What factors drive successful industrialization? Evidence and implications for developing countries

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ABSTRACT

This paper analyses the drivers of successful industrialization in developing countries. We consider two different periods, 1970–1990 and 1991–2014, likely to be affected by different patterns of industrialization due to major political, technological and organizational changes. We subsequently develop a methodology to identify a small group of countries for each period, which have exhibited a pattern of industrialization that is not only remarkable in absolute terms, but also sustained. Our analysis reveals that successful industrialization is driven by a combination of factors, including a country’s initial economic conditions, factor endowments and other characteristics, such as demography and geography. We also show that other variables that policymakers can control play a crucial role. This includes, among others, the promotion of investments (both public and privately funded) and education; the management of trade and capital openness; financial sector development and the promotion of both macroeconomic and institutional stability.

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1. Introduction

There is consensus that industrialization plays a key role in the process of a nation’s economic development. There are many reasons why pursuing sustained industrialization has long lasting benefits on economic development. Some of these reasons are still rooted in Kaldor’s law, which provides a conceptual framework for the link between manufacturing and economic growth. The major argument of proponents of industrialization relies on the productivity advantage of manufacturing over other sectors, as well as on the higher externalities that can arise from manufacturing growth (see also Szirmai, 2012, for a detailed discussion). As a matter of fact, not only the manufacturing sector displays levels of productivity that are higher compared to those of other sectors and has a greater capacity to absorb labour force (Timmer et al., 2015; McMullan et al., 2014), it also promotes savings, boosts the process of capital accumulation and offers higher investment opportunities (Lewis, 1954; Szirmai and Verspagen, 2015). In addition, the manufacturing sector promotes economies of scale by driving technological progress (Arrow, 1962; Thirlwall, 2002), while providing spillover effects through linkages to other economic sectors (Hirschman, 1958).

More recent research has shown that industrialization allows for greater economies of scope, with countries that can produce larger varieties of goods also being far more likely to undergo rapid economic growth (Hausmann et al., 2007; Hidalgo et al., 2007).

As far as developing countries are concerned, both the data (Fig. 1) and the existing empirical evidence seem to support the industrialization-growth nexus. Rodrik (2006) emphasizes that episodes of growth acceleration are often associated with an increasing role of manufacturing in the economy. The same author shows for a large sample of countries that manufacturing is the only sector of the economy achieving unconditional convergence in productivity (Rodrik, 2013). Szirmai and Verspagen (2015) analyse the importance of manufacturing as a driver of economic growth using data for 88 countries (21 advanced economies and 67 developing countries) over the period 1950–2005. They report that manufacturing has a positive impact on economic growth. Cantore et al. (2017) get to very similar results with a sample of 80 countries.

Still, this early evidence contrasts with more recent analyses revealing a tendency in developing countries to embark on a path of growth not necessarily driven by industrialization (Rodrik, 2016; Diao et al., 2017). Rather, premature deindustrialization (i.e. countries achieving their peaks in manufacturing at earlier stages of economic development) and the shift towards services, together with the rise of breakthrough technologies (i.e. recent improvements in automation), have led many to argue that

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development through manufacturing growth has become a more difficult path to undertake for current developing countries (IMF, 2018; Eichengreen and Gupta, 2009). In fact, this is also consistent with theories suggesting leapfrogging stages of development to rapidly catch-up (Brezis et al., 1993).

However, evidence is not necessarily supporting these concerns, and there are a number of arguments to keep promoting the process of industrialization, especially in lower income countries. On the one hand, while services are indeed increasingly becoming a major source of income, trade, employment and even productivity growth (IMF, 2018) this is not necessarily so in developing countries, where a process of ‘tertiarization’ is still occurring in low-wage/low-productive non-tradeable activities with a consequent stall of economy-wide growth in presence of a weak domestic demand (AfDB, 2017). Conversely, manufacturing production could be expanded through exports in spite of the presence of small domestic markets. Most importantly, manufacturing could also help to reduce the technological gap promoting the adoption of new technology and the development of high-productivity jobs – as recently pointed out by Rodrik (2007). Indeed, most of new technological developments related to automation (e.g. Industry 4.0) are built upon old technologies and manufacturing knowledge, suggesting that building a manufacturing base is still a necessary condition to catching-up. Last, while the potential threat of automation is indeed massive for a considerable share of manufacturing jobs, this is less likely to occur for low-wage and labour intensive activities, i.e. where it is not yet cost-efficient to develop these new technologies (UNIDO, 2018; World Bank, 2017).

As a matter of fact, and in spite of the IT revolution, natural resource booms, commodification of some labour intensive manufacturing products, the key role that manufacturing played in the most successful countries has not been affected. A recent work by Haraguchi et al. (2017) shows that during the past 20 years the share of value added and employment of manufacturing for developing countries remained the same to previous 20 years in absolute term. Rather, differences occurred between countries, with China and a few other emerging economies making the lion’s share of developing countries’ manufacturing growth (see also Baldwin, 2016). Yet, as labour costs in China are rapidly growing, this provides additional incentives for low-income countries to enter low-skilled and labour intensive stages of production within global value chains (Lin, 2012; AfDB, 2017). And the advent of global production networks is also another point in favour of industrialization, since the fragmentation of international production allows now developing countries to develop and specialize into (often very specific) stages of production following their comparative advantage, rather than having to invest heavily to build the whole industry domestically (Tagliani and Winkler, 2016; Baldwin, 2016).

A last, but important, argument for industrialization has to do with its inclusiveness, which is potentially high. Evidence reported by UNIDO (2018) shows that countries with higher levels of manufacturing on GDP are those with lower levels of poverty and inequality while being the most promising to reduce gender discrimination in the job market.

In light of the above discussion it is even the more important today to understand what are the factors that contribute to a successful process of industrialization and why have some countries—more than others—been successful in maintaining a sustained pattern of industrialization over the last decades. Policies obviously play a decisive role. Newman et al. (2016) review the causes of weak manufacturing development in Africa by comparing it to successful cases in East Asia, and claim that the role of policies is key in explaining the different patterns observed in the two country groups. Asian countries display a set of policies and institutional conditions that have pushed rapid industrialization and structural change. The key elements for such success stories can be found, among others, in the capacity to implement a transformation based on labour-saving technological change combined with high levels of investment in human and physical capital (Martorano et al., 2017). Rodrik (2004) discusses the role of policies in promoting industrialization and emphasizes the importance of strategic collaboration between the government and the private sector. In a subsequent paper, Rodrik (2007) focuses on the challenge of industrialization within the context of an open economy claiming that successful industrial policies should be based on a combination of targeted interventions to promote new export industries and a competitive exchange rate. Aghion et al. (2011) argue that sectoral policies may foster productivity and economic growth when they target the most competitive sectors. A similar argument has been put forward by promoters of the new structural economics approach, who argue that countries should pursue a path of development that is based on the identification and the exploitation of existing comparative advantages (Lin, 2012).

The objective of this paper is to analyse the drivers of successful industrialization in developing countries. By pursuing this objective, we provide two main contributes to the existing literature. First, we suggest a simple method to define successful industrialization. On the basis of this method we identify a small group of countries who experienced a sustained pattern of rapid growth of manufacturing value added over the last forty years, accounting for two different periods, 1971–1990 and 1991–2014. Second, we examine whether the experiences of successful industrialization entail a set of common factors. We do this by empirically analysing the determinants of successful cases of industrialization among a large group of emerging and developing countries.

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2 The World Bank (2017) estimates that 2 to 8% of jobs in developing countries are exposed to the risk of automation.
3 Wood (2017) reaches a similar conclusion using a different lens of analysis. He demonstrates that the pattern of re-distribution of manufacturing is consistent with the results of an augmented Heckscher-Ohlin model, i.e. a model based on countries’ relative factor endowments. Over time, manufacturing value added has moved towards (skilled-scarce) labour abundant and land-scarce countries in Asia, while it failed to reach land-abundant countries in Africa and Latin America.
Understanding the drivers of successful and sustained processes of industrialization raises important policy implications for those developing countries, particularly in SSA, Latin America and South Asia, which are still underperforming in terms of industrialization and their likely capacity to link up to regional and global production networks.

The remainder of the paper is structured as follows. Section 2 develops a simple methodology to select a group of successful industrializers. Section 3 presents the empirical analysis, providing detailed information on the data and the model. Section 4 discusses the results of the empirical specification. Section 5 concludes, highlighting some of the implications of our findings.

2. Identification of successful industrializers

In this section, we explain how we identify “successful” industrializers. Our main source of information is the UN National Accounts Statistics, which provides annual data on manufacturing value added (MVA) in constant US dollars over the period 1970–2014 for virtually all countries in the world. Considering our focus on developing countries, we have removed all countries from our initial sample classified as high income by the World Bank at the end of each of the periods (1970–1990 and 1991–2014). Moreover, we also dropped countries with a population of less than 1 million from our analysis to eliminate potential outliers from our sample.4 Our final sample includes 126 countries for the period 1971–1990 and 112 countries for the period 1991–2014.5

The idea of using 1990 as a breaking point comes from Rodrik (2016), who shows that pre- and post-1990 trends in manufacturing employment are statistically distinguishable. As a matter of fact, the post-1990 period is not only characterized by strong political changes, but it is also a period during which economic globalization, thanks to significant reductions in communication costs following the ICT revolution, began thriving, marking important changes in the organization of international production and thus affecting the industrialization patterns of the majority of countries around the world (Baldwin, 2016). Importantly for the remaining of the analysis, this trend is also confirmed by our data. Running a modified version of the Chow test, we find in fact that these two periods are significantly different as far as the factors explaining successful industrialization are concerned.6

Based on this sample, we computed the annual MVA growth rates and analyse the distribution of this variable for the sample over the two periods. Table 1 reports the mean, median and 75th percentile value referring to the countries included in our analysis.

To proceed with the identification of “successful” industrializers, our strategy relies on a simple methodology that uses thresholds drawn directly from the observed distribution of the outcome of interests. The identification strategy builds on the following stages:

1. For each country, the average MVA growth rate during the period of analysis (1971–1990 and 1991–2014) must be higher than the average growth rate of MVA for the entire sample over the same period (i.e. larger than 4.26% per cent in the post-1990, and larger than 4.99% per cent in the pre-1990 period);
2. We then define an “episode” of industrialization as any year in which the annual rate of MVA growth is higher than the average annual MVA growth rate of the reference group/period;
3. A first group of industrializers is identified by grouping countries according to number of successful “episodes” recorded over each of the two periods. Countries are classified as “industrializers” if they experienced a number of episodes larger than the average number of episodes for the entire distribution (i.e. 9.5 in the first and 9.9 in the second period).

Table A1 in the Appendix presents the list of industrializers, together with some summary statistics on episodes of industrialization, for the two periods.

Finally, in order to refine our selection and to focus on a smaller group of “successful industrializers”, we add two more criteria that relate to the pattern and sustainability of the industrialization process:

1. We consider only those countries that recorded less than 25 per cent negative episodes (i.e. less than 5 drops in 1970–1990 and less than 6 in 1991–2014);
2. We select only those countries that recorded more than 75 per cent episodes of above average growth (i.e. 16 or more years of high growth for the first period and 18 or more years of high growth for the second period).

Table 2 provides a list of the selected countries, while Figure A1 in the Appendix plots the distributions of the MVA growth rates based on the different groups7.

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4 The excluded countries had a population lower than 1 million in terms of average value for both periods.
6 We have developed a Chow test to proof that these two periods are significantly different in explaining processes of industrialization. In doing so, we have computed our model (discussed in Section 3) over the whole period of analysis and for each sub-period i.e. 1971-1990 and 1991-2014. Then, we have computed the likelihood-ratio Chow test comparing the results related to these different periods and using the STATA command “ltest”. The likelihood-ratio Chow test rejects the null hypothesis of stable coefficients (Prob > F = 0.000).
7 While Figure A1 gives only a visual confirmation of the goodness of our selection, we run two additional tests for robustness. First, a standard t-test run on the two groups of industrializers (successful and non-successful) fails to reject the hypothesis of equality in their mean values of MVA growth (F: 37.43; p-value: 0.0000). Second, results of the two-sample Kolmogorov-Smirnov test for equality of distribution confirms that the distribution of MVA growth in the group of successful
As it could have been expected, the list is dominated by Asian countries. Successful industrializers during the first period include some of the most notable cases of the early and new Tigers (Korea, Malaysia), together with Turkey. In both cases, industrialization was initially driven by the state interventions aiming at "governing the market" (Wade, 1990) and allowing a process of structural transformation. However, while industrialization in East Asian economies was characterized by a shift of resources from low-tech products to more sophisticated ones (Martorano and Sanfilippo, 2015), the process of industrialization in Turkey was mainly focused on the development of the capital-intensive sector which resulted to be a less successful strategy after the process of trade liberalization in the 1980s (Cecen et al., 1994). The second period is mainly characterized by countries who were able to take advantage from globalization and fragmentation of international production. Beyond the well-known cases of China and Vietnam (and, to a lesser extent, of Bangladesh and India), it is worth showing that also smaller countries such as Cambodia, Laos and Myanmar have taken advantage from their proximity to the regional production hub that has established in Asia. These countries have been playing an important role in regional production networks and in the expansion of intraregional trade benefiting from the fact that larger Asian economies are currently upgrading within the value chain while offshoring some of the labour intensive phases of production (ADB, 2015).

The successful industrializers were selected on the basis of sustained, high MVA growth. Importantly, not only these countries experienced rapid growth of MVA over a long period of time, but they have also recorded structural change with increases in the share of MVA in GDP, indicating faster growth of their manufacturing sector relative to the rest of the economy. At the beginning of the two periods, i.e. 1970 and 1991, the respective groups of successful industrializers (with the exception of China) had a lower share of manufacturing in GDP than the average of other developing countries (Table A3 in the Appendix). After two decades, the majority of successful industrializers had a higher manufacturing share than the average of other developing countries. Even those countries that had a lower manufacturing share than the average increased their manufacturing share significantly over the years.8

3. Data and model specification

In this section, we present the setting of an empirical test that aims to identify the factors that promoted industrialization in the selected group of successful countries. The following baseline model is estimated:

\[
\text{industrializer}_{it} = \beta \sum \delta_t + \theta_i + u_{it}
\]

where i and t indicate the country and the year. \(\theta_i\) are the time fixed effects used to control for country invariant shocks (such as global financial crises; international commodity price fluctuations) that might have affected growth and industrialization, while \(u_{it}\) is the idiosyncratic error term.

Our dependent variable is a binary indicator which takes a value of 1 if the country is classified as a successful industrializer according to the definition provided in Section 2. The method we use to identify successful industrializers influences the way we implement our empirical strategy. Since we selected a sub-set of countries with a sustained pattern of industrialization over the two periods considered (i.e. with a very small variation of the dependent variable during each sub-period), the dummy takes a value of 1 for the entire sub-period of interest if the country is in the group of successful industrializers. For example, while Indonesia and Oman report a value of 1 for all 19 years of the period 1971–1990, the value for all the years included in the 1991–2014 period is 0, since both countries were not classified successful industrializers in the second period. It is important to clarify that this makes the identification strategy adopted in this paper different from what it is usually done in standard growth regressions. In fact, our empirical analysis does not aim at identifying factors leading to MVA growth over time, nor to explain short term shocks in MVA growth (that are frequent in our sample, see Table A1).9 Rather, our identification strategy builds on the one adopted in the literature that looks at sustained growth episodes. In that literature, for each country the period around which a growth episode occurs is coded one while the comparison group includes countries that have not had a growth episode in the same year (see Hausmann et al., 2005). In the same way, our analysis exploits the pooled dimension of the data applying a standard probit estimator. The results should therefore be interpreted as the incidence of each factor on the probability of belonging to the group of more successful industrializers in any given time period.

3.1. Control variables

In Eq. (1), Z is a vector of variables on which we base our main output. Along the lines of the literature focusing on the drivers of economic growth (Hausmann et al., 2005; Sala-i-Martin et al., 2004; Sachs and Warner, 1995) and of industrialization (Haraguchi, 2015; Chenery and Syrquin, 1975), these variables refer to economic, demographic, institutional and policy-related factors that may have affected the incidence of successful industrialization over the period of analysis. While these variables cover a number of dimensions found in previous literature to matter for industrialization, structural transformation and overall economic growth (McMillan et al., 2012; Hausmann et al., 2007), data limitations, especially concerning the coverage of earlier years and of some low-income economy, have affected the possibility to include additional variables that might contribute to the identification of sustained patterns of industrialization.

The first control is the level of real GDP per capita (\(\LGDP_{PC}\)), which is used to account for cross-country differences in stages of development. Such differences may matter since countries that start from lower levels of economic development have more probability to catch up with more advanced countries and therefore, to undertake sustained patterns of industrialization. Indeed, poorer countries are characterized by a higher productivity growth rate in their manufacturing sector, which in turn promotes an unconditional convergence with the technological frontier (Rodrik, 2013).

To control for the role of investment, we introduce the gross fixed capital formation (private and public) on GDP (\(\GFCP_{GDP}\)). Higher investments are expected to promote industrialization by stimulating aggregate demand and boosting productive capacities (Weiss and Clara, 2016).

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8 Oman, which is a resource-rich country, may be an exception. Even though the country’s manufacturing share tripled from 1970 to 1990, its share was still low at the end of the period because the country started with a very low manufacturing share of less than 1 per cent.

9 Still, we have also run standard growth regressions for comparison. Results of specifications using the growth of MVA as a dependent variable (either based on yearly data and using 3- or 5-years averages) are reported in Tables A4 in the Appendix. Cross-sectional estimators using the continuous variable are generally close to ours, but still there are less clear results on some variables, including education or openness, that we can rather identify in the analysis that follows as strong predictors of manufacturing success.
Several growth theories also emphasize the crucial role of human capital. Endogenous growth models assume that investment in human capital prevents returns to capital from falling and contributes to an increase in capabilities for innovation and the adaptation of new technologies (Romer, 1986). This is clearly relevant for industrialization. To capture this effect, we include a variable representing human capital endowments measured by the average number of years of education of the workforce (HC), derived from the Barro-Lee Barro and Lee, (2013) dataset.

We use information on the domestic credit to the private sector (as a percentage of GDP) to control for the level of financial development (CREDIT). The nexus between financial development and production dates back to Schumpeter, who claimed that well-functioning financial institutions boost technological innovation by selecting and funding the winners, i.e. entrepreneurs with high probabilities of implementing innovative processes and realizing innovative products. There is a large body of literature that focuses on the role of financial systems in promoting savings and investment decisions of individuals and firms, especially in industries within the manufacturing sector (Rajan and Zingales, 1998).

Macroeconomic policies related to international openness and integration are also included, since they can—directly or indirectly—affect the manufacturing sector’s development. First, we include the real effective exchange rate (REER), which plays an important role in fostering the productive sector, as discussed extensively in the literature (Rodrik, 2008). More specifically, a stable and competitive exchange rate is expected to promote the growth of the tradable sector (Martorano and Sanfilippo, 2015). A competitive exchange rate has been found to be more protective of the nascent domestic manufacturing sector compared, for instance, to tariffs (Helleiner, 2011), especially in countries that specialize in labour intensive industries. Second, we also include an indicator of capital account openness (KAOPEN). Capital account can result in both positive and negative spillovers to the domestic economy, and it has been managed differently by developing countries over time. In a Solow growth model, opening to capital inflows lowers interest rates and allows firms to borrow, thus raising their investment rates (Chari et al., 2012). On the other hand, capital liberalization might lead to higher volatility and economic instability.

We also account for the countries’ institutional conditions. Stable institutions have been identified as a key precondition for economic development, as well as a way to enable a good business climate for the private sector (Xu, 2010). We use the number of consecutive years under the current regime type (Boix et al., 2014) as a proxy for political stability (POL). The underlying idea is that a strong and stable government might ensure the successful implementation of a long-term plan, which might be necessary to promote the development of new industries.

To capture other important characteristics of the country, including their endowments, we add the share of mineral rents as a percentage of GDP (NAT,RES). Greater reliance on natural resources tends to increase cyclical fluctuations in national income and raises the probability of negative performance in the long run (Rodríguez and Sachs, 1999). More specifically, Sachs and Warner (2001) use the Dutch disease argument to point out the potential detrimental effects of high natural resource rents on the development of the manufacturing sector.

Finally, factors related to geography can also impede industrialization. We add a dummy accounting for each country’s access to the sea (LANDLOCKED). Landlocked countries have fewer opportunities to be open to trade and to foster a successful process of industrialization (Easterly and Levine, 2003). As such, geographic constraints hamper the ability of these countries to increase productivity due to their limited access to large markets or their opportunities to exploit economies of scale (Sachs and Warner, 1995).

### Table 3

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Whole period</th>
<th>Pre,1990</th>
<th>Post,1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP,PIC</td>
<td>−0.444***</td>
<td>−0.190**</td>
<td>−1.701***</td>
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<tr>
<td></td>
<td>[0.058]</td>
<td>[0.087]</td>
<td>[0.181]</td>
</tr>
<tr>
<td>GFC,GDP</td>
<td>1.104***</td>
<td>−0.416</td>
<td>6.455***</td>
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<tr>
<td></td>
<td>[0.263]</td>
<td>[0.325]</td>
<td>[0.810]</td>
</tr>
<tr>
<td>CREDIT</td>
<td>0.012***</td>
<td>0.010**</td>
<td>0.024***</td>
</tr>
<tr>
<td></td>
<td>[0.001]</td>
<td>[0.004]</td>
<td>[0.003]</td>
</tr>
<tr>
<td>REER</td>
<td>−0.006***</td>
<td>−0.003**</td>
<td>−0.005*</td>
</tr>
<tr>
<td></td>
<td>[0.001]</td>
<td>[0.001]</td>
<td>[0.003]</td>
</tr>
<tr>
<td>KAOPEN</td>
<td>−0.055</td>
<td>0.239***</td>
<td>−1.011***</td>
</tr>
<tr>
<td></td>
<td>[0.035]</td>
<td>[0.045]</td>
<td>[0.181]</td>
</tr>
<tr>
<td>HC</td>
<td>0.062***</td>
<td>0.084*</td>
<td>0.105**</td>
</tr>
<tr>
<td></td>
<td>[0.022]</td>
<td>[0.045]</td>
<td>[0.028]</td>
</tr>
<tr>
<td>POL</td>
<td>0.002***</td>
<td>−0.002</td>
<td>0.008***</td>
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<td>[0.001]</td>
<td>[0.002]</td>
<td>[0.002]</td>
</tr>
<tr>
<td>NAT,RES</td>
<td>−0.041**</td>
<td>−0.369***</td>
<td>−0.014</td>
</tr>
<tr>
<td></td>
<td>[0.017]</td>
<td>[0.066]</td>
<td>[0.017]</td>
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<tr>
<td>LANDLOCKED</td>
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<td></td>
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<tr>
<td></td>
<td>[0.115]</td>
<td>[0.220]</td>
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<tr>
<td>Constant</td>
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<td>0.729</td>
<td>5.847***</td>
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<td></td>
<td>[0.455]</td>
<td>[0.604]</td>
<td>[1.041]</td>
</tr>
<tr>
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<td>Y</td>
</tr>
<tr>
<td>Observations</td>
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<td>998</td>
<td>1,491</td>
</tr>
</tbody>
</table>

Robust standard errors in brackets *** p < 0.01, ** p < 0.05, * p < 0.1.

Table A5 in the Appendix presents a description of the variables and their source. Table A6 in the Appendix provides descriptive statistics for the entire sample disaggregated by period. The means of the two sub-periods do not differ significantly. This might be understood as an indication of similarities among countries’ policies and characteristics over the two sub-periods. The only exceptions are represented by the variables measuring openness-related policies (REER and KAOPEN), which reflect a different international trend as regards trade and financial liberalization policies. Moreover, the level of domestic credit to the private sector increased following the process of internal liberalization while the stability of the political regime has decreased.

Table A7 in the Appendix reports a disaggregation of previous statistics distinguishing between the groups of successful industrializers and the rest of the countries, for the entire period as well as for both sub-periods separately. In nearly all cases, the mean values are statistically different, which is promising in view of the multivariate analysis. A preliminary assessment of such differences seems to indicate that the group of successful industrializers are, on average—and independently of the period considered—characterized by lower income; higher investments, access to credit and institutional stability, as well as by a lower dependence on natural resource rents and more competitive exchange rates. Other variables, such as capital openness and education, show less obvious differences.

### 4. Results

Table 3 presents the main output of our analysis, in which the variables described in the previous section are regressed against a dummy variable identifying the successful industrializers vis-à-vis other countries in our sample, for both the entire period (Column 1), and the two sub-periods (pre- and post-1990, Columns 2 and 3, respectively).

The coefficient related to the level of real GDP per capita is negative and statistically significant. This result seems consistent with standard patterns of structural transformation identified in previous studies (Timmer et al., 2015), and confirms that countries that experienced a prolonged period of high MVA growth
are generally those at earlier stages of economic development\textsuperscript{10}. Note that this pattern is consistent across the different time periods. Though this might seem to contradict the trend of “premature de-industrialization” in the most recent period as highlighted by Rodrik (2016), it does not seem to be an issue here considering that the successful industrializers in the post-1990 period include countries (all Asian) that have not been affected by this trend.

Second, Table 3 shows that investment was an important factor in the industrialization process over the period of analysis. Yet, there are some differences when looking at the two periods. While investment was a key ingredient in explaining the successful process of industrialization in the post-1990 period, our analysis indicates that it was less important in promoting industrialization in the pre-1990 period. One potential explanation is the characteristics of the countries considered and the models of specialization followed over time. While development in the first wave of industrializers was mostly attributable to labour intensive industries requiring lower shares of fixed assets, and the pre-1990 period is characterized by low FDI inflows (in turn, an important component of GFCF, Amighini et al., 2017), investment played a key role in the process of development in countries such as China, India, Laos and Viet Nam. These trends are illustrated in Fig. 2. While the figure depicts a strong positive relationship between investments and industrialization over time, it also shows that over the period 1991–2014, successful industrializers represent a cluster reporting above-average levels of investment compared to the rest of the countries included.

Our results also show that human capital endowments, measured by the number of years of education, are among the key factors contributing to a sustained process of rapid industrialization. This result is in line with our expectations. Countries that experienced rapid industrialization, such as the early Asian Tigers (and, most notably, the Republic of Korea) or most recently China, invested in human capital to fuel the increasing demand from expanding industries, as well as by upgrading the labour force’s skills as soon as the industries moved up the value chain.

The level of credit to the private sector is an additional factor that may explain the good performance recorded by successful industrializers. Indeed, credit constraints hamper firms from exploiting investment opportunities (Levine, 2005). This is especially true in low income settings in which the economy operates in a suboptimal equilibrium (Banerjee and Newman, 1993). Moreover, in case of macroeconomic shocks, this also affects the innovation process and long-term growth (Aghion et al., 2004).

As regards the role of external policies, the results in Table 3 seem to suggest that the successful industrializers adopted an undervalued exchange rate regime allowing the domestic sector to become more competitive. This tends to confirm the role of the exchange rate as an effective industrial policy tool (Rodrik, 2008). By keeping the exchange rate low, these countries were able to promote their tradable sector.

Table 3 shows also that the coefficient measuring the degree of openness of the capital account was positive and statistically significant in the pre-1990 period, but turned negative in the post-1990 period. The result for the pre-1990 period can be explained by the model of development followed by countries included in the list of successful industrializers. During that period, those who were part of the group of the Asian “Tigers” (Republic of Korea) and the other newly industrialized countries (NICs) (Malaysia, Thailand, Indonesia) adopted more pragmatic policies to maximize the advantages from international integration in a period in which volatile financial flows were of lesser concern. By contrast, successful industrializers in the post-1990 period implemented more conservative policies, as shown in Fig. 3. The relatively closed capital account strategy gave China’s economy the opportunity to buffer

\textsuperscript{10}Still, using contemporary levels of per capita GDP could cause concerns of potential endogeneity. As a robustness check we have replicated columns 2 and 3 of Table 3 replacing contemporary with initial (i.e. beginning of the period) values. Results not included for reasons of space and available on request, replicate current findings.
Table 4
Determinants of Industrialization Episodes.

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Robust standard errors in brackets *** p < 0.01, ** p < 0.05, * p < 0.1.

the negative consequences of financial crises which affected many developing countries (Gallagher et al., 2014). A similar strategy was followed by India, which was able to reduce the volatility of its exchange rate and take advantage of the necessary policy space.

Crucially, our results confirm the role of political stability as a driver of sustained industrialization. Higher stability provides the right environment to promote investments and is a necessary precondition for economic development. Finally, we show that geographic characteristics and countries’ endowments play a role as well. Geographic remoteness represents a major constraint to the development of a strong industrial sector due to the difficulty of achieving economies of scale caused by high transport costs. Column (3) shows that geographic characteristics also played a role in the period between 1991 and 2014. Indeed, all countries included in the list of successful industrializers has access to the sea. The only exception is Laos."

On the other hand, however, we find that the probability of a country to initiate a rapid and sustained process of rapid industrialization reduces the higher the dependence on natural resources, whose curse may crowd-out the local industry through an increase in the price of domestic factors.

4.1. Additional specifications

In this Section, we provide a set of additional specifications and robustness checks in which we take other potentially relevant dimensions into account, which have not been included in our core regressions due to (a) their high correlation/substitution with some of the key variables in (1); and (b) the lack of a sufficient number of observations, especially for earlier periods and for some lower income countries. Table 4 reports a first set of such variables.

In Column 1, we replace the investment variable with two new variables derived from the IMF that allows to differentiate between public and private investment. This may be of relevance, since the government plays a key role in providing basic infrastructures that are necessary to promote the process of industrialization. Recent contributions emphasize the potential role public investment can play in terms of risk-taking, fostering technological development and innovation (Mazzucato, 2011). Existing evidence also shows that in some of the successful cases of industrialization, such as in the Republic of Korea, public investment has been crucial.
for creating pecuniary externalities without crowding-out private investments (Vos, 1982; Storm, 2017). Table 4 confirms these assumptions and shows that private investment on its own has a positive and significant role in promoting industrialization. Still, after computing the average marginal effect, we find that the coefficient is slightly higher in the case of public investment compared to private investment (0.332 and 0.284, respectively).

In Column 2, we consider the cost of labour. We do this by comparing countries according to their level of real wages per worker. Finding this information across a wide range of developing countries and over such a long time period is difficult. We therefore rely on information provided in related works by Lavopa (2015) and Haraguchi et al. (2017), which collects data on the shares of manufacturing wages in total and on the total number of persons employed in manufacturing, which we have merged to calculate an indicator of labour costs per worker. Including this variable in our model slightly reduces the number of observations, but does not affect the main results. Crucially, it reveals another characteristic of successful industrializers, namely their relatively lower labour cost (due, for instance, to an abundant labour force like in China or Bangladesh) that has given them a competitive edge in building low-value added specializations from which to kick-start their process of industrialization.

In Column 3, we introduce the lending interest rate (in %) which represents the bank rate for meeting the financing needs of the private sector. The coefficient is negative and statistically significant. This confirms the key role monetary policy plays in the process of industrialization, demonstrating that higher interest rates can have adverse effects on manufacturing firms by raising the cost of borrowing and thereby reducing their investments (Stiglitz, 2017).

In Column 4, we introduce a variable reporting the number of patent applications, which is a proxy for countries’ innovation potential. There is a wealth of literature on the link between the innovative capacity of a country, the ability to build national innovation systems and the sustainability of their industrialization (Nelson and Winter, 2009). In fact, our results indicate that being innovative is positively correlated with the probability of being a successful industrializer.

In Columns 5 and 6, we include information on trade policies, namely the average rates of applied tariffs, calculated for all goods and the manufacturing industries. Though the literature shows that tariffs are often used as an industrial policy tool, especially to protect infant industry (Storm, 2017), we only find weak evidence for this. The two coefficients are in fact negative, but both are not statistically significant and the number of observations drops consistently due to the lack of coverage of many years and countries. The result may also highlight the heterogeneity among countries, since tariffs are used differently according to distinctive domestic conditions and periods, i.e. tariffs are less compelling for labour-abundant than for labour-scarce countries (the latter being those countries that are more likely to adopt import substitution policies, see O’Rourke and Williamson, 2017).

In Column 7, we introduce a variable for the interest payments on external debt (% of GNI) as a proxy for macroeconomic stability (LDEBT). Although the macroeconomic environment is not a sufficient condition to promote industrialization, it is a necessary one to provide a better playing field and favouring domestic and foreign investments (Rodrik, 2006). Results in Table 4 confirm these expectations, showing that countries that experienced sustained industrialization over both periods considered were also those with a lower cost on their debt, and were therefore more likely to free resources to foster economic growth, including through industrialization.

As industrialization is a process characterized by its potential to promote inclusiveness and broader participation of a large number of people in new opportunities in the manufacturing sector, it is likely that demographic variables may explain certain patterns as well. Column 8 presents the results of our main specifications, including a coefficient measuring the age dependency ratio (% of working age population), which is as well a proxy for the supply side (AGE,DEP). The coefficient that measures the age dependency ratio is negative and statistically significant; this is consistent across periods. This adds an important point to our investigation of factors shaping sustained industrialization. In fact, demographic effects played a key role in East Asia’s economic “miracle” (Bloom and Williamson, 1998). Another notable example is China, whose pattern of industrialization has followed the prediction of Lewis, exploiting the large availability of young (mostly unskilled) workers moving from the rural to urban areas to fuel the manufacturing sector’s development (Yao, 2011).

In Column 9, we include information on inequality. On the one hand, high disparities push many people into low-wage jobs, hampering the development of domestic markets and the process of industrialization (Murphy et al., 1989). On the other hand, high inequality tends to reduce the effectiveness of policies due to the high dependence of institutions on class-based power structures. This was the case of Latin American countries where “the state’s lack of relative autonomy precluded certain policies from being pursued” (Jenkins, 1991: 201.). Our results seem to confirm the view that high inequality tends to be harmful for the process of industrialization, with countries that experienced fast MVA growth being on average less unequal compared to others.

Finally, in Column 10, we introduce an index of religion fractionalization (REL) to account for social stability. A large strand of literature argues that less fractionalization and more social networks may promote civic engagement and contribute to industrialization (Putnam et al., 1993; Knack and Keefer, 1997). By contrast, a more fractionalized society is expected to be less cohesive and hence less able to join forces, and moreover contributes less to the development of local industries. Indeed, our results seem to confirm the above-mentioned arguments, demonstrating that a more cohesive society is on average more likely to undertake prolonged phases of high industrialization.

4.2. Robustness checks

This section introduces some additional analyses to control for the robustness of our results.

A first robustness test is carried out on the methodology. Our dependent variable, measuring the successful periods of MVA growth for a relatively small group of countries (6 or 7 for each sub-period) could, in principle, be affected by the so-called “rare events” bias. Such a bias, commonly known as a “small sample bias”, is higher the smaller the number of cases in the less frequent of the two events, and could affect the maximum likelihood estimation of a model such as a standard probit or logit. An alternative method consists of estimating the model through penalized likelihood. Penalized likelihood is a general approach to reducing a small sample bias in a maximum likelihood estimation (Firth, 1993)14.

More information is available at http://data.worldbank.org/indicator/FR.INR.LEND.

13 Importantly, this model specification does not include the variable on education due its high correlation (-0.75) with the age dependency ratio.

14 This index measures the probability that two randomly selected individuals from a given country will belong to a different religious group.

15 We do this by means of the user-written STATA command firthlogit (Coveney, 2015)
Table A8 in the Appendix replicates our core estimation (as reported in Table 3) using a penalized likelihood estimator. We do not find any major differences, thus reducing any potential concerns about the small size of our selected sample of successful industrializers.

Second, our selection of samples used for the analysis might be questioned. One could argue for instance that the characteristics that seem to be peculiar to the sub-group of successful industrializers may be common to other industrializers as well, this being particularly true for those countries reporting high levels of MVA growth but do not have a sustained pattern of growth (i.e. those countries reported in Table A1). To deal with this issue, we compare the successful industrializers with the sub-group of other industrializers only (i.e. those countries included in Table A1, but that are not selected among the successful industrializers). The results, reported in Table A9 in the Appendix, appear consistent with the previous ones (except for the investment variable), and seem to strengthen our findings by showing that the characteristics discussed above appear unique to the smaller group of industrializers.

Third, the choice of variable on which we based the selection of successful industrializers may be challenged as well. To some extent, periods of high growth of total MVA could be linked to more general periods of sustained economic growth, which could raise the question about an industrial take-off. One might argue that an additional condition for determining successful industrialization is a high rate of MVA on GDP, an indicator that can separate the growth of manufacturing from a possible link to overall economic growth. To check the robustness of our results, we follow a similar procedure to that described in Section 2, but use instead the rate of growth of the MVA on GDP ratio. We can thereby adjust the list reported in Table 2 by excluding those countries that have not been listed among the successful industrializers based on the new criteria. While no substantial differences were visible during the pre-1990 period, a more precise selection was made for the post-1990 period, since countries like China, Cambodia, India and Laos were excluded, considering the high growth experienced by these economies over the last decades. We then run our estimates on the adjusted samples. The results, reported in Table A10 in the Appendix, confirm once again the robustness of our key findings. Two striking differences emerge and—unsurprisingly—both relate to the post-1990 sample. First, the coefficient of political stability turns negative and significant. Such a negative coefficient might be explained by the decrease in the number of countries with long lasting regimes (China, Cambodia and India), whereas the sample of successful industrializers mostly includes countries that have recently experienced political transitions, such as Bangladesh, Myanmar and Viet Nam. Second, the coefficient of the exchange rate now turns positive and significant. This appears consistent with the new sub-sample of countries. In smaller economies with less diversified exports and highly volatile terms of trade, a pegged regime or the dollarization strategy might be a better strategy to reduce transaction costs, assure price stability and increase policy credibility (Frankel, 1999).

Finally, we have checked the sensitivity of our main results to the selection criteria discussed in Section 2. We have done this by modifying the thresholds used in the different steps of the selection exercise. First, we have modified step 1 (keeping the other steps unchanged) so that the median MVA growth rate during the period of analysis must be higher than the average growth rate of MVA for the entire sample over the same period. Second, we have modified step 2 (keeping the other steps unchanged) so that we now define an “episode” of industrialization as any year in which the annual rate of MVA growth is higher than the median annual MVA growth rate of the reference group/period. Third, we have modified (in a more restrictive way) the thresholds used to define the successful cases, using the 10th percentile of the negative episodes and the 90th of the total episodes, instead of the 25th and 75th, respectively. Results based on the additional groups are reported in Table A11 in the Appendix. They do not show consistent differences either in the list of the countries or in the results. The only difference—as one could expect—is that when adopting less restrictive thresholds (the median instead of the mean), there is a larger number of cases, and some of the findings related to openness and institutions are not fully confirmed.

4.3. Conclusions and implications

Industrialization is one of the key pillars of long-term economic growth. Due to the manufacturing sector’s capacity to absorb workforce, enhance diversification and structural transformations, while spurring the growth of other sectors through linkages, it remains essential for many developing countries to promote their own industrialization.

In this study, we explored whether it is possible to identify some factors that are common to countries that have undertaken a strong and sustained process of industrialization over the last decades. We considered two different periods, 1970–1990 and 1991–2014, which were likely to be affected by different patterns of industrialization due to significant political, technological and organizational changes. We then developed a simple methodology to identify a group of countries for each period, which have shown a pattern of industrialization that is not only remarkable in absolute terms, but also sustained (i.e. occurring over a long-time span). Our selection method allowed to confirm some of the well-known stories of success (mostly including East Asian economies, such as South Korea, China and Vietnam) but also to spot on some stories of success that did not persisted over time (such as Turkey during the first phase) or on the ongoing industrialization of smaller countries such as Laos, Cambodia and Myanmar.

Using these selected groups of countries, we ran a multivariate analysis with the objective of identifying the key characteristics of their exceptional industrialization pattern.

We show that there are some common features that are relevant to the process of industrialization of different countries across different periods. Some of the factors that we have identified in this study are common to what found in the literature on the determinants of growth and growth accelerations (Sala-i-Martin et al., 2004; Hausmann et al., 2005; Sachs and Warner, 1995). For example, our results confirm that successful industrialization is correlated to high institutional stability, which in turn contribute to the creation of a sound investment climate. These are dimensions that have strongly characterized the rise of emerging economies in East Asia over the last decades and in which substantial policy efforts are being undertaken in other low-income economies (Newman et al., 2016).

We also pair existing growth literature by emphasizing the role of economic policies and reforms (Hausmann et al., 2005; Rodrik, 2008) as drivers of sustained industrialization. Yet, policies to support industrialization can be peculiar, and we outline how selectivity in trade and capital flows can largely affect industrial development in developing countries (Lall, 1993; Lin, 2012). More specifically, our work emphasizes the role of the exchange rate as an effective industrial policy tool (Rodrik, 2008). Our study also depicts the crucial responsibility governments assume to develop policies that are effective under different circumstances and in dif-

\footnote{For instance, Uganda's MVA growth rate was higher than 5 per cent over the period 2004 – 2011, while in Equatorial Guinea, it was even higher (around 15 per cent in 200, 2008 and 2009). However, in both cases, the MVA growth rate was lower than the GDP growth rate. As a result, the growth rate of the MVA/GDP variable decreased, signalling a reduction in the importance of the manufacturing sector in these economies.}
different periods. The openness of the capital account, for instance, deserves special attention considering the different types of capital (e.g. short vs. long-term), the direction of capital flows and their potential consequences in terms of economic stability. The most recent group of rapid industrializers, such as China and India, have followed more conservative strategies or a gradual process of capital account liberalization to reduce the volatility of their exchange rates while leaving margins to pursue economic adjustments.

Investment in physical capital is particularly crucial in increasing local production capacity. Differently from other works that do not differentiate between public and private investments, we show that the former are especially relevant in providing positive externalities to the private sector and in reducing potential bottlenecks on the supply side (Storz, 2017). In fact, in most of the countries included in our group of successful industrializers (e.g., Korea or China more recently), public investment played a key role by crowding-in private investments. Similarly, investments in the provision of a well-trained labour force are essential in ensuring that the industrialization process becomes sustainable, since they allow an upgrade of local capabilities and skills and facilitates the process of structural transformation.

Finally, we identify some additional demand and supply side factors that are specifically relevant for supporting the process of sustained industrialization in developing countries, including factor endowments, favourable demographic trends, as well as lower levels of inequality and low interest rates.

While we acknowledge that some of the factors that characterized previous industrialization have clearly some external validity, we need to be cautious about the possibility to generalize policy implications for new industrializers merely on the basis of the past. One potential concern is that the cases analysed here remain largely confined to the experiences of a selected group of countries based mostly in East Asia, whose set of policies has differed over time (think of the Republic of Korea earlier on or China and Viet Nam more recently). Second, a potential challenge for the future is that the complex pathway through which new technologies and globalization will influence structural change is likely to require different policy responses compared to the past. No one-size-fits-all solution exists, and specific policies will therefore have to be implemented to reflect the different sizes, economic specializations, levels of development and countries’ institutions.

Acknowledgements

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.strueco.2018.11.002.

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