specification              | $(X_{ik} - M_{ik})/(X_{ik} + M_{ik})$             | Between products                     | Excludes import effects                       |
| Revealed competitive advantage   | $RCA_{ik} = (M_{ik}/M_{i})/(M_{wk}/M_{w})$        | Between countries/products           | Most extensive, but biased to 0               |

MPR = market penetration rate.
Source: Authors’ compilations.

measures a country’s aggregate export competitiveness. However, this index cannot distinguish a country’s competitiveness in different destinations. The MPR does not have this problem. Defined as $X_{ijk}/M_{jk}$, it measures the share of country i’s exports of good k to country j, $X_{ijk}$, in country j’s total imports of good k, $M_{jk}$. However, both the MPR and international market share are subject to the influence of the relative economic size of countries and thus may not reflect real competitiveness.

To take economic scale into account and make cross-country comparisons reasonable, Balassa (1965) proposed the concept of revealed comparative advantage, calculated as $(X_{ik}/X_{i})/(X_{wk}/X_{w})$, where $X_{ik}$ and $X_{wk}$ are again exports of good k of country i and the world as a whole, and $X_{i}$ and $X_{w}$ are total exports of country i and the world, respectively. Nevertheless, like international market share, it cannot be applied to destination-specific studies. In addition, if we sum up a country’s revealed comparative advantage in all product markets using export shares as weights, the aggregation tends to bias toward unity when deviations of export intensities from world average levels are smoothed out.

Besides scale effects, another challenge to the MPR and international market share is that they do not consider re-exports. As a result, for a country that concentrates on transit trades such as a “hub port,” its MPR and international market share, which only use export data, can both be large, even if it runs a trade deficit.

In contrast, the trade specification coefficient adopted by Liu (2002) takes into account import information. It is calculated as $(X_{ik} - M_{ik})/(X_{ik} + M_{ik})$, where $X_{ik}$ and $M_{ik}$ are, respectively, country i’s exports and imports of good k. However, if the coefficient is around 0, it may suggest either weak competitiveness or a large share of intra-industry trade. In addition, this index uses a country’s domestic information, so it cannot compare competitiveness relative to other countries. Also, like international market share and revealed comparative advantage, this index cannot distinguish export competitiveness across destinations.
Defined as \( (X_{ik}/X_i)/(X_{wk}/X_w) - (M_{ik}/M_i)/(M_{wk}/M_w) \), the revealed competitive advantage index is a hybrid of the revealed comparative advantage index and the trade specification coefficient, and takes both economic scale effects and re-exports into account. However, it also has the disadvantages of these indices.

To sum up, the MPR stands out as a relatively ideal index to measure export competitiveness by destination and product. Nevertheless, it also requires several modifications prior to application.

**B. Modifications to the Market Penetration Rate**

Both economic scale effects and re-exports tend to impair the MPR’s ability to represent the relative strength of Chinese exports. First, because the PRC’s economic size continued to expand even if the relative strength of its exports remained constant, the MPR still increased. That is, the MPR may have exaggerated the country’s gain in the relative strength of its exports because of economic size effects. Second, most economies recorded imports from the PRC and Hong Kong, China separately. However, most imports from Hong Kong, China were actually re-exported products from the PRC. Therefore, failing to take the products exported through the PRC’s main “hub port” into account tends to underestimate the relative strength of the PRC’s exports.

To deal with economic size effects, we exclude changes caused by the PRC’s expanding economic size from the MPR directly. In particular, if we let \( y_c \% \) be the PRC’s GDP growth rate over a particular period and \( y_r \% \) be the GDP growth rate of the rest of the world (i.e., the world excluding the PRC and the destination economy), then \( (y_c \% - y_r \%) \) measures the rate of relative expansion of the PRC’s economy in that period. As a result, if the PRC’s MPR in the previous period was \( x \% \), then it would grow by \( (y_c \% - y_r \%)x \% \) in this period simply due to the effect of the PRC’s relatively expanding economic size. Hence, in order to accurately represent the relative strength of the PRC’s exports, an amount of \( (y_c \% - y_r \%)x \% \) must be excluded from the MPR.

To take into account the PRC’s transit exports through Hong Kong, China, we prefer to add all products re-exported by Hong Kong, China back to the PRC’s direct exports of these products to each destination market. Unfortunately, while we have access to the PRC’s export destination and product-level export data, we could not obtain such detailed information on transit exports. As an alternative, we have to assume that the PRC’s transit exports of any product through Hong Kong, China were eventually allocated to each destination in a share that is identical to the PRC’s direct exports of that product to the destination.

Mathematically, let \( X_{Hk} \) be the PRC’s exports of good \( k \) to Hong Kong, China and let \( X_{jk} \) be the PRC’s exports to destination \( j \), other than Hong Kong, China. Supposing we calculate the PRC’s transit exports of good \( k \) through Hong Kong, China to destination \( j \) as \( X_{Hk}(X_{jk}/\Sigma_j X_{jk}) \), we can then add transit exports to the
PRC’s direct exports to destination \( j \) to get its total imports from the PRC, \( X_{ijk} \), and calculate the MPR correspondingly. This allows us to take the PRC’s transit exports through Hong Kong, China back into account.

### III. Measuring the Market Penetration Rate of the People’s Republic of China

#### A. Data and Method

The MPR is defined as \( X_{ijk} / M_{jk} \), where \( X_{ijk} \) is the PRC’s exports of good \( k \) to country \( j \) (including transit exports through Hong Kong, China), and \( M_{jk} \) is country \( j \)’s total imports of good \( k \). As mentioned earlier, the ratio is then adjusted for economic size effects. To calculate these ratios, we need export destination data and product-level export data of the PRC as well as each destination market’s product-level total imports and product-level imports specifically from the PRC. These data are available from the CEIC database at a monthly frequency from January 2002 to June 2014.

Once these ratios—i.e., the PRC’s MPR in each destination–product market—are calculated, they can be further aggregated across two dimensions. By summing them over all products according to \( \Sigma_k (\alpha_{jk} X_{ijk}) \), we get the PRC’s MPR in a specific destination \( j \). The aggregation weight here, \( \alpha_{jk} \), is the share of destination \( j \)’s imports of good \( k \) in its total imports, \( M_{jk} / M_j \). By summing them over all destinations according to \( \Sigma_j (\beta_{jk} X_{ijk}) \), we get the PRC’s MPR in a specific product market \( k \). The aggregation weight here, \( \beta_{jk} \), is the share of the PRC’s exports of good \( k \) to destination \( j \) in its total exports of good \( k \), \( X_{jk}/X_k \).

Finally, we can sum up the PRC’s MPR on both dimensions according to \( \Sigma_j \gamma_j [\Sigma_k (\alpha_{jk} X_{ijk})] \), where \( \alpha_{jk} = M_{jk} / M_j \) is the same as before and \( \gamma_j = X_j / X \) is the share of the PRC’s total exports to destination \( j \) in its total exports to the world. This weighted sum measures the PRC’s aggregate MPR.

In this paper, we consider 14 major destinations of Chinese exports. They are the US; the EU; Hong Kong, China; ASEAN countries; Japan; the Republic of Korea; India; the Russian Federation; Australia; Taipei, China; Brazil; Canada; Saudi Arabia; and South Africa. Together they account for more than 80% of the PRC’s total exports. However, Hong Kong, China is regarded as a hub port through which the PRC’s products are re-exported to other destinations. Therefore, we examine how the PRC’s MPR changed over time in just the remaining 13 destinations.

With regard to the PRC’s MPR in different product markets, we notice that products have been categorized under the various data standards for data of different sources. In particular, import data reported by most destination markets adopted the SITC classification standard, whereas the PRC’s customs data for exports adopted the HS classification standard. To match the two standards, we aggregate the nine product categories under the SITC classification into the six product categories of...
Table 2. Transformation of Product Categories

| SITC Nine Product Categories | HS Six Product Categories                  |
|------------------------------|--------------------------------------------|
| Food and live animals, beverage and tobaccos, oil, and wax | Food, live animals, beverages, tobacco, oils, and fats |
| Mineral fuels, lubricants, and raw materials | Petroleum, coal, and gas |
| Chemical and related products | Chemicals, pharmaceuticals, and plastic products |
| Nonedible raw materials, products classified by raw materials | Leather, rubber, metal, and textile manufactures |
| Machinery equipment | Machinery and transport equipment |
| Miscellaneous products | Furniture, clothing, and other products |

SITC = Standard International Trade Classification, HS = Harmonized System.
Source: Authors’ compilations.

the HS classification as shown in Table 2. Hence, we eventually examine the PRC’s MPR in six product markets: (i) food, live animals, beverages, tobacco, oils, and fats; (ii) petroleum, coal, and gas; (iii) chemicals, pharmaceuticals, and plastic products; (iv) leather, rubber, metal, and textile manufactures; (v) machinery and transport equipment; (vi) furniture, clothing, and other products.

B. Aggregate Market Penetration Rate

Figure 1 shows the PRC’s aggregate MPR (solid line and the left axis) during 2002–2014 against its average external demand (dashed line and the right axis). The aggregate MPR—i.e., the weighted average of its MPRs for different destinations and product markets—was 9.7% in January 2002 but normalized to 100 in the figure. According to the solid line, the PRC’s aggregate MPR had been generally increasing during the sample period, indicating enhanced relative strength of Chinese exports, but its growth rate had been slowing overall. The measure dipped abruptly at the onset of the global financial crisis then shortly recovered. It plateaued afterwards but declined again in mid-2010 because of the prolonged global crisis. It was in 2012 when the MPR started a gradual recovery. Overall, it is obvious from Figure 1 that the growth rate of the PRC’s aggregate MPR has been slowing.

Using shares of the PRC’s exports to each destination in its total exports, $\gamma_j$, as weights, the dashed line in Figure 1 shows the weighted average of the PRC’s external demand. The external demand for each destination is measured by its total imports, $M_j$. Therefore, average external demand is calculated as $\sum_j (\gamma_j M_j)$. It was $67.7$ billion in January 2002 (also normalized to 100 in the graph). According to the dashed line, the PRC’s average external demand had been rapidly growing before the financial crisis. However, it suddenly shrank by a third with the shock of the crisis. It later began to recover and recently approached its previous peak.

Figure 1 also reveals that the PRC’s aggregate MPR is not completely driven by external demand. In particular, while average demand for the PRC’s exports
Figure 2. Market Penetration Rate of the People’s Republic of China, by Destination Market (2002–2014)

AU = Australia; BZ = Brazil; CA = Canada; EU = European Union; IN = India; JP = Japan; KR = Republic of Korea; RU = Russian Federation; SAUDI = Saudi Arabia; SOUTH = South Africa; TAP = Taipei, China; US = United States.

Note: ASEAN includes Brunei Darussalam, Cambodia, Indonesia, the Lao People’s Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam.

Source: Authors’ computations.

sharply contracted by a third from the pre-crisis peak between August 2008 and May 2009, its aggregate MPR increased within the same period. On the other hand, while external demand was in clear recovery between mid-2009 and early-2012, aggregate MPR was declining. Thus, Figure 1 demonstrates that the PRC’s MPR must have been driven by fundamental factors other than external demand.

C. Destination-level Market Penetration Rate

In Figure 2, the MPR indicates the relative strength of the PRC’s exports in each destination market. As mentioned earlier, an increase in the MPR is equivalent to a gain in the relative strength of Chinese exports.

The PRC’s MPR in different destinations exhibits rather diverse patterns. In particular, despite a slowdown in growth prior to 2004, the PRC’s MPR in Japan subsequently remained almost flat. In the EU, India, the Russian Federation, and the Republic of Korea, the MPR had been increasing before the financial crisis, but
plateaued as well afterwards. The range of fluctuation of the measure in the Russian Federation also widened at the same time. The PRC’s MPR maintained an uptrend throughout the period, but the measure’s growth rate also slowed. After the financial crisis, there was an apparent slowdown in the growth of the MPR in these markets. The PRC maintained a constantly rising MPR only in ASEAN, Australia, Brazil, Saudi Arabia, and South Africa.

Figure 3 shows the dynamics of the PRC’s export destination structure from 2002 to 2014. The 13 economies shown in Figure 2 are the PRC’s major export partners, accounting for over 80% of the PRC’s total export value.

The share of these economies in the PRC’s exports has been declining over time. On closer examination, the share of exports that went to Japan shrank from close to 20% in early-2002 to less than 10% in mid-2014. This was a reasonable change given the stagnation of the PRC’s MPR in that market. The combined export share accounted for by the EU, India, the Russian Federation, and the Republic of Korea swelled prior to the financial crisis and contracted subsequently, but did not change much overall. Since the PRC’s MPR was increasing in these markets in the first half of the period and decreasing in the second half, the change of this share also makes sense.

The share of the PRC’s exports that went to ASEAN, Australia, Brazil, Saudi Arabia, and South Africa expanded during the period, from merely 11% in 2002 to about 20% in 2014. This, coupled with the country’s constantly growing MPR in these markets, helped to strengthen the PRC’s aggregate MPR.
Meanwhile, the combined export share of the US; Canada; and Taipei, China quickly declined, from almost 35% in 2002 to less than 25% in 2014, despite the slowing but still positive growth of the PRC’s MPR in these economies. Figure 3 thus implies that a prompt shift to other destination markets where the PRC’s MPR remained on the rise can be a quick way to support the relative strength of the PRC’s exports.

D. Product-level Market Penetration Rate

In Figure 4, the MPR indicates the relative strength of the PRC’s exports in each product market. Similar to the example earlier, an increase in the MPR is equivalent to a gain in the relative strength of the PRC’s exports. The PRC’s MPR also varies in different product markets. Solid lines in Figure 4 characterize the PRC’s MPR in the six main product markets. Dashed lines are year-on-year growth rates of the MPR, while dotted lines are linear fits of the growth rates.

In the market for food, live animals, beverages, tobacco, oils, and fats, the PRC’s MPR remained almost steady at around 9%, but the linear trend, though close to zero, sloped downward slightly, suggesting a gradual weakening. In the market for petroleum, coal, and gas, the measure was stable prior to 2010 but experienced a decline afterwards.

The PRC’s MPR in the market for chemicals, pharmaceuticals, and plastic products had been growing constantly before 2011, with the linear trend of the growth rate almost flat at around 10% during the sample period. However, the measure plateaued afterwards. The case was similar for furniture, clothing, and other products, except that the MPR in that market stopped growing since 2008. As for leather, rubber, metal, and textile manufactures, and machinery and transport equipment, the growth rate of the PRC’s MPR in those markets had been positive but slowing.

Figure 5 shows the dynamics of the PRC’s product structure during the 10-year sample period. Three kinds of products—leather, rubber, metal, and textile manufactures; machinery and transport equipment; and furniture, clothing, and other products—constantly made up the bulk of the PRC’s exports. In particular, the sum of their export shares was always above 90%. The share of machinery and transport equipment had been gradually rising; while that of furniture, clothing, and other products had been gradually falling. The share of leather, rubber, metal, and textile manufactures did not change much. Whereas the export share of chemicals, pharmaceuticals, and plastic products was expanding, the shares of the remaining products (other two products) slightly shrank.

In a nutshell, the PRC’s MPR has largely improved since the country’s access to the World Trade Organization (WTO), but the growth rate of the competitive measure has been slowing. After August 2010, the country’s MPR even started to fall. Only after 2012 was a slight recovery observed. In the meantime, signs of a weakening MPR have occurred in various destinations and product markets.
Figure 4. Market Penetration Rate of the People’s Republic of China, by Product Market (2002–2014)

Food, live animals, beverages, tobacco, oils, and fats

Petroleum, coal, and gas

Chemicals, pharmaceuticals, and plastic products

Leather, rubber, metal, and textile manufactures

Machinery and transport equipment

Furniture, clothing, and other products

Note: The solid line represents the PRC’s MPR (left axis), while the dashed line represents its growth rate (right axis). The dotted line is the linear fit of the MPR growth rate’s trend.

Source: Authors’ computations.

IV. Determining Export Competitiveness of the People’s Republic of China

A. Empirical Specification

The MPR is higher if exports are cheaper. According to the gravity equation of Eaton and Kortum (2002), export prices are determined by production costs, trade costs, and productivity. In particular, the price of good $k$ that country $i$ exports to
country \( j \) is \( p_{ij}(k) = c_i d_{ij} / z_i(k) \), where \( c_i \) is country \( i \)'s production cost, \( d_{ij} \) is the trade cost between these countries, and \( z_i(k) \) is country \( i \)'s productivity in producing good \( k \). In addition, the MPR is also affected by the yuan’s exchange rate. When the yuan is cheaper, the PRC’s exports tend to be favored in price competition with other exporters. Of course, the PRC’s MPR is still directly subject to price pressures from competitors. That is, to have a high MPR, the price of the PRC’s exports not only needs to be low, but also needs to be lower than that of other exporters. Although prices of other exporters are not generally available, Anderson and van Wincoop (2004), and Baldwin and Taglioni (2006) argue that these effects of third countries can be totally accounted for by multilateral resistance terms, which are essentially destination dummies. MPR determinants are summarized in Figure 6.
Accordingly, a parsimonious determination equation of the MPR can be specified as

\[ P_{jkt} = \alpha_j + \alpha_k + \alpha_t + W_t + \tau_{jt} + ULC_{kt} + RER_{jt} + \varepsilon_{jkt}, \]  

(2)

where \( P_{jkt} \) is the MPR of the PRC in destination \( j \) and product market \( k \) at time \( t \), while \( \alpha_j, \alpha_k, \) and \( \alpha_t \) are fixed effects of destinations, product markets, and time, respectively. The destination fixed effects also control for multilateral resistance effects as in Anderson and van Wincoop (2004)—i.e., the effects of a third country on the PRC’s MPR in the same destination.

\( W_t \) is the PRC’s real wage rate at time \( t \). As labor is the most important non-tradable input, the wage rate is often used as a proxy variable for production costs (Turner and Van’t dack 1993). The PRC’s manufactures have been mainly labor-intensive. As the unit labor cost shows, wage costs accounted for about 40% on average of the PRC’s total manufacturing output. Hence, the wage rate captures a large portion of the domestic component of production costs.

Meanwhile, \( \tau_{jt} \) denotes the PRC’s trade costs with destination \( j \) at time \( t \). It can be indirectly estimated using the gravity model and captures a wide range of factors that we discussed previously. \( ULC_{kt} \) is the PRC’s unit labor cost in product market \( k \) at time \( t \) and represents productivity. In particular, a high unit labor cost implies low profits, which further suggests low productivity.

To take into account price effects, we calculate the growth rate of the real exchange rate of the yuan against partner \( j \)’s currency and denote it by \( RER_{jt} \). Finally, \( \varepsilon_{jkt} \) represents the error term.

B. Data

Our empirical analysis covers the period from January 2002 to June 2014. The dependent variable, MPR (denoted by \( P_{jkt} \)) is calculated from the monthly imports of each destination in each product market. We still consider the PRC’s 13 major trading partners and the six product markets categorized under the SITC classification. The real wage rate, \( W_t \), is represented by annual nationwide data obtained from WIND. It measures average labor costs across all industries in real terms and is normalized to 100 in 2002. The Conference Board reports the PRC’s unit labor cost, \( ULC_{kt} \), in the manufacturing sector and its 19 industries annually. The problem, however, is how to establish a match between these 19 industries and the six product categories under the SITC classification. Table 3 presents a simple rule. By summing up each industry’s unit labor cost under a specific category using its monthly output share as weights, we can estimate the productivity of the PRC in that product market. Because weights change month to month with output share, this measure of productivity features monthly variations.
Table 3. Transformation between the 19 Manufacturing Industries and Six Product Categories of the People’s Republic of China

| 19 Manufacturing Industries                                      | Six Product Categories                      |
|-----------------------------------------------------------------|---------------------------------------------|
| Food, beverage, and tobacco processing                          | Food, live animals, beverages, tobacco, oils, and fats |
| Petroleum refining                                              | Petroleum, coal, and gas                    |
| Chemical and pharmaceutical manufacturing                        | Chemicals, pharmaceuticals, and plastic products |
| Textile, paper and printing, metal and nonmetallic mineral      | Leather, rubber, metal, and textile         |
| General machinery, transportation equipment making, electronic | Machinery and transport equipment           |
| making, other cultural and office products                      |                                             |
| Garment, leather, and fur products, wood processing and         | Furniture, clothing, and other products     |
| furniture making, other products                                |                                             |

Source: Authors’ compilations.

The rate of the yuan’s real appreciation relative to destination \(j\)’s currency, \(RER_{jt}\), is calculated using monthly inflation rates in the PRC and destination \(j\), and the nominal exchange rate between the two currencies. In particular, we compute:

\[
RER_{jt} = \ln\left(\frac{e_{jt}}{e_{jt-1}}\right) - \ln\left(\frac{\text{CPI}_t}{\text{CPI}_{t-1}}\right) - \ln\left(\frac{\text{CPI}_{jt}}{\text{CPI}_{jt-1}}\right),
\]

where \(\ln\left(\frac{e_{jt}}{e_{jt-1}}\right)\) is the monthly average depreciation rate of destination \(j\)’s currency relative to the US dollar, \(\ln\left(\frac{e_t}{e_{t-1}}\right)\) is the monthly average depreciation rate of the yuan against the US dollar, and \(\ln\left(\frac{\text{CPI}_t}{\text{CPI}_{t-1}}\right)\) and \(\ln\left(\frac{\text{CPI}_{jt}}{\text{CPI}_{jt-1}}\right)\) are, respectively, monthly inflation rates in the PRC and destination \(j\).

As to ASEAN countries, we first calculate their \(RER_{jt}\) based on this equation and then aggregate the rates using the PRC’s exports to each of these countries as weights. This aggregated variable therefore approximates the appreciation rate of the yuan’s real effective exchange rate to ASEAN countries.

Trade costs, however, include too much information to be directly calculated. We have to compromise by estimating these costs in an indirect way via the gravity model. Xu, Liang, and Zhang (2010) proposed a modified gravity equation that can infer trade costs annually from trade values and GDP as follows:

\[
\tau_{jt} = 1 - \left[\frac{\text{EXP}_{cjt} \times \text{EXP}_{jct}}{s^2 (\text{GDP}_{ct} - \text{EXP}_{ct}) (\text{GDP}_{jt} - \text{EXP}_{jt})}\right]^{1/\rho-1}. \tag{3}
\]

In Equation (3), \(\text{EXP}_{cjt}\) and \(\text{EXP}_{jct}\) are, respectively, the PRC’s exports to destination \(j\) and its exports to the PRC at time \(t\), while \(\text{EXP}_{ct}\) and \(\text{EXP}_{jt}\) are, correspondingly, their total exports. \(\text{GDP}_{ct}\) and \(\text{GDP}_{jt}\) refer to the gross domestic product. Trade costs are additionally determined by two parameters, \(s\) and \(\rho\). In particular, \(s\) represents the share of tradable goods in all products. When the share of tradable goods is low, countries trade less not only because of trade costs but also
because of nontradability. Therefore, the estimate of real trade costs from exports and GDP must be adjusted downwards. That is why $\tau$ is positively correlated with $s$.

On the other hand, $\rho$ measures the elasticity of substitution across products. When products are highly substitutable, countries automatically trade less with any given level of trade costs. Hence, the estimate of real trade costs from exports and GDP must be adjusted downwards as well. That is why $\tau$ is negatively correlated with $\rho$. Xu, Liang, and Zhang (2010) set $\rho = 8$ and $s = 0.8$ following the literature. These are the values that we use as well.

Finally, in order to avoid the potential threat of endogeneity, all explanatory variables are lagged by 1 year. However, it should be noted that the regression results are not qualitatively different even if we do not lag these variables.

C. Estimation and Results

A problem one encounters with directly estimating Equation (2) is that dependent and independent variables may share common trends. In this case, estimates tend to include positive biases, where results are larger than the unbiased estimates. Although we introduced year and month dummies, common trends still cannot be completely teased out. In fact, we experimented by estimating Equation (2) directly and found that most coefficients expected to be negative turned out to be positive, contrary to the theory. Hence, in order to correct the results of our empirical analyses, we have to detrend all variables.

In particular, we assume that there are common annual trends between the dependent variable and independent variables. Month on month, however, we assume there are only cyclical variations. To detrend the dependent and independent variables, we therefore only need to regress each variable on the calendar year denoted by $year$. The residual in this regression will then be the detrended portion of the variable. Mathematically, let $y$ represent the dependent variable or any of the four independent variables. It can thus be detrended according to the following equation:

$$y_{jkt} = \text{const}_{jk} + \beta_{jk} \cdot year + \delta_{jkt}.$$  \hspace{1cm} (4)

In Equation (4), $\text{const}$ is the constant term, $year$ is a continuous variable of calendar years, and $\beta$ measures the annual trend. As usual, $\delta$ is the error term, but its fitted value is also the estimate of the detrended portion of variable $y$. Note that to detrend variable $y$, we take its values in each product market $k$ in each destination $j$ as an individual time series. That is, we assume that in each “destination–product group,” variable $y$ has a different trend.

Note also that although we address common trends among variables, we do not necessarily need to restrict their trends to be exactly “common.” That is, in Equation (4), we allow for the case that each variable has a different trend. However,
Table 4. Determinants of Export Competitiveness of the People’s Republic of China

| Share of Imports from the PRC (%) | All                  | Australia | Brazil   | ASEAN    | Russian Federation | Republic of Korea | Canada |
|---------------------------------|----------------------|-----------|----------|----------|-------------------|-------------------|--------|
| Unit labor cost (%)             | -0.024***            | -0.014*** | -0.063** | -0.003   | -0.333***         | -0.037           | -0.052***|
|                                 | (0.008)              | (0.004)   | (0.016)  | (0.020)  | (0.066)           | (0.024)          | (0.014) |
| Real wage index                 | -0.067***            | -0.008    | -0.002   | -0.010   | -0.241***         | -0.080***        | -0.081***|
|                                 | (0.005)              | (0.012)   | (0.010)  | (0.014)  | (0.042)           | (0.013)          | (0.008) |
| Trade cost (%)                  | -0.304***            | -0.421    | -0.713***| -0.262   | -0.945            | -0.481***        | -0.321  |
|                                 | (0.084)              | (0.331)   | (0.136)  | (0.181)  | (0.966)           | (0.253)          | (0.213) |
| REER appreciation (%)           | -0.010               | -2.575*** | -0.049   | -0.028   | -0.956            | -1.563***        | -1.701***|
|                                 | (0.026)              | (0.514)   | (0.284)  | (0.020)  | (1.796)           | (0.514)          | (0.458) |
| Constant                        | Yes                  | Yes       | Yes      | Yes      | Yes               | Yes               | Yes     |
| Industry FE                     | Yes                  | Yes       | Yes      | Yes      | Yes               | Yes               | Yes     |
| Month FE                        | Yes                  | Yes       | Yes      | Yes      | Yes               | Yes               | Yes     |
| Destination FE                  | Yes                  | No        | No       | No       | No                | No                | No      |
| Observations                    | 13,650               | 1,050     | 1,050    | 1,050    | 1,050             | 1,050             | 1,050   |
| R-squared                       | 0.110                | 0.238     | 0.165    | 0.273    | 0.166             | 0.210             | 0.383   |
| Adjusted R-squared              | 0.108                | 0.222     | 0.148    | 0.258    | 0.149             | 0.194             | 0.370   |

| Share of Imports from the PRC (%) (continued) |
|-----------------------------------------------|
| US South Africa Europe Japan Saudi Arabia Arabia TAP India |
| Unit labor cost (%)                           | -0.016***            | -0.120** | -0.037** | -0.004   | -0.019           | -0.027           | -0.074***|
|                                 | (0.004)              | (0.053)  | (0.017)  | (0.018)  | (0.034)          | (0.017)          | (0.025) |
| Real wage index                            | -0.073***            | -0.131***| -0.095***| -0.030** | -0.017           | -0.055***        | -0.030** |
|                                 | (0.007)              | (0.026)  | (0.009)  | (0.011)  | (0.018)          | (0.009)          | (0.012) |
| Trade cost (%)                              | -0.943***            | -1.823***| -0.474** | -0.746***| -0.066           | 0.069            | -0.463** |
|                                 | (0.288)              | (0.686)  | (0.222)  | (0.255)  | (0.289)          | (0.122)          | (0.195) |
| REER appreciation (%)                       | -0.987               | -1.247    | -0.420   | -3.252***| -9.642**         | -2.149**         | -0.294  |
|                                 | (3.822)              | (0.882)  | (0.574)  | (0.613)  | (5.041)          | (1.050)          | (0.780) |
| Constant                                    | Yes                  | Yes       | Yes      | Yes      | Yes              | Yes              | Yes     |
| Industry FE                                 | Yes                  | Yes       | Yes      | Yes      | Yes              | Yes              | Yes     |
| Month FE                                    | Yes                  | Yes       | Yes      | Yes      | Yes              | Yes              | Yes     |
| Destination FE                              | Yes                  | No        | No       | No       | No               | No               | No      |
| Observations                                | 1,050                | 1,050     | 1,050    | 1,050    | 1,050            | 1,050            | 1,050   |
| R-squared                                   | 0.467                | 0.110     | 0.384    | 0.305    | 0.257            | 0.287            | 0.140   |
| Adjusted R-squared                          | 0.456                | 0.091     | 0.371    | 0.291    | 0.242            | 0.272            | 0.123   |

ASEAN = Association of Southeast Asian Nations, FE = fixed effects, PRC = People’s Republic of China, REER = real effective exchange rate, TAP = Taipei, China, US = United States, * = p < 0.1, ** = p < 0.05, *** = p < 0.01.

Source: Authors’ computations.

for as long as these trends are positively correlated, regression results will be biased upwards, and detrending with Equation (4) will be necessary.

Table 4 summarizes our empirical results. Since annual trends have already been taken out, year dummies are unnecessary after detrending. Month dummies, however, are still needed to control cyclical variations. The first column is the result of the three-way fixed-effects model that pools the PRC’s MPR in all destinations
and product markets, and includes destination dummies, product market dummies, and time (month) dummies. With detrended variables, the signs of all coefficients are now consistent with theoretical predictions. In addition, except for the appreciation of the yuan’s real exchange rate, the other three coefficients are all significant. The results shown in this column imply the following:

(i) A fall in the unit labor cost by 1 percentage point, which improves productivity, raises the PRC’s MPR by 0.024 percentage point on average. The PRC’s unit labor cost was largely stable for almost all products except for petroleum, coal, and gas. Thus, the small coefficient and the general stability of the variable together imply that productivity was not an important driver of the PRC’s MPR in terms of economic magnitude.

(ii) A rise in the real wage index by 1 unit depresses the PRC’s MPR by 0.067 percentage point on average. Although the number also seems small, the economic magnitude is not. In the PRC, average annual growth of the nationwide real wage was maintained above 10% from 2002 to 2009, sometimes reaching 15%. Thus, because of the growth of the real wage index alone, the PRC’s MPR would fall by 0.7 or even 1 percentage point per year on average. In other words, the soaring real wage index was a main negative contributor to the MPR. However, beginning in 2010, the annual growth rate of the real wage index declined to about 8% such that the negative effect imposed by wage growth on the MPR became smaller.

(iii) A rise in trade costs by 1 percentage point hurts the PRC’s MPR by 0.304 percentage point on average. According to inferences of the gravity model, the PRC’s trade costs with its 13 major partners were declining by 2.3% per year on average. Thus, the improvement in trade costs alone could raise the PRC’s MPR by more than 0.7 percentage point each year. In other words, trade costs were the main positive contributor to the MPR. However, trade costs overall improved at a slower rate over time. Before 2010, its annual rate of decline was above 2.5%. Hence, the positive effect it generated on the MPR was able to outweigh the negative effect of a rising wage rate. However, the rate of decline fell below 2% beginning in 2010. Consequently, the MPR declined. This situation reversed again in 2012 when the growth of the real wage index slowed. Hence, the MPR began to recover.

(iv) Real appreciation of the yuan by 1% brings down the PRC’s MPR by 0.01 percentage point on average. Quantitatively speaking, its effect is negligible. Statistically, the coefficient is insignificant as well. Therefore, the change in relative value of the yuan does not seem to be an important driver of the PRC’s MPR.
The other 13 columns of Table 4 are destination-by-destination results. We make several important observations. First, the coefficient of the variable representing unit labor cost is positive for all destinations and significant for eight destinations, with large magnitudes appearing in the context of the Russian Federation and South Africa. Second, the coefficient of the real wage index is always negative and is significant in nine destinations, with large magnitudes likewise appearing in the Russian Federation and South Africa. Third, the coefficient of trade costs is negative in almost all destinations except Taipei, China, where it is positive but insignificant. The coefficient is negative and significant in seven economies, with large magnitudes appearing in South Africa and the US. Lastly, the coefficient of the variable representing real exchange rate appreciation is negative in all destinations, but significant in only six (less than half of the sample). Large magnitudes appear in the context of Australia and Taipei, China. In a nutshell, regression results based on the whole sample and on each destination market are all largely in line with theoretical expectations.

V. The Outlook of the People’s Republic of China’s Market Penetration Rate

A. Prediction Method

According to Equation (2), the dependent variable, the PRC’s MPR, can be forecast based on reasonable predictions of the independent variables. In particular, if we assume that all determination coefficients remain the same as estimated in Table 4, then according to Equation (2), the MPR can be directly obtained using these estimated coefficients and the predicted values of the variables on the right-hand side.

In this study, the prediction window is set from July 2014 to end-2016. The specific forecasting procedure is as follows:

(i) Predict the four independent variables. For each variable, we estimate an AR(1) model using observed values during 2002–2014. Supposing that the estimated autocorrelation coefficient remains constant until end-2016, we can then iterate the variable forward, and predict its value into the future. It is worth noting that production and trade costs are annual data. The real wage index of the PRC and its trade costs for any destination are taken as individual time series. Unit labor costs meanwhile are of monthly frequency but exhibit clear patterns across months. We thus take the unit labor cost in each product category at any specific month as an individual time series. For example, with regard to the unit labor cost of chemicals, pharmaceuticals, and plastic products, there are 12 sets of time series, each corresponding to a specific
month. This enables us to impose different autocorrelation coefficients for different months. Finally, although data on the appreciation of the yuan’s real exchange rate are also of monthly frequency, the monthly patterns are not significant. Hence, we can take the yuan’s appreciation against each destination’s currency as an individual time series. In addition, only the time series on the appreciation of the yuan against the US dollar and the Saudi riyal have unit roots that must be first-differenced before performing the autoregressions.

(ii) Predict the detrended MPR. We first detrend the predicted values of the four independent variables obtained in the previous step by Equation (4). We then assume that the coefficients in Table 4 remain constant within the prediction window and use the detrended predictions of the four independent variables to forecast the detrended MPR according to the linear relationship. Note that during the prediction, we also assume that destination fixed effects, product market fixed effects, and month fixed effects remain constant at levels that we estimated before.

(iii) Add back yearly trends. To obtain the final prediction of the MPR, yearly trends must be added back to the detrended MPR calculated in the previous step. We predict the yearly trends in the future against two different scenarios. In the first scenario, which we call the “status quo,” we assume that the yearly trends stop growing with calendar years and remain unchanged beginning 2014. That is, the PRC’s MPR immediately loses its pre-crisis momentum of growth, such that it will remain stable over time if production costs, trade costs, productivity, and real exchange rates all do not change. In the second scenario, which we call the “optimistic case,” we assume that yearly trends still grow along with calendar years throughout the prediction window. In other words, we assume in this case that the pre-crisis momentum will be immediately regained in the future, such that even if production costs, trade costs, productivity, and real exchange rates all do not change, the MPR will still grow over time simply due to the momentum of growth as it did before the crisis.

B. Results

Figure 7 presents our forecast of the PRC’s MPR in various destinations. In each panel, the solid line represents the real or observed value. It starts from January 2002 and ends in June 2014. The dashed line represents the predicted MPR in the status quo scenario, while the dotted line represents the predicted MPR in the optimistic case. Both lines range from July 2014 to end-2016. There is also a vertical line in each panel specifically in July 2014, indicating the start of the prediction window.
Figure 7. Prediction of the Market Penetration Rate of the People's Republic of China by Destination Market (2002–2016)
The outlook for the PRC’s MPR offers relief if the optimistic scenario happens. An enhancement of the MPR, which indicates a gain in the relative strength of the Chinese exports, can be expected in all destination markets except Japan. Nevertheless, it should be remembered that the optimistic case assumes the pre-crisis momentum will be immediately regained in all destinations, which is hardly realistic. In the status quo scenario, however, the outlook of the MPR appears gloomy. In particular, the MPR will flatten out or fall in most markets, although it will keep growing in ASEAN and the Republic of Korea.
These findings at the destination level suggest that the PRC’s aggregate MPR is likely to stop increasing in the near future unless the optimistic case happens. However, the constant uptrend of the MPR in ASEAN and the Republic of Korea still brightens the outlook. This suggests that an adaptive shift of export shares to these markets can be an effective strategy to support the PRC’s overall exports.

Figure 8 showcases our forecast of the PRC’s MPR in various product markets. The graphed variable is the weighted average of the PRC’s MPR in each product
market across all destinations, where the weights are the shares of the PRC’s exports to each destination in its total exports of that product. We assume that the weights do not change beginning 2014. In particular, we let the weights in any month of the prediction window be exactly identical to those in the same month for the year 2013. This implies that we assume away composition effects resulting from destination shifts in this prediction. As before, the solid line in each panel represents the revealed (observed) MPR, the dashed line represents the predicted MPR in the status quo scenario, and the dotted line represents the predicted MPR in the optimistic case. The vertical line indicates the start of prediction.

Figure 8 reveals that if the optimistic case happens, then the MPR will keep on increasing, indicating a gain in the relative strength in four product markets: the market for chemicals, pharmaceuticals, and plastic products; furniture, clothing, and other products; machinery and export equipment; and leather, rubber, metal, and textile manufactures. However, if the status quo scenario occurs, the MPR will plateau or fall in all product markets except for leather, rubber, metal, and textile manufactures.

VI. Conclusions

Since the global financial crisis, the PRC’s export growth has significantly slowed. This paper examined if this is simply caused by the shock of the crisis or if it reflects fundamental changes in the relative strength of the country’s products. We used the MPR as a measure of competitiveness and found that it generally increased during 2002–2014. Despite this overall growth, however, the rate of growth of the MPR has slowed. In particular, an abrupt decline was observed immediately after the breakout of the financial crisis in 2008 and a gradual but longer decline seen between mid-2010 and 2012. Aggregate MPR underwent a gradual recovery afterwards. Weakening signs of the PRC’s MPR could also be perceived at more detailed destination and product markets.

With investigations into four underlying determinants of MPR, we identified production and trade costs as the two main drivers. In particular, the PRC’s quickly increasing labor costs has a significantly negative impact on the MPR, which is partly offset by the country’s decreasing trade costs with most of its trading partners. However, as the rate of decline in trade costs slows, the negative effect of rising production costs begins to dominate. The effects of productivity growth and the real exchange rate appreciation are generally insignificant or small in economic magnitude.

Finally, we predicted the PRC’s MPR in different destinations and product markets until 2016. In the optimistic scenario, the MPR will increase in all destination markets except Japan and in four out of six product markets except for petroleum, coal, and gas; and food, live animals, beverages, tobacco, oils, and fats.
While this outlook is comforting, the optimistic case assumes that yearly trends will immediately regain the pre-crisis momentum, which seems unrealistic. In the “status quo” scenario, however, the MPR will plateau or fall in most markets except in ASEAN and the Republic of Korea in terms of destinations; and for leather, rubber, metal, and textile manufactures in terms of products.

Seeing this gloomy outlook, adaptive policies are urgently needed. In particular, trade and industrial policies that can facilitate structural change toward destinations and product markets where the MPR is growing will be crucial in order to stabilize export growth and avoid any severe harm to the export sector. In addition, as the MPR declines, macro policies that can stimulate domestic demand—e.g., increasing the wage income and reducing income inequalities, improving the social security system, and facilitating infrastructure building—are also essential to maintain the PRC’s high economic growth.

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*ADB recognizes “China” as the People’s Republic of China.*