The trapped dragon: A province-by-province analysis of the middle-income trap in China

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Abstract

China has been a prime candidate in the study of the middle-income trap (MIT), with inconclusive results. In this article, we pursue the question at a provincial level, and identify those provinces that are, or will be, trapped and those that have escaped. The 10 provinces identified as trapped are: Shanxi, Inner Mongolia, Liaoning, Jilin, Shaan'xi, Qinghai, Xinjiang, Heilongjiang, Gansu and Hebei. Productivity is found to be the most obvious reason behind a trapped province.

Introduction

The slowdown in growth rates among middle-income economies has been widely addressed in the literature. In a 2007 report, *An East Asian renaissance: Ideas for economic growth*, the World Bank formally raised the concept of a 'middle-income trap' (Cai, 2012). The middle-income trap (MIT) phenomenon was developed further by Gill and Kharas (2007) to explain the condition when developing countries face a sharp deceleration in growth after a sustained period of increases in per capita income. Research into the best way to identify countries that have fallen into this

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trap, as well as ways to avoid or escape it, has intensified. Stagnation in income associated with MIT can pose grave problems for people living in such regions (Bulman et al., 2018), particularly in terms of future sustainable development. The World Commission on Environment and Development defines sustainable development as 'development that meets the needs of the present generation without compromising the needs of future generations' (WCED, 1987). Being stuck in the MIT would be undesirable for future generations, since it would lead to long-term income stagnation (Bulman et al., 2018) and hence lowered living standards. Therefore, since economic development and social equity considerations are also embedded in the very notion of sustainable development (Mori & Yamashita, 2015), we argue that more empirical research on the topic of MIT is needed. In this article, we seek to identify Chinese provinces that have managed to escape the MIT, as well as those that are/will be trapped. At the same time, researchers have offered many reasons that explain the MIT, some of which include high income inequality, social conflict, labour disputes and government failure in curbing market monopolies, as well as inappropriate macroeconomic policies such as excess money supply, which leads to hyperinflation or debt crisis (Wang, 2018). In this article, we find that productivity is the most obvious reason behind a trapped province. We contribute to the literature by focusing on the Chinese context, since research on this has been scattered, with many conflicting solutions (Wang, 2018).

Additionally, we justify the importance of this research by noting that, given its size and importance, China has been a prime target for MIT research (Aiyar et al., 2013; Albert et al., 2015; Bailliu et al., 2014; Cai, 2012; Cao et al., 2009; Eichengreen et al., 2012; Glawe & Wagner, 2017; Huang, 2016; Wu, 2014; Zeng & Fang, 2014; Zhang, 2014). The slowing down of its economy from 10.6 per cent growth in 2010 to 6.1 per cent in 2019 spotlighted China's overall difficulties with growth acceleration. In fact, Premier Li Keqiang himself made reference to the MIT when he delivered the Government Work Report to the National People's Congress on 5 March 2016 (*China Daily*, 17 March 2016). So far, however, findings are mixed. Some have argued that China has fallen into the MIT (Cook, 2014; Woo, 2012), while others believe that China will escape or has already escaped the trap (Huang, 2016; Wong, 2016).

We believe that there are two reasons for these mixed findings. First, as pointed out by Glawe and Wagner (2017), there is no universally accepted and unambiguous definition of the MIT. Different definitions will lead to different results. Second, all previous MIT studies look at China as one single entity. The diversity that exists within China is well known. In 2015, for example, Jiangsu province had a per capita GDP of 87,995 yuan while in Gansu province it was 26,165 yuan. Similarly, while the annual economic growth for the whole of China was 6.4 per cent in 2015, Tianjin municipality still clocked a 9.3 per cent growth while Liaoning and Shanxi managed only 3 per cent growth. Thus, while some provinces, particularly those in the north and north-east with heavy reliance on natural resources and heavy industries, may be more likely to fall into the MIT, others, such as Tianjin, Beijing, Shanghai and Jiangsu province, may have escaped the MIT. Therefore, to provide a finer-grained analysis of the MIT in China, in this article, we study the phenomenon at the provincial level.

Employing commonly used rules of determining the MIT, we identify each province's situation, and investigate whether it is likely to be 'trapped' or whether it will escape the MIT. Admittedly, to apply some of these rules, a forecast of future provincial per capita GDP is required. While there are various GDP forecast models (for a survey, see Bergheim, 2008), we adopt the simple linear autoregressive integrated moving average (ARIMA) model. We chose not to use structural and non-linear models because of a limited data availability problem at the provincial level. Moreover, as stated by Granger (1989) and later shown by Hess and Iwata (1997) for the case of the US, and Simpson et al. (2001) for the case of the UK, simple linear models are frequently only marginally less precise than forecasts made by complex and non-linear models. Therefore, we admit at the outset that the ARIMA model employed here is used purely for data-mining purposes, with the intention of searching for patterns that could lead to further research into the provincial-level MIT in China.

In the next section, we introduce the four main approaches that have been used to identify the MIT. In section 3, we use these approaches to identify which of China's provinces have been trapped. Finally, we discuss our findings in section 4 and draw some conclusions in section 5.

Approaches to identifying the MIT

One of the most controversial problems in identifying countries that are trapped or have escaped is a lack of a clear and widely accepted definition of MIT. Traditionally, the word 'trap' is used to describe an economic state of super-stable equilibrium that cannot be changed by normal short-term outside forces. Since the proposition of MIT lacks theoretical foundations, opponents argue that it is ad hoc to simply call those countries that are transitioning slowly from middle-income level to high-income level trapped (Barro, 2016). Indeed, except for a few theoretical studies (e.g. Aoki, 2011; Agénor & Canuto, 2015; Dabús et al., 2016; Hansen & Prescott, 2002) that try to investigate why middle-income countries might be stuck with low growth rates, most other related studies are empirical identifications of whether a country has fallen into the MIT. The latter studies include those by Kharas and Kohli (2011), Eichengreen et al. (2012, 2014), the World Bank (2013), Jankowska et al. (2012), Felipe et al. (2012), Cai (2012), Aiyar et al. (2013), Flaaen et al. (2013), Han and Wei (2015), Arias and Wen (2016), and Glawe and Wagner (2017). These studies find that many Latin American and Asian economies, whose per capita income levels belong to the somewhat defined 'middle-income range', are natural suspects of countries that might have fallen into the MIT. However, due to the lack of theoretical prescription as to what constitutes the MIT, these empirical studies tend to resort to descriptive or quantitative definitions. In what follows, we introduce four definitions of the MIT that have been relatively well acknowledged and used in previous studies. Since some of these definitions are essentially similar, we use the three most representative definitions.

The simplest definition of the MIT is by Felipe et al. (2012) (Definition 1). According to this definition, a country is in the MIT if it stays for more than 28 years in the lower-middle-income range (LMIR) or for more than 14 years in the upper-middle-income range (UMIR), where LMIR stands for the per capita income range between \$2,000 and \$7,250 per year, and UMIR is per capita income range between \$7,250 and \$11,750 per year. The income ranges are measured in 2010 USD. By comparing the growth rate of countries in each income group, the authors argue that for a country to avoid falling into the lower-middle-income trap (i.e. to move into the upper-middle-income group), it needs to maintain an average annual growth rate of at least 4.7 per cent; for a country to avoid falling into the upper-middle-income trap (i.e. to move into the high-income group), it needs to maintain an average annual growth rate of at least 3.5 per cent.

Another definition of the MIT is based on the slowdown in economic growth given by Eichengreen et al. (2012) (Definition 2). According to this definition, a middle-income country falls into the MIT if the following three conditions are fulfilled: (1) the seven-year average per capita GDP growth rate was at least 3.5 per cent prior to the slowdown; (2) the difference between the seven-year average growth rate before and after the growth slowdown is greater than 2 per cent, showing a significant drop in growth rates; and (3) the per capita GDP in the year of the growth slowdown is greater than \$10,000 (measured by 2005 purchasing power parity (PPP) price, in USD), implying that the country is a middle-income rather than a low-income country. Extending on this idea and focusing on Asian economies, Aiyar et al. (2013) argue that the MIT is a special case of the growth slowdown; that is, a large, sudden and sustained deviation from the previous growth path.

The third definition (Definition 3) uses the Catch-Up Index (CUI) made popular by Woo et al. (2012), Bulman et al. (2014) and Robertson and Ye (2015), among others. This definition measures a country's per capita GDP relative to that of the US. A country is said to be trapped if its CUI is in the 20–50 per cent range for more than 50 years (Woo et al., 2012). By contrast, Bulman et al. (2014) use 8–36 per cent CUI as the criteria range, while Robertson and Ye (2015) use 10–50 per cent as the criteria range. The differences among the choices of CUI range partly reflect the dispute among economists as to the exact measure of the middle-income range. This problem is addressed in the fourth definition given by the World Bank (2013), where a country is in the MIT if its per capita income was 4.5–45 per cent of that of the US for the period 1960–2008. The World Bank definition is essentially similar to the third one, where MIT is defined by comparing the target country with a reference country. Therefore, in our study, we use the first three definitions of MIT. For the third definition, we choose Bulman et al. (2014)'s CUI range since its middle-income range seems more consistent with Definition 1.

Identifying China's trapped provinces

Although we use these well-adopted definitions of the MIT, our work differs from previous studies because we are the first to study the MIT phenomenon at China's provincial level. For the past 30 years, the growth performance of China has been significantly higher than in most low-income countries as well as high-income countries. The economic reforms that started in 1978 have transformed China from a predominantly agrarian economy to an urban-based manufacturing growth hub (Pakrashi & Frijters, 2017). China is now the second-largest economy in the world, and is well on its way to becoming the largest. The slowdown in economic growth since 2010, however, has caused many to wonder if China's growth model is unsustainable and if it would follow some of its Asian neighbours and fall into the MIT (Aiyar et al., 2013; Albert et al., 2015; Bailliu et al., 2014; Cai, 2012; Cao et al., 2009; Eichengreen et al., 2012; Glawe & Wagner, 2017; Huang, 2016; Wu, 2014; Zeng & Fang, 2014; Zhang, 2014).

Glawe and Wagner (2017) use various definitions of the MIT and test whether China has fallen into or will escape the trap. They find that under different definitions, the results vary significantly. They attribute these findings to the fact that there is no widely accepted and theoretically supported definition of MIT, an argument shared by other studies in the field. Other studies mainly believe that China may fall into the MIT if it fails to undertake some fundamental reforms. Zhuang et al. (2012) and Wu (2014) argue that slow growth in productivity and increasing income inequality may cause China to fall into the MIT. Yao (2015) argues that a financial crisis is more likely to happen in middle-income countries, causing them to fall into the MIT and that China is running the risk of a financial crisis. Albert et al. (2015) argue that China needs to rebalance from overinvestment and excessive credit growth to avoid potential crisis and growth slowdown.

As mentioned earlier, all studies of the Chinese economy realise the vast differences that exist between the various provinces in China. Not only are the differences obvious in terms of size, they also vary in terms of annual growth and income per capita, as shown in Table 1. Economic structures also differ. While the north-eastern provinces are the rust belt of the country, with minerals and heavy industry as their prime drivers, the south-eastern provinces' main drivers are light industries producing mainly consumer goods. While municipalities like Shanghai and Beijing are financial powerhouses, Yunnan and Sichuan provinces are still relatively agrarian. Thus, considering China as one entity when studying the MIT makes policy prescriptions arising out such studies either meaningless or, at best, too general. It is worthwhile then to consider the MIT at a provincial level to identify provinces that have escaped the MIT, those that are trapped and those that are heading into the trap.

To study the MIT at the provincial level in China is not very different from considering the phenomenon among countries in Central and Eastern Europe (Pruchnik & Zowczak, 2017). Members of the European Union are centralised in some aspects of policy and governance (e.g. monetary policy, foreign policy) while decentralised in other aspects (e.g. fiscal policy). Similarly, while China's Communist Party is seen as an authoritarian government, there is a high degree of decentralisation when it comes to resource allocation and business activities. Provinces are relatively self-contained and conditions are conducive for regional competition (Feltenstein & Iwata, 2005; Zhang, 2005). In fact, China's decentralisation policies have been linked to its macroeconomic performance (Cai & Treisman, 2006). Furthermore, China's *hukou* (household registration) policy, which restricts the movement of labour from one province to another, is yet another reason to consider the MIT at a provincial level in China.

Table 1. Diversity within China

Provinces	Real GDP per capita (in 2010 USD)					Average GDP growth rate (%)				
	1980	1990	2000	2010	2016	1980–89	1990–99	2000–09	2010–15	2016
Beijing	1,148	2,036	5,382	10,909	14,825	6.6	9.4	8.1	4.8	7.7
Tianjin	1,009	1,532	3,871	10,781	14,877	4.7	8.8	10.9	5.9	6.6
Shanghai	2,026	2,597	6,703	11,237	14,691	2.4	9.5	5.9	3.5	9.5
Jiangsu	402	927	2,625	7,805	12,317	9.2	9.9	11.1	8.5	8.3
Zhejiang	350	940	2,993	7,638	10,802	11.3	11.5	9.6	6.4	7.6
Inner Mongolia	268	649	1,450	6,993	9,578	9.2	7.6	16.7	6.6	4.2
Fujian	259	775	2,497	5,912	9,562	13.2	12.3	8.4	8.9	8.8
Guangdong	358	1,092	2,841	6,608	9,412	12.7	9.5	9.1	5.8	7.8
Shandong	299	798	2,080	6,072	8,755	10.6	10.1	11.4	6.6	5.5
Chongqing	265	519	1,400	4,076	7,487	7.5	9.9	10.6	11.0	10.7
Hubei	318	677	1,404	4,122	7,117	7.3	6.9	11.2	10.6	8.7
Jilin	331	767	1,640	4,667	7,017	9.0	6.7	11.2	7.8	6.2
Shaan'xi	248	545	1,108	4,008	6,517	7.2	6.8	13.2	10.0	5.8
Liaoning	603	1,186	2,493	6,256	6,506	8.0	6.7	9.2	7.3	–23.0
Ningxia	322	612	1,199	3,967	6,067	7.1	6.2	11.9	8.7	7.1

Provinces	Real GDP per capita (in 2010 USD)					Average GDP growth rate (%)				
	1980	1990	2000	2010	2016	1980–89	1990–99	2000–09	2010–15	2016
Hunan	271	540	1,210	3,651	5,939	6.5	8.5	11.1	9.4	7.4
Hainan	236	686	1,517	3,520	5,722	10.1	8.1	7.8	9.6	8.4
Qinghai	352	685	1,146	3,562	5,629	7.2	5.4	11.1	9.6	5.5
Hebei	317	644	1,693	4,234	5,526	7.8	9.1	9.6	5.0	6.2
Henan	235	479	1,216	3,611	5,463	8.6	8.9	11.5	7.6	8.0
Heilongjiang	516	891	1,850	3,999	5,228	6.2	7.5	7.5	6.3	2.5
Xinjiang	305	753	1,645	3,698	5,227	9.6	7.8	7.9	8.6	1.0
Jiangxi	254	498	1,082	3,139	5,186	6.5	7.9	10.6	9.6	9.2
Sichuan	238	499	1,106	3,129	5,133	7.2	8.8	10.2	9.6	7.9
Anhui	216	519	1,066	3,085	5,055	9.8	6.9	9.7	10.3	8.6
Guangxi	207	468	1,038	2,986	4,898	8.5	8.9	9.6	10.2	7.6
Shanxi	329	671	1,276	3,882	4,551	6.5	6.5	11.1	4.8	0.8
Tibet	350	561	1,020	2,515	4,544	4.3	7.2	9.6	9.7	9.8
Guizhou	163	356	615	1,938	4,284	8.3	5.2	11.6	14.3	11
Yunnan	198	538	1,064	2,327	4,043	9.3	8.3	7.5	9.7	8.5
Gansu	288	483	921	2,380	3,550	5.4	6.3	9.3	8.3	4.9

Source: CEIC database.

Forecasting future GDP per capita and growth

As seen from the various definitions of MIT, there is a need to have a long time series to make meaningful predictions of future growth. For many developing countries that have a short history, forecasting future GDP per capita and GDP growth becomes necessary. This is particularly true for China. Since China is still in the middle-income range, according to many definitions of the MIT, but growing fast, it is necessary to predict if China will be trapped in the future. Take for example the third definition of the MIT: it uses the CUI, which requires a 50-year threshold. Since China's per capita income relative to the US is currently in the UMIR, we need to predict if and when China will move out from this range. Thus, GDP forecast is needed.

In previous MIT studies that focus on empirical identifications, GDP forecast was not an issue since they would normally use GDP projections from the World Bank, the Organisation for Economic Cooperation and Development, or the International Monetary Fund (Glawe & Wagner, 2017). However, there are no provincial-level GDP projections that are readily available. Estimates need to be made. There are several methodologies that are used to forecast GDP. Both linear models, such as the

ARIMA models and exponential smoothing models and non-linear models appear in the literature. Forecasting for the US, Hess and Iwata (1997) find that although many popular non-linear models can be used to replicate business dynamics and GDP time series, they perform no better than simple ARIMA models. In a similar analysis for the UK, Simpson et al. (2001) show that non-linear models perform relatively poorer than linear models for certain time periods. ARIMA models are quite well accepted for forecasting China's GDP (Wu et al., 2015; Zhang, 2007; Zhou, 2016). These models have also been used to forecast future provincial GDP (e.g. Guangdong: Hua & Zhao, 2010; Fujian: Zhao & Chen, 2007; Shaan'xi: Wei et al., 2010; Hubei: Zhang, 2015; Chongqing: Xue et al., 2017). Therefore, we use the ARIMA model to forecast each province's GDP using historical time series of GDP data. Admittedly, the prediction power of the ARIMA model decreases when the period being forecast lengthens. Our forecasted results are based on the assumption that no significant structural reform will be taken within the forecasting period. We acknowledge that this assumption is relatively strong. However, except for Definition 3 of the MIT for several provinces, we do not need to forecast for longer than 20 years. Moreover, some provinces, such as Liaoning, Shanxi and Inner Mongolia, suffered a significant drop in growth rates over the past three years. For these provinces, the ARIMA model cannot provide a sensible forecast (the ARIMA models report negative growth rates). While we do not need any forecast to conclude that these provinces are trapped by the MIT, according to our Definition 2 (growth slowdown), we still use the exponential smoothing technique to forecast their future growth rate and test for other definitions.

The ARIMA model is a generation of the autoregressive moving average (ARMA) model. It is fitted to time series data either to better understand the data or to predict future points in the series. This model is standard in the literature for forecasting GDP and other financial time series (e.g. Wu et al., 2015; Zhang, 2007; Zhou, 2016). Given a time series of data X_t, where t is the time index and X_t are real numbers, an ARMA model is given by:

$$X_t - \alpha_1 X_{t-1} - \ldots - \alpha_p X_{t-p} = \varepsilon_t + \theta_1 \varepsilon_{t-1} + \ldots \theta_q \varepsilon_{t-q} \quad (1)$$

where α_i (i=1, 2, …, p) are the coefficients of the autoregressive part of the model, θ_j (j=1, 2, …, q) are the coefficients of the moving average part, and ε_t~ε_{t-q} are the i.i.d. error terms. To estimate this model, the time series data must be stationary. Therefore, for non-stationary data (which is usually the case for GDP per capita data), we take first order (or higher order) differencing of the original data. In particular, define:

$$X_t^{'} = X_t - X_{t-1} \quad \text{(first order differencing)}$$

$$X_t^{''} = X_t^{'} - X_{t-1}^{'} \quad \text{(second order differencing)}$$

$$X_t^{'''} = X_t^{''} - X_{t-1}^{''} \quad \text{(third order differencing)}$$

We then first use the augmented Dicky-Fuller test to determine which order differencing will make the original data stationary. Let us suppose it is the d^{th} order. Next, we apply the stationary data to test the optimal ARMA lags p and q in equation (1), using ACF (autocorrelation function) and PACF (partial autocorrelation function) statistics, as well as Akaike information criterion (AIC). Finally, we estimate the obtained ARIMA (p,d,q) model.

Table 2 shows our estimated results for each province, including the optimal parameters (p,d,q), and predicted results for the next five years and beyond.

Table 2. Forecasted real GDP per capita (in 2010 USD), selected years

Provinces	Forecasts								
	(p,d,q)	**2017**	**2018**	**2019**	**2020**	**2021**	**2030**	**2040**	**2050**
Beijing	(1,2,0)	15,356	16,183	17,034	17,903	18,793	27,694	39,473	53,240
Tianjin	((2,2,1)	14,813	15,131	15,629	16,037	16,479	20,956	26,856	33,737
Shanghai	(1,2,1)	14,902	15,614	16,327	17,046	17,775	25,017	34,610	45,843
Jiangsu	(1,2,1)	13,013	13,868	14,748	15,654	16,585	26,161	39,333	55,173
Zhejiang	(0,2,2)	11,313	11,976	12,657	13,355	14,071	21,301	31,001	41,230
Inner Mongolia	(1,2,2)	9,724	10,151	10,473	10,807	11,111	13,083	15,065	17,337
Fujian	(1,2,2)	10,026	10,667	11,327	12,001	12,692	19,613	28,797	39,552
Guangdong	(1,2,1)	9,765	10,296	10,838	11,390	11,955	17,577	24,972	33,576
Shandong	(1,2,1)	9,160	9,604	10,064	10,530	11,010	15,786	22,086	29,432
Chongqing	(1,2,1)	7,992	8,645	9,325	10,032	10,765	18,560	29,748	43,597
Hubei	(2,2,2)	7,363	7,743	8,126	8,524	8,942	13,271	19,097	26,001
Jilin	(3,2,3)	7,453	7,774	8,079	8,379	8,672	11,002	14,108	18,092
Shaan'xi	(2,1,2)	6,896	7,245	7,542	7,803	8,054	10,078	12,808	16,277
Liaoning	(1,2,1)	6,762	7,013	7,256	7,490	7,713	9,599	12,199	15,503
Ningxia	(2,2,1)	6,193	6,469	6,747	7,032	7,323	10,220	14,019	18,429
Hunan	(2,2,2)	6,219	6,578	6,944	7,319	7,704	11,603	16,841	23,034
Hainan	(1,2,3)	5,798	6,125	6,446	6,783	7,126	10,613	15,322	20,911
Qinghai	(1,2,2)	5,828	6,058	6,282	6,500	6,710	8,395	10,669	13,559
Hebei	(2,2,2)	5,315	5,448	5,652	5,929	6,272	9,710	13,406	17,967
Henan	(3,2,3)	5,719	6,043	6,390	6,776	7,151	11,073	16,474	22,974
Heilongjiang	(1,2,3)	5,514	5,804	6,043	6,349	6,599	9,477	13,283	17,767
Xinjiang	(1,2,1)	5,411	5,624	5,833	6,035	6,229	7,795	9,906	12,589
Jiangxi	(1,2,1)	5,344	5,669	6,007	6,359	6,722	10,479	15,654	21,879
Sichuan	(2,2,3)	5,207	5,448	5,701	5,976	6,257	9,482	15,050	23,886
Anhui	(1,2,1)	5,134	5,404	5,691	5,993	6,309	9,635	14,239	19,768
Guangxi	(1,2,1)	5,116	5,414	5,720	6,036	6,362	9,704	14,292	19,800
Shanxi	(2,2,0)	4,530	4,709	4,883	5,052	5,215	6,525	8,293	10,539

Provinces	Forecasts								
	(p,d,q)	2017	2018	2019	2020	2021	2030	2040	2050
Tibet	(1,2,1)	4,844	5,205	5,574	5,952	6,339	10,228	15,416	21,517
Guizhou	(1,2,2)	4,864	5,428	6,036	6,688	7,386	12,545	21,002	26,595
Yunnan	(1,2,1)	4,160	4,394	4,637	4,890	5,150	7,838	11,518	15,922
Gansu	(1,2,1)	3,386	3,519	3,649	3,776	3,898	4,877	6,198	7,877

Source: Authors' summary of estimated results.

Results of analysis

Table 3 shows provinces that have escaped the MIT, those that are forecasted to escape and provinces that are trapped, as well those that are forecasted to be trapped within one to two years, based on our first definition by Felipe et al. (2012). The second and third columns show the number of years the specified province remains in the lower-middle-income range (LMIR) and upper-middle-income range (UMIR) respectively. Beijing, Tianjin, Shanghai and Jiangsu have escaped from the MIT, since the number of years they are within particular income ranges is less than the maximum (28 years in LMIR; 14 years in UMIR). For the rest of the provinces, we predict whether a province will escape the MIT or be trapped, based on our forecasted growth. For example, we predict that Hebei will escape the MIT because it will move out of the UMIR within 13 years, a year earlier than the MIT definition. On the other hand, Inner Mongolia will be trapped, as our forecast shows that it will remain in the UMIR for 16 years, two years longer than the MIT definition. We conclude that based on Definition 1, Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shaan'xi, Gansu, Qinghai and Xinjiang will be trapped in the MIT.

Table 3. Provincial MIT based on Definition 1

Provinces	Years in LMIR	Years in UMIR	Current Status	Prediction
Beijing	14 years	11 years	–	Escaped
Tianjin	13 years	7 years	–	Escaped
Hebei	21 years*	13 years*	still in LMIR	Will escape
Shanxi	31 years*	N.A.	still in LMIR	Will be trapped
Inner Mongolia	9 years	14 years*	Still in UMIR	Will be trapped
Liaoning	22 years*	20 years*	Still in LMIR	Will be trapped
Jilin	15 years	16 years *	Still in UMIR	Will be trapped
Heilongjiang	22 years*	14 years*	Still in LMIR	Will be trapped
Shanghai	22 years	11 years	–	Escaped
Jiangsu	13 years	6 years	–	Escaped
Zhejiang	14 years	9 years*	Still in UMIR	Will escape
Anhui	27 years*	11 years*	Still in LMIR	Will escape

Provinces	Years in LMIR	Years in UMIR	Current Status	Prediction
Fujian	15 years	7 years*	Still in UMIR	Will escape
Jiangxi	17 years*	10 years*	Still in LMIR	Will escape
Shandong	13 years	10 years*	Still in UMIR	Will escape
Henan	17 years*	10 years*	Still in LMIR	Will escape
Hubei	13 years	12 years*	Still in UMIR	Will escape
Hunan	16 years*	11 years*	Still in LMIR	Will escape
Guangdong	17 years	9 years*	Still in UMIR	Will escape
Guangxi	17 years*	11 years*	Still in LMIR	Will escape
Hainan	17 years*	11 years*	Still in LMIR	Will escape
Chongqing	12 years	7 year*	Still in UMIR	Will escape
Sichuan	18 years*	11 years*	Still in LMIR	Will escape
Guizhou	11 years*	8 years*	Still in LMIR	Will escape
Yunnan	20 years*	12 years*	Still in LMIR	Will escape
Tibet	17 years*	10 years*	Still in LMIR	Will escape
Shaan'xi	14 years*	18 years*	Still in LMIR	Will be trapped
Gansu	38 years*	N.A.	Still in LMIR	Will be trapped
Qinghai	19 years*	21 years*	Still in LMIR	Will be trapped
Ningxia	15 years*	13 years*	Still in LMIR	Will escape
Xinjiang	24 years*	21 years*	Still in LMIR	Will be trapped

Note: * indicates the number of years in particular income range based on our forecast.

N.A. indicates that per capita income of the province will not surpass the definition of either lower-middle-income range (LMIR) or upper-middle-income range (UMIR) before 2050.

Source: Authors' summary.

Definition 2, by Eichengreen et al. (2014), identifies the MIT based on the economic growth rates before and after a slowdown period. More specifically, an economy is trapped if:

1. $g_{t,t-n} > 3.5\%$;
2. $g_{t,t-n} - g_{t,t+n} > 2\%$;
3. $y_t >$ USD10,000 (based on 2005 PPP price);

where $g_{t,t-n}$ is the average growth rate between year *t-n* and *t*; $g_{t,t+n}$ is the average growth rate between year *t* and *t+n*; and y_t is the per capita GDP in year *t*.

If the above three conditions are fulfilled, the economy experiences a growth slowdown in year *t* and falls into the MIT. Eichengreen et al. (2014) define *n*=7. For convenience and consistency with other definitions, we transform the 2005 PPP price into 2010 USD price, so that the third condition is now defined as $y_t >$ \$4,664, a level which is roughly equal to the median of the LMIR given in Definition 1 above.

In addition, we impose a fourth condition:

4. $g_{t,t+n} > 3.5\%$

This condition implies that after the growth slowdown, the seven-year average growth rate must be lower than 3.5 per cent. If an economy suffers a growth slowdown that is featured by conditions (1)–(3) but still maintains a significantly high growth rate, it is very unlikely that this economy has been trapped by the MIT. In other words, a slowdown by 2 per cent per capita growth from an initially high level (for instance, from 8 to 6 per cent) may still allow a country to maintain rapid convergence to a high-income status (Agénor, 2017; Felipe et al., 2012; Im & Rosenblatt, 2013). Felipe et al. (2012) also emphasise this 'minimum growth rate' of 3.5 per cent for a middle-income country to escape from the MIT. Therefore, to make Definition 2 consistent with other definitions of the MIT, we impose condition (4) as well.

Table 4 shows the results of provinces that are trapped based on Definition 2. The second column indicates the year of slowdown based on a seven-year average. The third and fourth columns indicate the average annual economic growth rate before and after the slowdown year for the trapped provinces, respectively. We find that Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Shaan'xi, Qinghai and Xinjiang are heading into the MIT in the near future. All other provinces are considered not trapped based on Definition 2.

Table 4. Trapped provinces based on Definition 2

Provinces	Slowdown year	$g_{t,t-n}$	$g_{t,t+n}$	Status
Hebei	2015	5.3%	2.8%	trapped
Shanxi	2014	6.1%	2.9%	trapped[1]
Inner Mongolia	2013	13.1%	3.2%	trapped
Liaoning	2010	12%	3.0%	trapped
Jilin	2016	7.7%	3.49%	trapped
Shaan'xi	2017	8.0%	3.4%	trapped
Gansu	2014	9.6%	2.9%	trapped
Qinghai	2017	7.3%	3.2%	trapped
Xinjiang	2014	9.0%	3.2%	trapped

Note: [1] Shanxi province experienced the growth slowdown in 2013, but in that year condition (3) is not fulfilled. The per capita income of Shanxi in 2013 is $4,565, marginally below the requirement of condition (3). Since this difference is negligible, we classify Shanxi as in the middle-income range.

Source: Authors' summary.

Table 5 shows our results for trapped provinces using Definition 3. In our analysis, we use Bulman et al.'s (2014) range which defines an economy as trapped if its CUI: $\frac{\textit{the country's per capita income}}{\textit{US per capita income}}$ ε (8%, 36%) for over 50 years. As expected, this definition requires forecasting growth rates into the future. We use the ARIMA model, as explained earlier, as well as the exponential smoothing model to improve our forecasts. Our results in Table 5 show the number of years China's provinces will be in the middle-income range (column 4). For some provinces, the CUI does not meet the 36 per cent mark by 2050, according to our forecast, but has stayed within the specified range (8 per cent, 36 per cent) for less than 50 years. Therefore, to see whether these provinces will be trapped, we extend these provinces' forecast until the 36 per cent threshold is met or the 50-year criteria is met. We identify Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shaan'xi, Gansu, Qinghai, Ningxia and Xinjiang as trapped provinces.

Table 5. Provincial MIT based on Definition 3

Provinces	Year = 8%	Year = 36% (est.)	CUI years	Conclusion
Beijing	1996	2026	31 years	Not trapped
Tianjin	1999	2025	27 years	Not trapped
Hebei	2009	N.A.	over 50 years	Trapped
Shanxi	2010	N.A.	over 50 years	Trapped
Inner Mongolia	2007	N.A.	over 50 years	Trapped
Liaoning	2006	N.A.	over 50 years	Trapped
Jilin	2009	N.A.	over 50 years	Trapped
Heilongjiang	2010	N.A.	over 50 years	Trapped
Shanghai	1992	2031	40 years	Not trapped
Jiangsu	2004	2029	26 years	Not trapped
Zhejiang	2002	2039	38 years	Not trapped
Anhui	2013	2053	41 years	Not trapped
Fujian	2007	2045	39 years	Not trapped
Jiangxi	2013	2059	47 years	Not trapped
Shandong	2006	2049	44 years	Not trapped
Henan	2011	2055	45 years	Not trapped
Hubei	2010	2049	40 years	Not trapped
Hunan	2011	2052	42 years	Not trapped
Guangdong	2003	2044	42 years	Not trapped
Guangxi	2013	2055	43 years	Not trapped
Hainan	2011	2056	46 years	Not trapped
Chongqing	2010	2042	33 years	Not trapped
Sichuan	2012	2053	42 years	Not trapped
Guizhou	2016	2040	25 years	Not trapped
Yunnan	2017	2062	46 years	Not trapped
Tibet	2015	2055	41 years	Not trapped
Shaan'xi	2010	N.A.	over 50 years	Trapped
Gansu	2022	N.A.	over 50 years	Trapped
Qinghai	2011	N.A.	over 50 years	Trapped
Ningxia	2010	N.A.	over 50 years	Trapped
Xinjiang	2011	N.A.	over 50 years	Trapped

Source: Authors' summary.

Discussion

It is not our intention here to criticise any particular definition of MIT, as each has its own merits and issues. However, based on the three popular definitions from previous literature, we find seven provinces in China that are or will be trapped under all definitions: Shanxi, Inner Mongolia, Liaoning, Jilin, Shaan'xi, Qinghai and Xinjiang. Three other provinces are trapped, based on two of the three definitions—Heilongjiang, Gansu and Hebei—while Ningxia is only identified as trapped under Definition 3. Ignoring Ningxia, we have 10 provinces in China that we can confidently confirm as trapped or heading into the MIT. These provinces are what we term the 'trapped dragon', given its obvious shape (see Figure 1). The trapped dragon comprises 10 provinces in the north extending from the east to the west except for Tianjin and Ningxia that are located in the northern area.

Figure 1. The trapped dragon

Source: Authors' representation.

Regional growth disparity

Since the reform and opening up in 1978, China has maintained rapid economic growth in general. The regional growth disparity, however, has become a well-known concern both in the academic circles as well as in the policymaking space. As predicted by neoclassical growth theory, as a result of a diminishing return from capital investment there exists a '*b*-convergence' of per capita income between less-developed regions and more-developed regions (Barro & Sala-i-Martin, 1995). However, most empirical studies on China's regional growth show that such '*b*-convergence' does not exist (see, for example, Liu et al., 2004; Shen & Ma, 2002; Zhu et al., 2014). In fact, there is evidence to show that regional development can even exhibit patterns of divergence, particularly after 1990 (Dai & Mao, 2015).

Reasons for an absence in absolute growth convergence among different regions in China have been investigated frequently in the literature. The general idea is that several important assumptions for a '*b*-convergence' are violated in China including distortions in the goods and factor markets (Cai et al., 2002), restrictions in inter-regional labour migration due to the *hukou* policy (Liu, 2001), preferential treatment among coastal provinces (Dong, 2004) and significant differences in the adoption of technology among provinces (Li & Xu, 2008). Controlling for these factors, a conditional growth convergence might be identified among China's provinces, with human capital, investment rate and trade dependence acting as important conditions (Cai & Du, 2000). Demurger (2001) also showed that infrastructure development and the ability of local government to raise funds for the public good could act as key differentiating factors to explain the growth gap among provinces. In fact, in the study by Shen and Ma (2002), there is clear evidence of a 'club convergence' in China, such that growth convergence can be detected among the eastern coastal region and the western inland region. This observation can be explained by the differences in human capital and market openness between the two regions.

Furthermore, the unequal growth rates in total factor productivity (TFP) also contribute directly to the inter-regional development disparity. As shown by Shiu and Heshmati (2006), the eastern region of China exhibits, on average, higher TFP growth when compared with the western region. There are many factors contributing to such TFP growth differences including foreign and domestic investment in information, communication and technology. Huang et al. (2019) further add that indigenous research and development investment plays a leading role in promoting TFP, while the differences in human capital and technological absorptive capacity explain the differences in TFP growth among provinces. Regional government preferential policies also contribute to TFP disparities. Chen et al. (2019) show that special development zone policies contribute differently to TFP of firms in the coastal and inland regions of China. Although many economic development zones were created in China's inland with the hope of reducing growth disparities, most efforts failed to promote productivity growth in the lagged regions resulting in a spatial misallocation of resources.

In sum, previous studies acknowledge the regional growth disparity in China, and identify various factors that cause such disparity. In this study, we categorise China provinces into three: provinces that are in the MIT, provinces that have escaped from the MIT, and provinces that are neither trapped nor escaped the trap.

Factors behind the trapped dragon

Having identified the trapped provinces, it is also important to determine why these provinces face such a dilemma. Otsuka et al. (2017) point to erroneous policies and strategies of the government and the private sector in handling a transitional economy. They explain that in an effort to prolong economic growth, the government sometimes will promote and subsidise sunset industries that drag the economy down in the long run. In addition to the growth convergence literature, the MIT literature addresses triggers that result in economies getting caught up in the trap, including weak human capital development (Cherif & Hasanov 2015; Egawa 2013), low TFP (Aiyar et al., 2013; Eichengreen et al., 2014), economic structure—particularly an export structure that is more inclined towards imitative products rather than innovative products (Eichengreen et al., 2014; Flaaen et al., 2013; Otsuka et al., 2017)—increasing income inequalities (Bulman et al., 2014), and weak financial sector reforms (Han & Wei, 2015). Glawe and Wagner (2017), in their study of the MIT in China and other developing countries, identify 18 such trigger factors, but they highlight the three most important ones: human capital, export structure and TFP. We consider these three factors now at the provincial level.

We use the share of population that have college education and above as the measure of human capital. Compared to Beijing, Shanghai and other provinces that have escaped the MIT, the human capital of the trapped provinces is significantly lower (see Figure 2). In addition, the share of population that has a college education and above increased faster in Beijing and Shanghai as compared to the trapped provinces. However, it should be noted that the level of human capital in other non-trapped provinces such as Sichuan, Anhui and Guangdong is not significantly higher than our trapped provinces. Therefore, while human capital can partly explain the difference between trapped and escaped provinces, it cannot explain the differences between trapped provinces and provinces that are neither trapped nor have escaped.

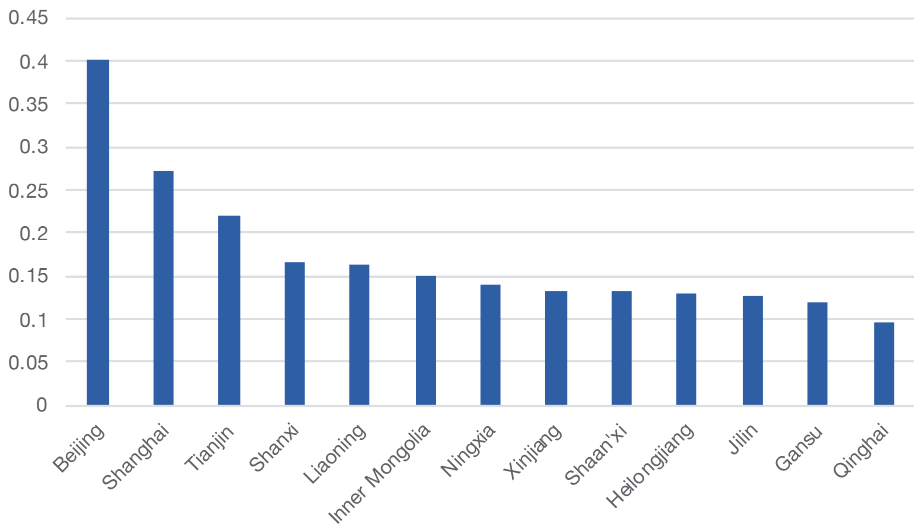

Figure 2. Share of population with college education and above, 2015
Source: Authors' representation.

Export data at the provincial level is not available. Thus, we resorted to the GDP structure of the provincial economy to provide a general idea of the export structure. We find that the trapped provinces rely much more on secondary industry than escaped provinces (see Table 6). The services sector contributed over 80 per cent of GDP in Beijing in 2015, while secondary industry contributed less than 20 per cent. However, in the trapped provinces, secondary industry can contribute more than 50 per cent of the local GDP (for instance, Shaan'xi). Heavy industries, agriculture and mining make up significant shares of their economies. Table 7 looks at the industrial sector in more detail. We find that mining is a significant sector for Shanxi and Shaan'xi, our representative trapped provinces. Within the mining sector, Shanxi's main sector is coal mining and petroleum, and petroleum and gas extraction. As for the manufacturing sector, for trapped provinces shown in the table, mining-related sectors like petroleum processing, metal and nonmetal smelting are the dominant ones. Compare this to automobile manufacturing and computers and electronic equipment manufacturing in Shanghai and Beijing, or the light industries like leather or electrical machinery in Fujian and Anhui.

Table 6. Economic structure of selected provinces, 2015

	Beijing	Shanghai	Fujian	Anhui	Shanxi	Liaoning	Shaan'xi
Gross regional product (billion RMB)	23,014.59	25,123.45	25,979.82	22,005.63	12,766.49	28,669.02	18,021.86
Primary industry (%)	0.6	0.4	8.2	11.2	6.1	8.3	8.9
Secondary industry (%)	19.7	31.8	50.3	49.7	40.7	45.5	50.4
Tertiary industry (%)	79.7	67.8	41.6	39.1	53.2	46.2	40.7
Agriculture, forestry, fishery, animal husbandry (%)	0.6	0.5	8.4	11.6	6.5	8.7	9.3
Industry (%)	16.1	28.5	41.6	42.1	34.1	39.3	40.8
Construction (%)	4.2	3.4	8.7	7.7	6.6	6.6	9.9
Wholesale and retail (%)	10.2	15.2	7.9	7.5	8.4	10.4	8.3
Transport, storage and post (%)	4.3	4.5	6.0	3.6	7.0	5.9	4.0
Hotels and catering services (%)	1.7	1.5	1.5	1.9	2.7	2.2	2.4
Financial intermediation (%)	17.1	16.6	6.5	5.6	8.9	6.5	6.0
Real estate (%)	6.3	6.8	4.1	4.0	5.0	4.1	3.9
Others (%)	39.5	23.1	15.2	16.0	20.6	16.3	15.5

Source: China Statistical Yearbook, 2016.

Table 7. Industrial structure of selected provinces, 2015

	Beijing	Shanghai	Fujian	Anhui	Shanxi	LiaoNing	Shaan'xi
Gross output value of Industry	17,352.46	31,322.64	10,165.33	39,875.66	12,566.9741	33,498.56	20,333.97
Mining (% of total industrial output)	1%	0%	2%	3%	36%	5%	22%
Coal mining and dressing	0%	0%	31%	47%	93%	15%	49%
Petroleum and natural gas extraction	0%	100%	0%	0%	1%	12%	31%
Ferrous metals mining and dressing	32%	0%	20%	28%	6%	36%	4%
Nonferrous metals mining and dressing	0%	0%	11%	7%	0%	12%	10%
Nonmetal minerals mining and dressing	0%	0%	38%	18%	0%	18%	3%
Mining auxiliary activities	68%	0%	0%	0%	0%	8%	3%
Other mining industry	0%	0%	0%	0%	0%	0%	0%
Manufacturing (% of total industrial output)	72%	95%	92%	91%	51%	90%	71%
Farm products processing	3%	1%	6%	8%	5%	10%	8%
Food manufacturing	2%	2%	4%	2%	2%	1%	4%
Wine, beverages and refined tea manufacturing	1%	0%	3%	2%	2%	1%	4%
Tobacco products manufacturing	0%	3%	2%	1%	1%	0%	2%
Textile industry	0%	1%	5%	3%	1%	1%	2%
Textile, wearing apparel and accessories	1%	1%	5%	3%	0%	1%	0%
Leather, fur, feather and related products and footwear	0%	1%	10%	1%	0%	1%	0%
Timber processing, bamboo, cane, palm fibre and straw products	0%	0%	3%	2%	0%	1%	0%
Furniture manufacturing	1%	1%	1%	1%	0%	1%	0%
Paper making and paper products	0%	1%	2%	1%	0%	1%	1%
Printing and record medium reproduction	1%	1%	1%	1%	0%	0%	1%
Culture, education, art and crafts, sport and entertainment products	1%	1%	4%	1%	0%	0%	1%
Petroleum processing, coking and nuclear fuel processing	5%	4%	4%	1%	12%	11%	10%

	Beijing	Shanghai	Fujian	Anhui	Shanxi	LiaoNing	Shaan'xi
Raw chemical materials and chemical products	3%	8%	3%	6%	8%	7%	7%
Medical and pharmaceutical products	6%	2%	1%	2%	3%	2%	4%
Chemical fibre manufacturing	0%	0%	2%	0%	0%	0%	0%
Rubber and plastic products	1%	3%	4%	4%	1%	3%	3%
Nonmetal mineral products	3%	2%	8%	7%	5%	8%	8%
Smelting and pressing of ferrous metals	1%	4%	3%	5%	27%	11%	7%
Smelting and pressing of non-ferrous metals	1%	1%	3%	6%	9%	3%	10%
Metal products	2%	3%	3%	4%	2%	4%	2%
Ordinary machinery manufacturing	4%	8%	3%	6%	2%	8%	4%
Special purpose equipment manufacturing	4%	3%	2%	4%	3%	5%	4%
Automobile manufacturing	31%	18%	3%	7%	1%	9%	7%
Railroad, marine, aviation and other transport equip manu.	3%	3%	1%	1%	2%	3%	2%
Electrical machinery and equipment manufacturing	6%	7%	5%	13%	3%	4%	6%
Computers, telecommunication and other electronic equip manu.	17%	18%	8%	6%	10%	2%	3%
Equipments and instruments manufacturing	2%	1%	1%	1%	0%	1%	1%
Other manufacturing	1%	0%	1%	0%	0%	0%	0%
Comprehensive utilization of waste resources	0%	0%	0%	1%	0%	0%	0%
Metal products, machinery and equipment repair	1%	1%	0%	0%	0%	0%	0%
Production and supply of electricity, heat, gas and water (% of total industrial output)	26%	5%	6%	5%	13%	5%	7%
Production and supply of electricity and heat	90%	73%	89%	91%	90%	93%	86%
Production and supply of gas	9%	22%	7%	7%	9%	4%	12%
Production and supply of water	1%	5%	4%	2%	1%	3%	2%

Source: Various Provincial Statistical Yearbooks, 2016.

We also note that the economic structure in trapped provinces like Liaoning is not significantly different from those provinces that are neither trapped nor escaped (such as Fujian and Anhui). Thus, while the economic structure may provide some explanation for the MIT phenomenon, it does not fully explain the reason behind the trapped dragon.

A number of studies have attempted to measure provincial-level TFP in China (Bai & Yin, 2008; Han, 2017; Sun & Xiu, 2017). They use different approaches to estimate the TFP to make cross-provincial comparisons. Han's (2017) estimations, using the DEA-Malmquist methodology, show that all trapped provinces suffer from an average negative TFP growth between 2004 and 2013 (e.g. Shanxi (–5.4 per cent), Liaoning (–1.9 per cent), Jilin (–1.5 per cent) and etc.), while provinces that are not in the MIT have positive TFP growth rate (e.g. Jaingsu (+4.5 per cent), Guangxi (+4.1 per cent), Beijing (+2.2 per cent), and etc.). Based on the clear distinction in the TFP growth rate, we can conclude that productivity and its growth is an important factor that distinguishes a trapped province from a non-trapped province.

Thus, the general policy implication for the trapped dragon to escape from the MIT is to promote local TFP growth. To do so, the upgrading of industry structure is important, as there is evidence that certain industries outperform others in TFP growth rates (Dai & Mao, 2015; Zhu et al., 2019). Building local human capital and enhancing labour mobility across regions are also recommended policies (Cai & Du, 2000; Huang et al., 2019). In contrast, it should also be noted that some apparently popular policies, such as investments in local infrastructure or establishing special development zones in lagging regions, are found to be inefficient. Infrastructure investments by local government crowd out private capital and reduce the efficiency of such investments (Shi et al., 2017), while special economic development zones fail to promote improvements in local TFP and create spatial resource misallocation (Chen et al., 2019).

Conclusion

Previous studies tend to show that China is in or heading towards the MIT (Glawe & Wagner, 2017) while others claim that it has already escaped the trap (Huang, 2016). We argue that, given the economic diversity that exists in China, the MIT needs to be evaluated at the provincial level to be able to provide meaningful insights. While China as a whole is classified by the World Bank as an upper-middle-income country in 2017, municipalities like Beijing, Tianjin and Shanghai have per capita income that is well above the US$12,235 threshold and thus can be classified as high-income. At the same time, provinces like Gansu and Shanxi have average incomes of about US$4,000 and could still be classified as lower-middle-income. We use the three most popular definitions of the MIT and identify 10 provinces that are trapped or heading towards the MIT, which we refer to as the trapped dragon: Shanxi, Inner Mongolia, Liaoning, Jilin, Shaan'xi, Qinghai, Xinjiang, Heilongjiang, Gansu and Hebei. It should be noted that these provinces are trapped not because they are 'poor', but rather because their economic growth rates have experienced a prolonged slowdown, and a failure to address this malaise could result in these provinces lagging further behind their neighbours. We find low productivity to be an important distinguishing factor between trapped and non-trapped provinces, while weak human capital development and an economic structure that is more biased towards heavy industry and mining could explain the differences between trapped and escaped provinces.

An important policy implication that arises from this study is the need to prescribe different policies to different provinces in China. Clearly, for the trapped provinces, a transformation in economic structure is necessary. For the last three decades, the trapped provinces have focused on heavy industry, mining and agriculture and supported the economic growth and transformation of their neighbours. As the demands for physical infrastructure plateaus (thus, a decrease in demand for heavy industry inputs like iron and steel) and regional economies become more service-oriented, the trapped provinces can no longer continue to rely on their traditional industries as engines of growth. Just like their southern neighbours in the 1980s and 1990s, a shift towards light and more technologically advanced industries is necessary. It is relatively easier to improve productivity in such industries. However, an important prerequisite to attract more productive industries is the availability of human capital. In this regard, the policies pursued by provinces like Jiangsu and Guangdong in the 1980s and 1990s are useful templates for the trapped provinces. More in-depth studies on factors that push provinces into the MIT, on the one hand, and the provincial-specific economic growth models pursued by non-trapped provinces, on the other, will be useful in this regard.

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