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Manufacturing Employment, International Trade, and China

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Abstract

The objective of this paper is to better understand the evolution of manufacturing employment across the world. Manufacturing value added has grown rapidly since 2000, at least matching world GDP growth, even after the global financial crisis, reflecting mainly rising demand for manufactures especially in developing countries. However, manufacturing employment increased at only a slow pace, both before and after the global financial crisis. Manufacturing employment growth provided only about 10% of the new jobs needed to compensate for losses in agriculture and the growth of the active population. Most of the net job creation in manufacturing was in China, while most countries – both developing and developed – saw manufacturing employment decline as a share of total employment and several, including all or nearly all advanced countries, saw an absolute decline. The remarkable economic transformation in China has brought shifts in employment within the country, which were far larger, in fact of a different order of magnitude, than in other countries, entailing the redeployment towards manufacturing of tens of millions of workers, mainly drawn from agriculture. But, because China tends to consume much of the manufactures it produces, especially since the financial crisis, its increased integration into world trade is not at the root of the manufacturing employment stagnation in the rest of the world. In the sample of the countries we examined, including the United States, the increase in labor productivity in manufactures, due to automation and improved methods, was a far more important cause of employment decline than shifts in the manufacturing trade balance, contrary to a commonly held view. We find only weak evidence that the size of the manufacturing sector - measured in different ways -- is associated with rapid economic growth. Several countries have grown at a reasonable pace without seeing a large increase in the relative size of their manufacturing sector. While the growth of labor productivity in the manufacturing sector is higher than that of the economy as a whole on average, several economies saw economy-wide labor productivity grow faster than labor productivity in manufacturing, including several countries in East Asia.

Manufacturing Employment, International Trade, and China

Across poor and rich countries, few topics have featured as persistently in the economic policy discourse as the decline of employment in the manufacturing sector. The decline in manufacturing employment is often seen as a major reason for rising inequality, social tensions, and the slump of entire communities (Grabowski, 2017, Autor, 2016). With the rise of national populists and protectionists in recent years, the issue has become even more prominent.

Contrary to the commonly held view in advanced nations, manufacturing is not a stagnant or declining sector. We observe that world manufacturing value added has grown rapidly since 2000, at least matching world GDP growth, even after the global financial crisis, reflecting mainly rising demand for manufactures in developing countries. However, global manufacturing employment increased at only a slow pace both before and after the global financial crisis, reflecting the increase in labor productivity.

Much of the net job creation in manufacturing was in China, while most countries – both developing and developed – saw manufacturing employment decline as a share of total employment and several, including all or nearly all advanced countries, saw an absolute decline. In fact, on average across the world, including China, new net additions to manufacturing employment represented only about 10% of the new jobs created outside the agriculture sector, where employment declined.

The remarkable economic transformation in China has brought shifts in employment within the country, which were far larger, in fact of a different order of magnitude, than in other countries, entailing the redeployment of tens of millions of workers, mainly drawn from agriculture, in a short time. But, since China tends to consume much of the manufactures it produces (a trend that has become much more pronounced since the financial crisis), its increased integration into world trade is not at the root of the manufacturing employment stagnation in the rest of the world. In all the countries we examined, the increase in labor productivity in manufactures, due to automation and improved methods, was a far more important cause of employment decline than shifts in the manufacturing trade balance. This result confirms and extends a previous finding by Edwards and Lawrence (2013)[1] who examined in detail the experience of advanced countries.

Reflecting a catching-up process, labor productivity in manufacturing increased even more rapidly in developing than advanced countries, so many developing countries also saw only modest or no increase in manufacturing employment. As a consequence the share of manufacturing employment in total employment appears to have peaked in many developing economies, an outcome described as “premature deindustrialization” (Rodrik,2015).

1. Quoting : « In contrast to the view that international trade is the dominant source of declining US manufacturing employment…we argue that the trend is driven by the combination of a shift in domestid demand away from manufacturing and faster productivity growth in manufacturing – atrend that is evident in all industrial countries, even those with large trade surpluses » Edwards and Lawrence (2013)

The impact of manufacturing employment on the rest of the economy is very imperfectly measured by the available data. For example, much of what is classified under manufacturing counts firms (e.g. in pharmaceuticals) where the value added of physical production is small relative to that of R&D, marketing, distribution, etc. (Dadush,2015). Therefore, many manufacturing firms are actually mainly providers of services. On the other hand, firms that provide services (e.g. automobile repair shops) are a direct extension of manufacturing, although not necessarily of manufactures produced in the same country. Concerning manufacturing employment, trends are also difficult to interpret. For example, there has been outsourcing by manufacturing firms of many service activities. The data shows that the change in net domestic intermediate demand for manufactures, i.e. the change in the balance of trade between manufacturing and the other sectors in the same economy, was negative and – since 2000 - had a depressing effect on manufacturing employment, similar in magnitude to that of international trade in some countries.

Despite the blurring of the lines between manufacturing and services, the stagnation in manufacturing employment is universally seen as a problem where it occurs. Yet, without the rapid improvements in labor productivity in manufactures, vastly increased consumption of manufactures would not have been possible, and economic growth would have been slower. We attempt to test whether the size of the manufacturing sector, measured in different ways, matters for economic growth. Our results are mixed at best. What is certain is that many countries grew at sustained rates even though their manufacturing employment declined or failed to increase as a share of total. Whether they would have grown even faster had policies facilitated increased employment in manufacturing is less certain.

In the rest of this paper, we first examine the global trends in manufactures and in manufacturing employment. We then examine the experience of China and four other countries at different stages of development, including the United States in more detail. Our main findings are summarized at the end of the paper, leading to the concluding section which draws some policy implications.

The Global Picture

With the use of input-output tables, drawn from the World Input-Output Database (WIOD), we account for the effect on manufacturing employment of productivity and domestic and foreign demand. Where data is available, we separate the periods before and after the global financial crisis, 2001-2008 and 2008-2014[2]. Our intention is principally to provide an accounting of the proximate drivers of manufacturing employment rather than analysis of the deeper causes driving it, such as demographics, the business climate, labor market regulations, competition and other economic and policy factors.

The accounting methodology we employ is straightforward and is set out in the appendix[3]. To account for the changes in manufacturing employment, we draw on an identity: manufacturing output equals domestic demand (absorption) plus the trade balance of manufactures (export minus imports). In turn, domestic demand consists of final demand (spending on manufactures by consumers, government and for investment, including inventory accumulation) and net demand of the non-manufacturing sector, or net intermediate demand. The evolution of manufacturing employment can then be accounted for

2. The current version of WIOD offers data to 2014.
3. The methodology is an extension of that initially applied by the authors in Morocco, a country where concerns about the decline in manufacturing employment are especially acute in light of high unemployment and the need to create higher paying jobs in a lower middle-income country.

by separating the effect of final, intermediate and net foreign demands and labor productivity on labor demand. It turns out that the main challenges in the accounting exercise are to separate or properly define the manufacturing sector and to find appropriate deflators for the nominal values reported in input output or sources and uses tables. We assume that the relative labor content of different sources of demand is the same over the duration of the period under examination, or otherwise stated, that changes in the mix of demand for a given dollar of value added do not result in different employment levels. We believe that this assumption is likely to be not too distortive over the decade and a half under review.

According to the International Labor Office, manufacturing employment worldwide reached 466 million jobs in 2014, with a net creation of 63 million jobs since 2001[4]. The global financial crisis, which was most acute in 2009 but had a long tail, marked a significant slowdown in manufacturing employment from annual growth of 1.3% over 2001-2008 to 1% over 2008-2014. This is shown in Table 1 which evaluates the contribution of productivity, and demand components to manufacturing employment at the global level.

Table 1: Contribution to employment change in the world manufacturing sector

Contribution to employment change in percentage points*

Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Average employment growth rate
2001-2008	-6.3%	9.4%	-1.8%	0.0%	1.3%
2008-2014	-3.7%	5.7%	-1.0%	0.0%	1.0%

*the sum of productivity, Domestic Final demand, sectoral trade and international trade contributions equals to employment change.

Contribution to employment change in thousands of employees**

Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Employment change *
2001-2008	-185 098.6	274281.8	-52281.7	0.0	36901.5
2008-2014	-99 258.0	153305.7	-27469.4	0.0	26578.4

**the sum of productivity, Domestic Final demand, sectoral trade and international trade contributions equals to employment change.

Source: WIOD for demand components and value-added data & ILO for employment data

As shown in the table, the contribution of international trade to manufacturing employment at the global level is zero. International trade plays only a role in labor reallocation across countries not in total world employment.

4. For the methodology used by the ILO to estimate employment in manufacturing, see http://www.ilo.org/ilostat-files/Documents/TEM.pdf

Note that real value added in manufacturing (the sum of productivity growth and employment growth in table 1) has grown very rapidly, 7.6% a year, pre-crisis and less rapidly, 4.7% a year, post-crisis[5].

Domestic final demand, consisting of private consumption, investment, and government purchases, was by far the most important contributor to manufacturing employment growth at the global level(See Appendix 1 for a precise calculation of contribution). The contribution of sectoral trade to employment in manufactures – i.e. net demand for manufactures by other sectors – was negative, denoting net outsourcing of activities from manufacturing, mainly to the service sector, and thus the positive spillover effect on employment in the rest of the economy. The growth of labor productivity greatly contributed to reducing global employment in manufactures for a given level of output. Labor productivity in manufactures recorded a very sharp increase, advancing at 6.3% a year before the crisis and slowing to 3.7% a year after the crisis, reflecting mainly slowing demand for manufactures. Despite the fact that the manufacturing sector was hit hard by the global financial crisis (ILO2010[6]), manufacturing value added grew more rapidly than world GDP even after the crisis. Given the importance of manufacturing in world trade, this finding may appear inconsistent with the sharp slowdown of world trade post crisis relative to world GDP, but as we discuss further below, the apparent contradiction is due to the fact that more manufactures were consumed domestically (See also Mc Kinsey, 2019).

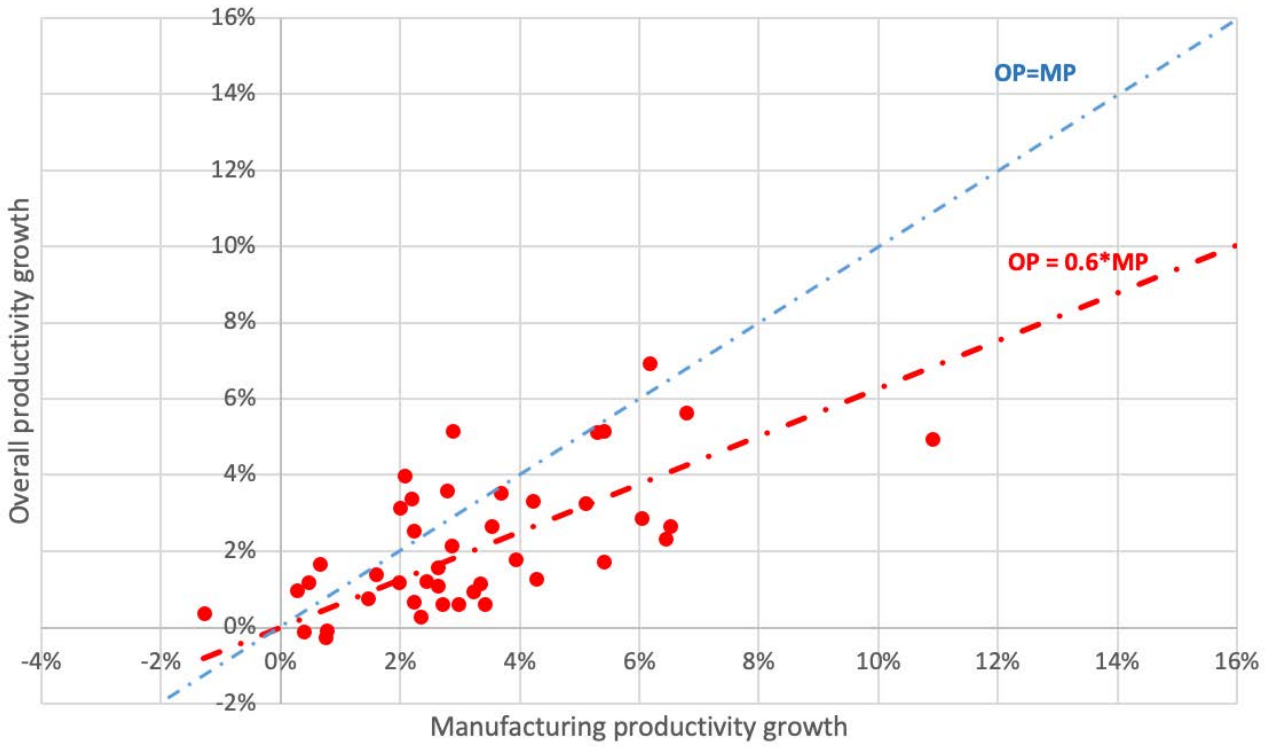
It is worth noting that in a pure accounting sense, had there been no labor productivity increase over 2001-2014, the manufacturing sector would have required 274 million more workers to satisfy demand, over 7 times as many as were actually added! This, of course, is a purely notional calculation since without the productivity increase there would be less growth in the purchasing power required to buy more manufactures in the first place.

How did labor productivity gains in manufactures compare with those in the economy as a whole? For this comparison and the analyses that follow, we use United Nations Conference on Trade and Development (UNCTAD) data for value added and ILO's data for employment, across a sample of countries. ILO offers a comprehensive dataset of employment estimates by economic activity using national source data and, where this is not available, estimates based on the ILO's Trends Econometric Models (TEM). The ILO cautions about the quality of data in countries with limited information[7]. In the expectation (or hope) that data is better for larger countries, we focus below on economies whose manufacturing employment exceeded 1 million workers in 2001. The 43 countries thus selected represent around 91% of the world's manufacturing employment in 2001 as well as in 2014.

Figure 1 shows as expected that there is a strong positive correlation between the growth of manufacturing labor productivity and economy-wide labor productivity.

5. United Nations Statistics Division (UNSTAT) displays a lower growth rate of the manufacturing sector of 5.7% a year before the crisis and 2.1% after. Still, the manufacturing sector outperforms the rest of the economy in both periods.
6. "Economic sectors at a glance: Economic recovery yet to be translated into jobs (Q&A)" ILO.
7. "ILO modelled estimates and projections: Data considerations and methodological approach"

Figure 1: comparing manufacturing (MP) and overall productivity (OP) growth in % across a sample of countries



*The 0.6 coefficient is significant at 1% level.

The figure also shows that productivity gains in the economy are on average 40% lower than in manufacturing[8]. Only 11 countries out of the 43 exhibit productivity growth higher in the rest of the economy than in manufacturing. Most are middle-income countries, including some of the fastest growing countries in Asia, such as China, Indonesia, Thailand, Bangladesh and Viet Nam. In these rapidly industrializing economies, the surge in manufacturing is only one aspect of a profound economy-wide transformation that affects labor productivityin other sectors as much as it does in manufacturing. This calls for the reexamination of the belief that manufacturing is always the sector that "pulls" the rest of the economy. There are clearly circumstances where developing economies can adopt modern techniques and methods as rapidly in services and agriculture as in other sectors, although, equally evident from the data, that is not the norm.

Diversity of Manufacturing Employment Trends Across Countries

As documented in a comprehensive report on employment trends in manufacturing (UNIDO, 2013), the increase in manufacturing employment since the turn of the century was concentrated in a small number of developing countries. While advanced countries saw manufacturing employment decline, most developing countries saw a small increase and some saw a small decline. Several authors (see,

8. Rapid productivity growth is a recognized characteristic of the manufacturing sector. Rodrik (2015) has argued that manufacturing sector is more prone to absorb technology and to generate economies of scale, and that productivity in manufacturing tends to converge to the higher levels found in advanced countries across the world unconditionally, i.e. with little influence of domestic conditions, which can inhibit convergence of productivity across the whole economy in many instances.

for example, Lawrence, 2018), Rodrik, 2015), have argued that the manufacturing share of GDP and (even more of employment) tends to peak earlier along the development path than in the past because of the availability of advanced manufacturing technologies and the speed with which they are adopted. This is the phenomenon known as "premature deindustrialization". Advanced techniques and methods increase the supply of manufactures relative to that of other sectors where adoption is slower and – because demand for manufactures is assumed to be relatively price inelastic and to rise less than that of services as incomes increase – the value of manufactured output declines relative to services. Hence, we observe that employment in manufactures appears to have peaked in China, South Africa and Brazil at between 15-19% of total employment, whereas the US peaked at 25% in 1953 and the UK at 32% in 1961 (Lawrence, 2018).

We broadly agree with this interpretation of the data but would qualify it in three ways. First, demand for manufactures at the global level continues to grow at rates close to or even faster than world GDP, even though it is far more sluggish in advanced countries. Second, a few countries saw productivity rise as quickly in the rest of the economy as in manufacturing, including – based on the data available to us - China[9]. Third, globalization (the decline in trade barriers and in transport costs) has created opportunities for a few highly competitive countries – most notably China – to gain large market shares in a short time. Yet, as Lawrence (2019) points out, even in China manufacturing employment appears to have peaked early.

The change in manufacturing employment in the sample of 43 large countries is shown in Table 2. Based on ILO data, over half of the increase in world manufacturing employment in the sample (and in the world) over 2001-2014 occurred in China. India was the other very large contributor to increased manufacturing employment. Countries that saw an upward or downward shift in manufacturing employment of over 3% point of total employment are shaded in blue. Of the 17 countries so identified, 12 saw a decline in manufacturing employment as a share of total employment of over 3% points. All advanced countries in the sample belong to this group, including Germany and Japan which are usually thought of as manufacturing champions.

Table 2: Manufacturing employment 2001-2014

Country	Employment change in Thousands	Employment change in %	Change in manufacturing employment share
China	32 294.08	22.0	3.1
India	13 529.03	31.2	1.2
Bangladesh	4 472.36	116.9	5.6
Viet Nam	3 829.84	94.1	4.7
Indonesia	3 486.44	28.2	0.2
Pakistan	2 888.78	48.7	0.3
Brazil	1 887.17	18.6	-1.1
Turkey	1 603.36	48.5	2.4
Thailand	1 547.17	31.2	2.6

9. See section on China below for a discussion of the imprecision of data on manufacturing employment in China.

Mexico	804.65	10.6	-3.0
Ethiopia	795.48	51.4	-0.1
Colombia	708.25	33.4	-0.7
Egypt	701.75	30.8	-0.9
Iran, Islamic Republic of	526.40	16.3	-1.5
Philippines	522.20	18.1	-1.4
Myanmar	518.16	24.6	1.4
Argentina	416.03	21.4	-0.7
Taiwan, China	395.77	16.4	-0.6
Peru	383.20	33.1	-0.7
Poland	320.00	11.0	-1.0
Venezuela, Bolivarian Republic of	297.50	25.4	-1.4
Sri Lanka	234.80	19.1	1.4
Malaysia	198.19	9.0	-6.2
Nigeria	195.48	5.0	-2.5
Morocco	43.96	4.1	-2.0
Czech Republic	8.87	0.7	-1.4
Korea, Republic of	-20.25	-0.5	-2.8
Australia	-42.75	-4.1	-2.9
Korea, Democratic People's Republic of	-68.50	-3.1	-2.4
South Africa	-83.37	-4.4	-4.0
Netherlands	-331.99	-28.4	-4.3
Romania	-348.38	-17.9	0.2
Portugal	-357.51	-32.4	-4.9
Canada	-515.64	-22.7	-5.3
Ukraine	-545.57	-18.2	-1.9
Germany	-743.18	-8.5	-4.0
Italy	-837.52	-17.2	-4.2
Spain	-941.62	-30.3	-6.4
France	-1 371.65	-29.3	-6.3
United Kingdom	-1 454.16	-32.0	-6.4
Japan	-2 086.66	-16.0	-3.2
Russian Federation	-2 841.20	-21.5	-5.6
United States	-3 863.97	-19.1	-3.4
Total	**56 155.0**	**0.2**	**0.0**

Source : ILO, Trends Econometric Models (TEM)

Five countries showed a gain in manufacturing employment as a share of total employment above 2% points, and all are developing nations, namely, China, Bangladesh, Vietnam, Thailand and Turkey. Bangladesh and Vietnam stand out for increasing their manufacturing employment share in total employment by 5.6% and 4.7% respectively. Overall, only 10 economies in the sample of 43 increased the share of manufacturing employment in total employment.

In the African continent, Ethiopia stands out for creating nearly 800,000 jobs in the sector, although the share of manufacturing in total employment barely changed. Ethiopia appears well positioned to become a manufacturing hub in Africa[10]. Morocco is among the developing nations that saw a decline in manufacturing employment share.

Policymakers in advanced countries often see the manufacturing sector as key to providing good jobs for new entrants into the labor force. In developing countries, policymakers often see manufacturing as key to development and to provide jobs for workers freed from agriculture. How do these perceptions stack up against the empirical evidence? The answer is, not well.

Between 2001 and 2014, according to the ILO statistics, about 492 million net new jobs were added worldwide, while 121 million net jobs were lost in agriculture, and about 63 million net new jobs were created in manufacturing. Thus, 613 million net new jobs were created in sectors other than agriculture and only about 10% of the net new jobs created were in manufacturing. Services accounted for 73% of the total net new jobs created, and industry other than manufacturing (construction, utilities, etc.) accounted for 17% of the total. We also know from Table 2 that only 5 countries in the sample of 43 countries examined saw a significant increase in manufacturing jobs as a share of total over this period, i.e. over 2% points. In nearly every country in the sample covered in Table 2 manufacturing played a marginal role at best in providing jobs for the newcomers and for migrants from the countryside. Even in the two countries that were most successful in increasing their share of manufacturing employment in total employment, Bangladesh and Vietnam, new manufacturing jobs accounted for less than a quarter of job creation outside of agriculture.

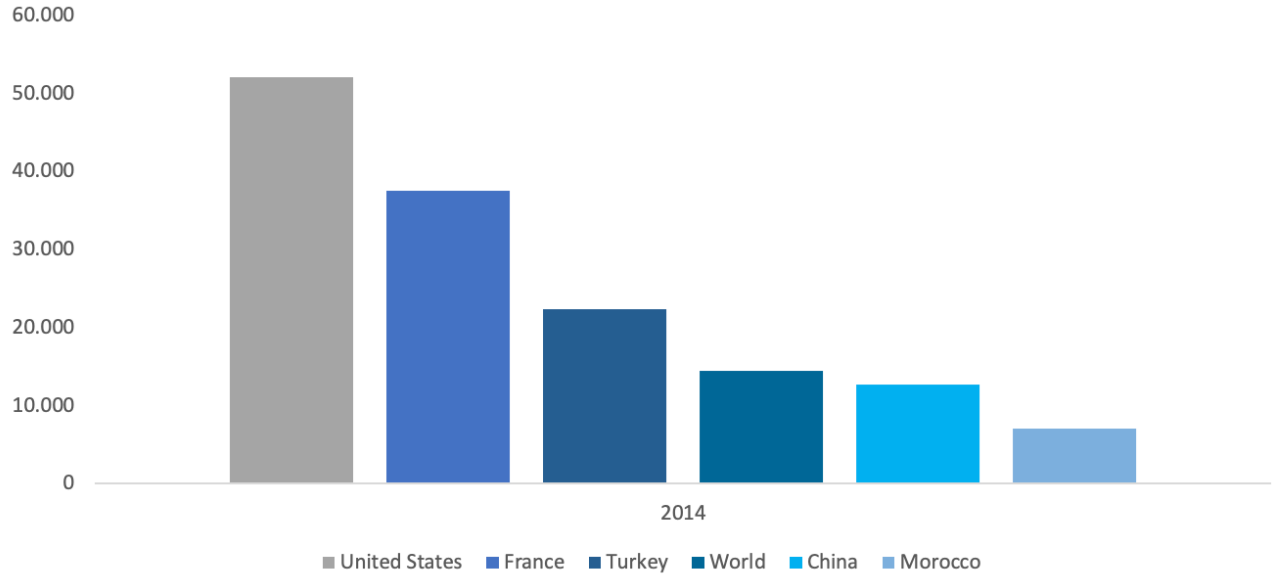
To improve our understanding of these trends, and especially the relative role of international trade, we will now account in more detail for the changes in manufacturing employment in a small group of countries.

Country Cases

The sample we examine includes five countries at different levels of development (Figure2): two high-income countries, namely France and the United States, where manufacturing employment has been falling, two higher middle-income countries, namely China, Turkey with increasing employment, and a lower middle-income country, Morocco, that sees declining manufacturing employment. We believe the sample, though kept small for ease of exposition, is sufficiently diverse to deepen our understanding of the trends affecting manufacturing at the global level, and to suggest hypotheses that can be tested using a more comprehensive statistical analysis.

10. Bloomberg "Ethiopia Already Is the 'China of Africa'" 2018.

Figure 2: GDP per capita, PPP (constant 2011 international $)



Source: WDI.

As for other countries, there are some differences in employment data between the ILO, national sources, WIOD and other providers such as the OECD. In most cases these differences are small and the evolution similar. Large differences exist for China which are discussed below.

High Income countries

France

We begin with France, which presents a relatively straightforward case of a slow growing manufacturing sector with shrinking employment, representative of many high-income countries. Over the period 2000-2014 France lost about 800,000 jobs in manufacturing, equal to about 23% of the total at the start of the period[11]. The rate of job losses increased after the financial crisis. Growth in labor productivity was an important contributor to the fall in the sector's employment both before and after the crisis.

Table 3: Contribution to employment change in France in percentage points*

Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Average employment growth rate
2000-2008	-2.8%	1.4%	1.3%	-1.5%	-1.6%
2008-2014	-2.2%	-3.1%	3.7%	-0.6%	-2.2%

11. The OECD data on employment display comparable data, with 782 thousands job losses, while ILO estimates pointed to 1.3. In percentage, the gap betwen the 3 data sources is small (23% for WIOD and ILO, and 29% for ILO's data).

Contribution to employment change in thousands of employees**

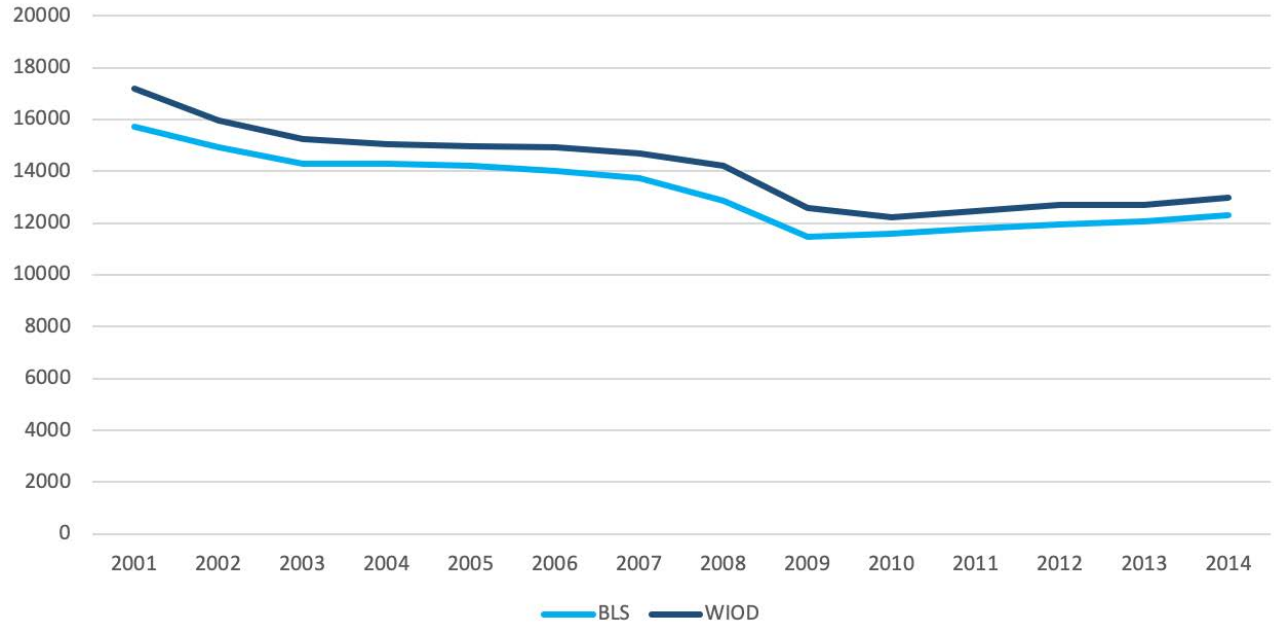
Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Employment change *
2000-2008	-738.5	377.7	331.2	-391.4	-421.0
2008-2014	-388.8	-546.8	651.9	-101.3	-385.0

The deterioration in the trade balance played a significant role in limiting employment in manufactures in France, and more so before the crisis than after. Domestic demand for manufactures was hard hit and fell sharply in the wake of the crisis, and by 2014, it had not recovered. The global financial crisis also limited the demand for foreign goods. Employment in French manufacturing would have fallen even more had the manufacturing sector did not reduce its purchases from the rest of the French economy and increased its sales to it, especially after the crisis. These trends are reflected in the sizable positive contribution of net intermediate demand to manufacturing employment.

United States

The United States lost about 3.5 million manufacturing jobs over 2001-2014, or approximately 27% of the total at the start of the period, according to Bureau of Labor Statistics (BLS) data, as shown in Figure 3.

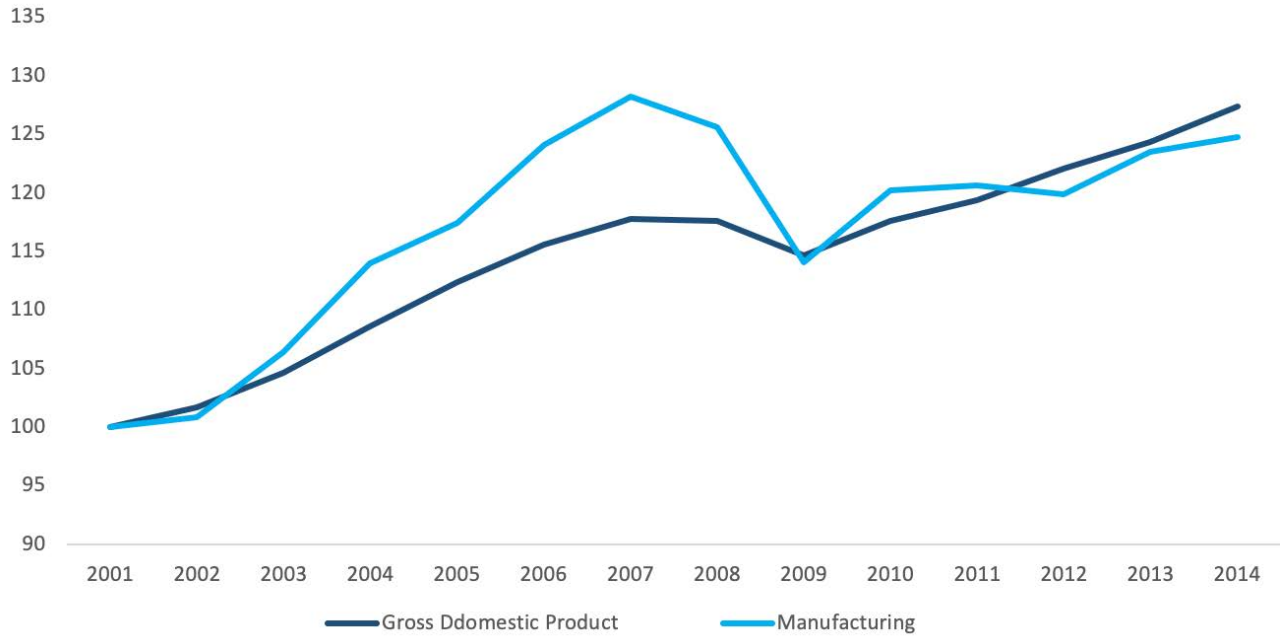
Figure 3: Manufacturing employment in USA by data source, (thousands)



Source: BLS and Federal Reserve Bank of St. Louis

The World Input Output data (WIOD) identifies a similar evolution of manufacturing employment as Figure 3 shows, but a higher number of point to point job losses, about 4.2 million, due to differences in the denomination of manufacturing[12]. According to data from the Bureau of Economic Analysis , the real value added of the manufacturing sector, grew rapidly before the global financial crisis at 3.3% and outperforms the economy in general, but the crisis hit the sector hard , halving the sector's growth rate, in line with the rest of the economy. (Figure 4).

Figure 4: GDP and Manufacturing value added index, (2000 base year)



Source: BEA and authors calculations

In the case of the United States, the choice of dataset and of deflators for manufacturing value added and for exports and imports affects the contribution to employment growth calculation significantly. Thus, deflators from the Bureau of Labor Statistics, or from the WIOD yield different results. The difference is especially pronounced in computing the growth rate or real value added in the manufacturing sector. The BLS displays a much lower growth rate of real value added in manufacturing than the WIOD and, indeed, than the Bureau of Economic Analysis (See Appendix 2 on Data Issues). On enquiring with BLS staff, it turns out that the real value added of the manufacturing sector is computed as a residual of a balancing exercise between real sources and real uses. We decided to present two set of results, one based on the WIOD tables and deflators and the other based on BLS sources and uses tables and deflators (Table 4).

12. The WIOD offers an employment dataset consistent with the Input output classification that display economic flows among commodities, rather than sectors as usually presented, including in the BLS dataset. The ILO reports a decline of manufacturing jobs of 3.8 million over 2001-2014.

Table 4

Contribution to employment change in percentage points in the United States

WIOD					
Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Average employment growth rate
2001-2008	-5.5%	1.9%	0.5%	0.3%	-2.7%
2008-2014	-3.7%	4.3%	-1.9%	-0.1%	-1.5%
BLS database					
2001-2008	-2.9%	2.8%	-1.4%	-1.3%	-2.8%
2008-2014	-2.2%	3.7%	-1.8%	-0.5%	-0.7%

Contribution to employment change in thousands of employees*

WIOD					
Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Employment change*
2001-2008	-6 051.9	2 156.3	605.1	324.1	-2 966.4
2008-2014	-3 031.6	3 490.5	-1 587.0	-93.7	-1 221.8
BLS database					
Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Employment change*
2001-2008	-2908.5	2826.0	-1451.5	-1327.0	-2861.0
2008-2014	-1661.0	2831.3	-1367.6	-360.7	-558.0

In both sets of data, Productivity growth was the most important contributor to the decline in manufacturing employment in the United States over 2001 and 2014 but was more important before the global financial crisis than after.

The rate of decline in manufacturing employment moderated post-crisis according to both sets of data. In the wake of the crisis, rapid growth in domestic final demand more than offset the employment decline in manufacturing due to rising productivity. The acceleration of domestic final demand in manufacturing in the United States post-crisis is a bit puzzling but is reported consistently by both data sources.

Net intermediate demand contributed negatively to manufacturing employment. The US manufacturing sector increased its dependence on inputs provided by the rest of the economy, and by 2014, the United States' manufacturing sector turned into a net consumer of inputs instead of net

provider. This observation draws attention to a supply chain perspective of employment creation in manufacturing. According to a Brookings analysis, in 2010, the narrowly defined manufacturing sector accounted for just 1/3 of the manufacturing-related jobs along the value chain[13], which includes upstream services such as research and development and design and downstream services such as sales, distribution and repair and maintenance. However, the extent to which these upstream and downstream jobs depend on manufacturing carried out in the United States or abroad is not specified in the Brookings analysis[14].

Throughout the period, international trade played a minor negative role in affecting US manufacturing employment according to both sets of data, and adopting a value chain perspective (which we do not do in this paper) only reinforces this conclusion since many service jobs are less tradable than production jobs.

It may appear surprising that trade played a minor role in the manufacturing job decline, since the trade deficit in manufactures widened by nearly 60% in the pre-crisis period, reaching around 746 billion dollars (BLS data) in 2008. However, a large part of the deterioration in the trade deficit reflected a decline in the terms of trade (price of exports/price of imports) of the United States, and/or a shift in composition of imports towards more expensive items and/or of exports towards less expensive items. Thus, volume effects were smaller than suggested by the nominal trade balance. The trade balance in real terms also displays a widening deficit, but at a far slower pace (26% using BLS data).

Houseman (2018) has taken a contrary view to the thrust of this article. He argued that growth in manufacturing value added was heavily concentrated in computer and electronics products, where productivity growth is very high, giving a misleading impression of the relative importance of productivity and trade in accounting for the employment decline: “Trade issues, in fact, have left a big dent in manufacturing employment”. It is not obvious that one should exclude computer and electronics from the calculations as it is an important sector in which the US has historically had a comparative advantage, and where comparative advantage is shifting. Nevertheless, we tested Houseman’s view by so doing. That reduces the annual growth in manufacturing productivity by a full percentage point before the 2008 crisis, but it also reduces the adverse effect on employment of trade, since there has been a large increase in the trade deficit in the computer and electronics products sector. So, productivity still ranks at the top of factors accounting for job losses in manufacturing, even after the computer and electronics product sector is excluded.

Middle-Income Countries

Among the middle-income countries in the sample, manufacturing employment trends diverged widely. We begin with China, where the analysis presents a special challenge because of the magnitude of the shifts affecting the manufacturing sector and the quality of the employment data.

13. Whitefoot, Valdivia and Adam « Innovation and manufacturing labor: a Value-Chain perspective » Brookings (2015).
14. Adopting a value added perspective is important, according to the Brookings analysis, because employment shifts in manufacturing are very different across occupations. “facilities performing services supporting manufacturing experienced job losses during the financial crisis, but the bulk of employment declines were concentrated in production facilities. What is more, it appears that occupations that are more prevalent in upstream and downstream services are less likely to be displaced by advances in automation ».

China

There is a large discrepancy between ILO's employment data and WIOD's. Manufacturing job creation in China over 2000-2014 was about 32.3 million according to ILO, while it was 60 million according to WIOD. According to Nick Lardy (2015) manufacturing employment in China is imperfectly measured because of differences in the quality and availability of data in the public and private sectors, and in urban centers and rural communities. Employment in public enterprises in urban centers is the best measured, while manufacturing in private enterprises in urban areas, where data series were compiled more recently, is less well measured. Least well measured are manufacturing in private enterprises in rural areas. Lardy's estimates are much closer to the ILO than the WIOD data[15]. WIOD appears to overestimate manufacturing employment growth and underestimate labor productivity growth. After contacting the WIOD team who acknowledged the disparity and are planning revisions to the Chinese data, we decided to rely on ILO employment data (Table 5)[16].

Even with the lower employment increase reported by the ILO, it is clear that China experienced dramatic transformation in its manufacturing sector, with both values added[17] and labor productivity growing at double digit rates over the period.

Using the I-O coefficients drawn from WIOD suggests that the rise in employment in manufacturing reflected both very rapid growth in domestic demand in manufactures and improvement in the trade balance. The latter played a consistently positive effect on manufacturing employment, though it was far more subdued in the period after the financial crisis than before. The penetration of Chinese manufacturing products in international market went up by a factor of eight in real terms prior to the crisis, while imports of manufactures in China grew more slowly. Due to its remarkable export performance pre-crisis, by 2008 China's domestic demand accounted for just 74% of exports compared to 146% in 2000. However, by 2014 domestic demand for manufactures had become 17% larger than exports, even as China continued to run a large trade surplus in manufactures.

15. Nick Lardy (2015) notes that "The best data on employment in manufacturing are for urban China…urban manufacturing employment soared from 32.4 million in 2000 to 52.4 million in 2014. But this is only part of the picture since by the early 2000s private firms and self-employed individuals were an increasingly important component of China's economy. Reflecting this development, the statistical authorities began to publish data on the sectoral distribution of workers in private firms and the self-employed. … between 2003 and 2014 these urban manufacturing workers increased from 10.9 million to 27.2 million. Thus … between 2003 and 2014 total urban manufacturing employment doubled and the share of the urban workforce employed in manufacturing rose from 15 to 20 percent. In addition, there are a significant number of manufacturing workers in rural areas….Workers in private firms and self-employed engaged in manufacturing in rural areas rose from 14.5 million in 2003 to 23.6 million in 2014.

16. The contribution in percentage of each factor to total employment does not change, except for productivity.

17. Growth of manufacturing Value added over 2000-2014 according to WIOD (14% a year), is higher than the number reported in the UNSTAT database (11% a year).

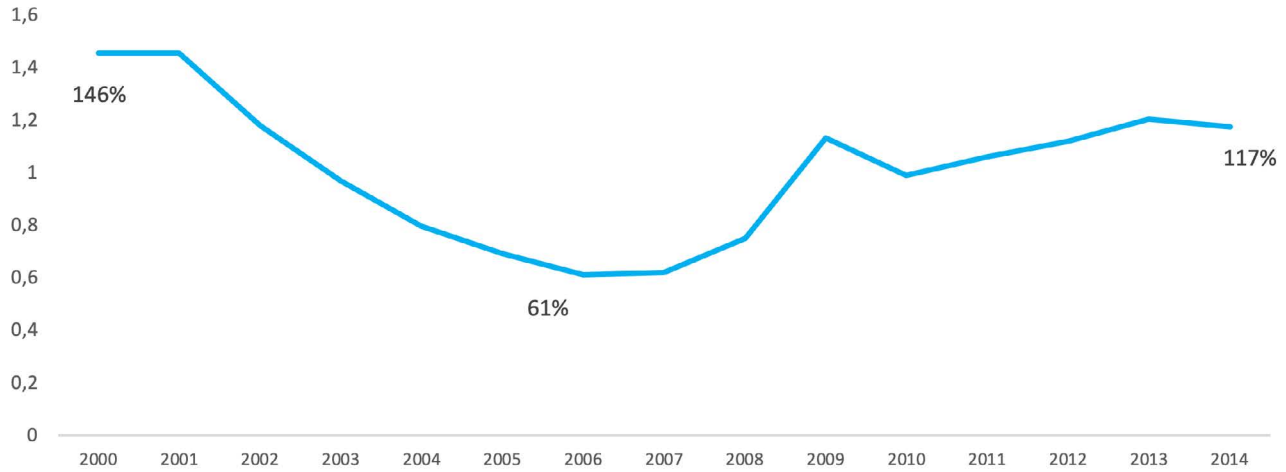
Table 5: Contribution to employment change in China (ILO employment data)

Contribution to employment change in percentage points*					
Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Average employment growth rate
2001-2008	-13.3%	8.7%	-3.3%	9.7%	1.8%
2008-2014	-11.3%	11.3%	-2.5%	3.7%	1.3%

Contribution to employment change in thousands of employees**(ILO employment data)					
Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Employment change*
2001-2008	-143716.7	94021.0	-36257.0	104938.1	18985.4
2008-2014	-115954.4	116364.6	-25640.0	38538.4	13308.6

Since the crisis, exports slowed sharply from growing 20% a year to 8% a year, while domestic demand for manufactures continued to advance rapidly (Figure: 5).

Figure 5: ratio of domestic demand to exports of maufacturing products, in china



The sharp export deceleration cannot be attributed solely to slower external demand growth. Increasing wages, real exchange rate appreciation, and policies that encouraged domestic consumption and investment also played a big role.

Net intermediate demand contributed negatively to employment creation in the manufacturing sector. Chinese manufacturing is becoming more dependent on other sectors in the Chinese economy as total purchases of inputs increased rapidly. By 2014, the sector was a net consumer of inputs from other sectors rather net provider in the beginning of the 2000s.

The continuous rapid improvement in labor productivity during the whole period is mostly due to improvement within sectors of manufacturing rather than reallocation of labor towards sectors with higher labor productivity. Capital deepening and technological adaptation within sectors were mainly responsible for the historic improvement in labor productivity in manufactures, and similar trends appear to have affected sectors other than manufacturing in China. The movement of labor across different manufacturing sectors (18 sectors desegregation) accounted for less than 20% of total manufacturing productivity growth.

Morocco

The data we need to identify factors affecting employment growth in manufacturing in Morocco is only available from 2007 but extends to 2015. Accordingly, we examine only one period, 2007 to 2015. Over this period, Morocco lost 80000 jobs, or 6.8% of the jobs at the start of the period (HCP data)[18]. In Morocco's case, domestic final demand for manufactures grew very rapidly, but its effect on employment was more than offset by a combination of rapid productivity growth and a sizable deterioration in the trade balance, larger in proportional terms than that evident in the other countries in the sample over any period.

Table 6: Contribution to employment change in Morocco

Contribution to employment change in percentage points*					
Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Average employment growth rate
2007-2015	-4.2%	6.7%	0.2%	-3.4%	-0.9%

Contribution to employment change in thousands of employees**					
Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Employment change*
2007-2015	-392.4	615.5	14.3	-318.8	-81.4

Turkey

Over the period, Turkey added over 1.8 million jobs in manufacturing, or approximately 44% of the total at the start of the period. Interestingly, employment in manufacturing grew much more rapidly after the crisis than before, despite a sharp slowing in domestic final demand. In the early 2000s, the manufacturing sector and the Turkish economy recovered from a severe currency crisis that caused GDP to plunge 6% in 2001. During the subsequent recovery, the manufacturing sector saw value added grow by 6.6% a year, yet without employment creation. In the aftermath of the global financial

18. The gap between ILO and HCP data for the moroccan case is sizeable. While ILO reportes a decrease of 15 thousands jobs (-1.3%), HCP data indicates a job lost of 81 thousands (-6.8%).

crisis, value added slowed sharply but employment increased as labor productivity growth turned negative, probably a result of labor hoarding, reduced working hours, and policies that discouraged layoffs.

Meanwhile, the contribution of international trade to manufacturing employment turned from negative to positive as imports slowed sharply, as did net intermediate demand for manufactures by other sectors of the Turkish economy.

Table 7: Contribution to employment change in Turkey

Contribution to employment change in percentage points*

Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Average employment growth rate
2000-2008	-5.8%	10.8%	-2.3%	-1.9%	0.8%
2008-2014	1.7%	1.8%	0.9%	0.8%	5.2%

Contribution to employment change in thousands of employees**

Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Employment change *
2000-2008	-1912,0	3581,8	-771,7	-636,5	261,7
2008-2014	495,1	534,4	252,8	235,0	1517,2

Manufacturing Employment and Growth

What about the often-assumed link between manufacturing and economic growth? To test the "manufacturing as the engine of growth hypothesis", we ran a simple regression, relating the growth in GDP per capita over the period to the change in manufacturing activity, while controlling for the level of development in the initial period. We measured the change in manufacturing activity in two ways, namely the change in manufacturing employment as a share of total employment, and the change in manufacturing share of total value added. One novelty of this specification is that we measure manufacturing value added share in real term, unlike Szirmai and Verspagen (2015). Falling manufactures prices compared to services are associated with a declining nominal share of manufacturing, but not necessarily a declining real share (Rodrik, 2015), a feature evident in advanced countries. Motivated by the outstanding growth performance of several Asian economies that saw a large increase in manufacturing activity, we also hypothesized an asymmetric relationship, i.e. that the increase in manufacturing activity stimulates growth but declining manufacturing activity may not depress growth or may not to the same extent. We find that the relationship between changes

in manufacturing weight share, whether measured in employment or value added, and the growth in per capita income is of the right sign but barely significant[19]. The asymmetric relationship, tested by regressing against two separate variables, changes in manufacturing activity when it is positive and when it is negative, yields somewhat more reliable results (Table 8).

Table 8: Regression results: Change in Manufacturing Employment Share

Variables	1st specification
Intercept	5.7***
Employment share up	0.4**
Employment share down	0.04
Logarithm of GDP per capita in PPP in 2001	-0.36**
Adjusted-R2	0.13***

Regression Result: Change in Manufacturing Value Added Share

Variables	2nd specification
Intercept	6.8***
VA share change UP	0.2***
VA share change down	-0.09
Logarithm of GDP per capita in PPP in 2001	-0.53***
Adjusted-R2	0.13***

***, **, * significant at 1%, 5% and 10%.

Source: WDI, ILO and UNCTAD, authors estimations.

There is a statistically significant positive relationship between manufacturing employment when it is increasing and economic growth but not when it is declining, and the same is true of value added. The results would suggest that countries tend to grow more rapidly when employment in their manufacturing sector expands, but they can grow even when their manufacturing sector declines in relative terms. The same applies for value added although the estimated effect is smaller.

However, as stressed by Cantore et al. (2014) the exogeneity assumption that guarantees unbiased estimators fails to hold, since there may be reversed causality between aggregate economic growth and the weight of manufactures in the economy. For instance, a low-income country that grows rapidly will tend to consume proportionately more manufactures. To propose a more statistically robust version, we introduce an instrument which is associated with the weight of manufacturing in the economy but is either uncorrelated or likely to be less correlated with growth, namely the change in the share of manufactured exports in total exports. It is likely that manufactures exports respond more to world conditions than to domestic factors. The asymmetric relation tested yielded results opposite to expectations (Table 9).

19. In both Specifications, the variables fail to explain the cross-country variability of growth, as adjusted-R2 stands below 0.1. Including a variable for resource dependence does not significantly improve the results.

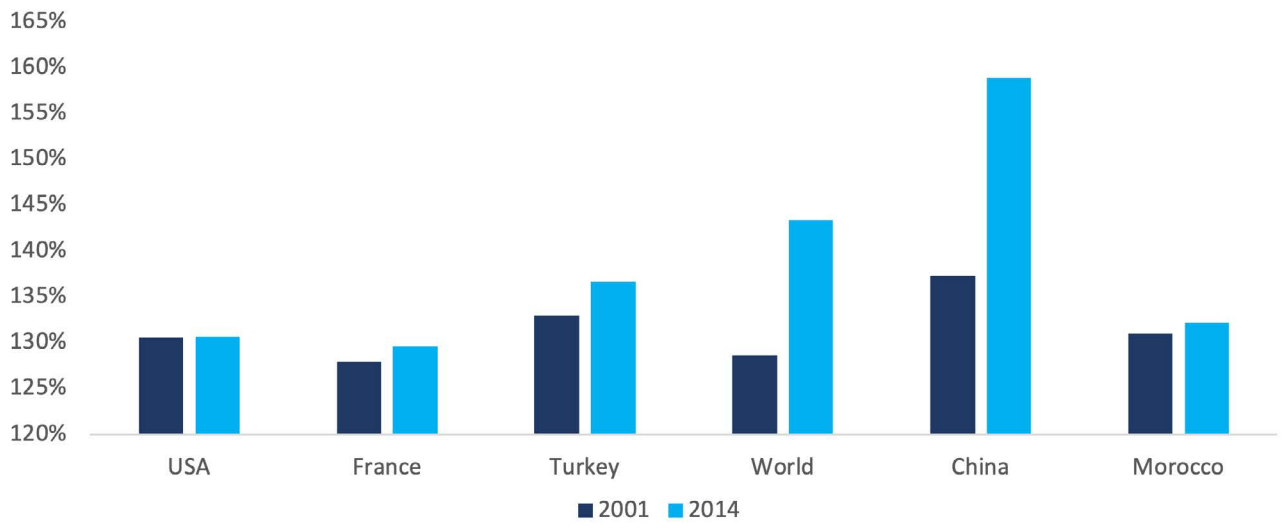
Table 9

Variables	3nd specification
intercept	6.8***
Manufacturing exports_share UP	0.05
Manufacturing exports_share Down	-0.04***
Logarithm of GDP per capita in PPP in 2001	-0.53***
Adjusted-R2	0.13***

The increasing share of manufactures in exports do not exert any effect on growth, unlike the two first versions that have shown that industrialization process is pro-growth. A decreasing share of manufactures in total exports is significantly associated with faster, not slower, growth. These very mixed results are in contrast with those of Cantore et al. (UNIDO, 2014) who, using techniques designed to avoid simultaneity bias, find a statistically significant link between growth in manufacturing value added and GDP growth. Cantore et al. also find that the boost to GDP growth is greater if it is due to increased labor productivity in manufactures rather than to increased employment. Our results are more in line with those of Fagerberg and Verspagen (2002) and more recently Szirmai and Verspagen (2015) who did not reject completely the role of manufacturing in growth but found clearly diminished importance of manufacturing in the recent periods, especially in middle-income countries.

Based on our review, we cannot confirm that increased manufacturing activity is necessary for economic growth. It is probable that countries that see large increases in manufacturing employment and value added as a share of total tend to grow significantly faster (Dadush, 2015), but it is clearly possible for countries to grow when manufactures as a share of total are stable or decline. As pointed out in the introduction to this paper, and as many authors have stressed, the manufacturing sector is becoming more integrated in the productive fabric (Figure 6) of the rest of the economy, making it more difficult to isolate its effect on economic growth.

Figure 6: Backward and forward integration of the manufacturing sector



Summary of Main Findings

Summarizing the preceding, we have identified the following stylized facts and relationships:

#Manufacturing employment grew modestly worldwide over 2001-2014 though it slowed after the global financial crisis. Continued rapid growth in demand for manufactures, especially in developing countries, contributed crucially to this trend, and enough to compensate for big increases in labor productivity. Productivity growth was generally much higher in the developing than in the advanced countries, reflecting catch-up in methods and automation. In the Chinese case, the shift of labor into higher value added/productivity sectors, accounted for only a small part of the productivity improvement.

#At the global level manufacturing contributed only about 10% of the new jobs required to accommodate new entrants and those workers leaving agriculture. Manufacturing employment appears to have peaked as a share of total employment in many developing countries, confirming the "premature deindustrialization" hypothesis. The service sector and the non-manufacturing industrial sector were far more important creators of jobs. Among the countries which employed in the manufacturing sector more than 1 million workers in 2001, only 5 countries, all developing, saw a significant increase in the share of manufacturing employment in total employment. However, adopting a value chain perspective on manufacturing employment may affect this conclusion, since large numbers of jobs in upstream and downstream sectors are not denominated as manufacturing. These upstream and downstream jobs clearly depend on manufacturing, although not necessarily on manufacturing that is based in the same country.

#Countries that increased their manufacturing employment share may have seen a significant boost to growth, although causality is as is often the case, difficult to prove. Many countries grew at sustained rates even though their manufacturing employment declined or failed to increase as a share of total.

Employment trends at the country level varied widely. In the sample of countries examined, there are only a few instances where the growth of domestic final demand for manufactures was sufficiently rapid to more than offset the decline in employment due to productivity increases. For example, over 2008-2014, domestic final demand for manufactures in China grew at 11.3% a year, but this was just enough to offset the effect on manufacturing employment of very large productivity increase.

#International trade played a secondary role in affecting employment relative to changes in domestic final demand and changes in productivity in nearly all countries. China in the pre-crisis period was an exception, as employment growth in manufacturing owed much to an improving trade balance. Though employment in manufacturing was weighed down by a deteriorating trade balance in France, Morocco and the United States, domestic demand trends and productivity played a far greater role.

#Net Intermediate demand also played a secondary role in determining manufacturing employment and was often of the same order of magnitude as the effect of international trade. The manufacturing sector tends to increase its net purchases from the rest of the economy. The two biggest economies, United States and China, saw a surge in net purchases or outsourcing from manufacturing to other sectors, reaching a point where manufacturing is a net purchaser from other sectors rather than a net provider.

#The changes in manufacturing employment in China were of a different order of magnitude compared to the changes seen in other countries. For example, over the whole period, 2001-2014, China added about 32 million manufacturing jobs according to the ILO, while Turkey added 2 million manufacturing jobs, the United States lost about 3 million manufacturing jobs, and France lost about 1 million manufacturing jobs. In fact, China added around 50% of the manufacturing jobs that were created in the world.

#Though, given its size, China's growing manufacturing capacity had a significant impact on many other countries through the trade balance, the evolution of its manufacturing sector reflects a profound domestic transformation rather than opportunities in international markets. This is evident from the fact that labor productivity in Chinese manufacturing was – apparently - no faster than that in the rest of the economy. In the post-crisis period manufacturing employment in China was driven far more by domestic demand and rising productivity than by opportunities in export markets, although that was clearly less true in the pre-crisis period.

#The global financial crisis had very different effects on final demand, across countries. The demand for manufacturing actually accelerated over 2008-2014 in China and the United States compared to 2000-2008, as the two largest economies were able to effect large stimulus policies. By contrast, demand for manufactures slowed sharply in France and Turkey. The effect of the crisis on manufacturing productivity was to slow it considerably across the sample.

Policy Implications

The manufacturing sector is often seen as declining in advanced countries. But this image is greatly misleading, since manufacturing remains a global growth sector. Global demand for manufactures is growing rapidly thanks mainly to the unfilled needs of developing countries where the penetration of many manufactures remains a fraction of that in advanced countries. Indeed, a more accurate view is that manufacturing is likely to remain a growth sector over the foreseeable future as the middle class in developing countries continues to expand (Arbouch and Dadush, 2019). This points to many market opportunities for the countries and firms best positioned to grasp them. Still, the sharp rise in labor productivity evident in manufactures across both developing and advanced countries, means that while the sector provides large opportunities to get more for less – reflected in higher wages – it also means that employment in manufactures tends to play at best only a minor role in providing jobs for new entrants in the labor force and for those who leave the countryside.

Manufactures represent the largest sector in world trade expressed in gross terms (though not in value added terms)[20]. Consequently, manufactures represent an important source of the foreign exchange needed to purchase essential consumer and producer goods on world markets. Manufacturing deserves the attention of policymakers for this reason and on account of its dynamism, productivity growth and ability to achieve economies of scale on world markets. However, countries that face a large unemployment or underemployment problems, such as Morocco, need to pay at least as much attention to facilitating the expansion of a flourishing construction, utilities and service sector as to manufacturing. Some of the service sectors present significant opportunities to earn foreign exchange.

20. http://www.oecd.org/trade/topics/services-trade/ According to OECD calculations, services account for more than 30% of the value added embedded in manufactured exports.

The idea that manufacturing employment is declining because of increased competition by China and by a few other developing nations, and that therefore the sector must be protected from foreign competition is misguided. Not only is the link between manufacturing employment and growth unproven, but International trade in most instances played only a secondary role in affecting manufacturing employment. Moreover, there are strong signs that the effect of international trade will become less important in the future as the Chinese economy becomes more reliant on domestic demand and its penetration of world markets slows. China, and many other rapidly growing developing nations, exhibit some of the fastest growth rates in imports of goods and services across a broad range.

Policymakers in both advanced and developing economies should pay attention to the effects of their policies and regulations on the competitiveness of the manufacturing sector, but they should also recognize and accept that competitiveness means rising productivity, and that, in turn, means less workers are needed. They should not judge the manufacturing sector's performance by the number of jobs added. Instead, they should evaluate the sectors' spillovers on the rest of the economy, and especially its effect on foreign currency receipts (in value added terms) and as an accelerator of the efficiency of associated sectors such as transport, telecommunication, banking, logistics, marketing services and, in the special case of food processing, agriculture.

The data suggests that only a few countries in Asia have been able to create large number of manufacturing jobs in labor-intensive light manufactures and to compete based on low wages. Moreover, as is evident in the case of China and other dominant producers that preceded China, manufacturing sectors that compete largely on cost, and employ large numbers of workers, such as finished garments, tend to quickly migrate to even lower cost and lower wage locations as incomes rise. Morocco, for example, and most countries that have higher wages and costs, may already have passed that income threshold. Their challenge then is to identify niches in higher value-added sectors in services and manufactures where they are internationally competitive. Countries in Sub-Saharan Africa that are poor and where population is young and growing rapidly may realistically aim to compete in labor-intensive manufactures but, with one or two exceptions, they have not yet established the business climate conditions necessary for so doing.

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Appendix 1[21]

Methodology

We quantify the effects on manufacturing employment in a simple accounting framework. The identity relation between employment, value added, and productivity is as follows:

Productivity = VA/Labor

$$\Delta(L) = \Delta(VA) - \Delta(P) \quad (1)$$

Where Δ denotes % change, and
VA= Value Added in manufacturing sector
L = Labor in the manufacturing sector, and
P= Labor productivity in the manufacturing sector

Assuming that inventory change is zero over the long run, total sources of manufactures equals total uses:

$$VA + M = DFD + X + NID \quad (2)$$

Where M denotes imports, X denotes exports, DFD denotes domestic final demand, and NID denotes net intermediate demand. The latter term denotes the sales of intermediate parts and material of the manufacturing sector to other sectors less the purchases of parts and materials from other sectors.

Rearranging the terms of the equation, we obtain:

$$VA = DFD + (X-M) + NID = NTD \quad (3)$$

Where NTD denotes net total demand for manufactures. Equations (1), (2) and (3) are identities, always true. Based on (3) and (1), we can write:

$$\Delta L = \Delta NTD - \Delta P \quad (4)$$

The growth of manufacturing employment equals the growth of net total demand for manufactures less productivity growth.

The growth of net total demand for manufactures over a period n is the result of the change in DFD, X-M, and NID, with their respective weights in the change of NTD. So, in the case of DFD, the contribution is calculated as follows:

$$((DFD_t)-DFD_{(t-n)})/(NTD_{(t)} - NTD_{(t-n)}))* \Delta NTD \; . \quad (5)$$

And is calculated similarly for X-M and NID. The sum of the contributions to NTD of DFD, X-M and NID equals the growth rate of NTD by definition, and also equals the growth rate of VA.

21. This appendix is based on Ait Ali & Dadush "Deindustrialization in Morocco" (PCNS, 2018)

To illustrate, see the table for France below over 2000-2008

Table 3: Contribution to employment change in France in percentage points*

Periods	Productivity	Domestic final demand	Sectoral trade	International trade	Average employment growth rate
2000-2008	-2.8%	1.4%	1.3%	-1.5%	-1.6%

Manufacturing employment in France declined over 2000-2008 at a compound annual growth rate of 1.6%. The contribution to manufacturing employment of rising labor productivity was negative, -2.8%. This implies that the growth of manufacturing value added in France over the period was 2,8%-1.6%, or 1.2% a year, equal to the growth in net total demand for manufactures. Domestic final demand and sectoral trade contributed positively to manufacturing employment, while international trade contributed negatively. The sum of the three contributions is 1.2%, equal to the growth rate of value added by definition.

Appendix 2

Data Issues

The analysis is carried out over 2000-2014, using mainly the World Input Output database (WIOD) that offers detailed National input output tables. The manufacturing sector is split into 18 branches. For simplicity and efficiency reasons, we decided to aggregate the 18 branches and get consolidated data on manufacturing. Unlike Supply and Uses tables, the IO tables offers the advantage of mapping the flows of final and intermediate goods and services at basic prices[22] among industries (industry × industry tables).

For our analysis, we initially used the WIOD deflators to obtain real manufacturing value added. We then compared the computed real value added growth rate to that reported by UNSTAT. For France and Turkey, the WIOD-based real growth rates are far higher, especially before the crisis. For instance, according to UNSTAT, the compound growth of manufacturing value added in France between 2001-2008 is around 1.1%, while WIOD reports 5.6%. For China and USA, the growth rates show some differences to UNSTAT numbers but are close enough.

Therefore, the challenge is to extract real trends out of the nominal variables in the Input Output Tables (IOT) for France and Turkey. The WIOD reports price levels for gross output, value added, and intermediate inputs, following the same nomenclature as in the IOT. Unfortunately, there are no deflators in WIOD for exports and imports. We resort to national sources to extract trade deflators.

For France, we used import and export prices index (Eurostat database), while for Turkey, the choice

22. "The World Input-Output Database (WIOD): Contents, Sources and Methods" discussed extensively the database and the underlying assumptions.

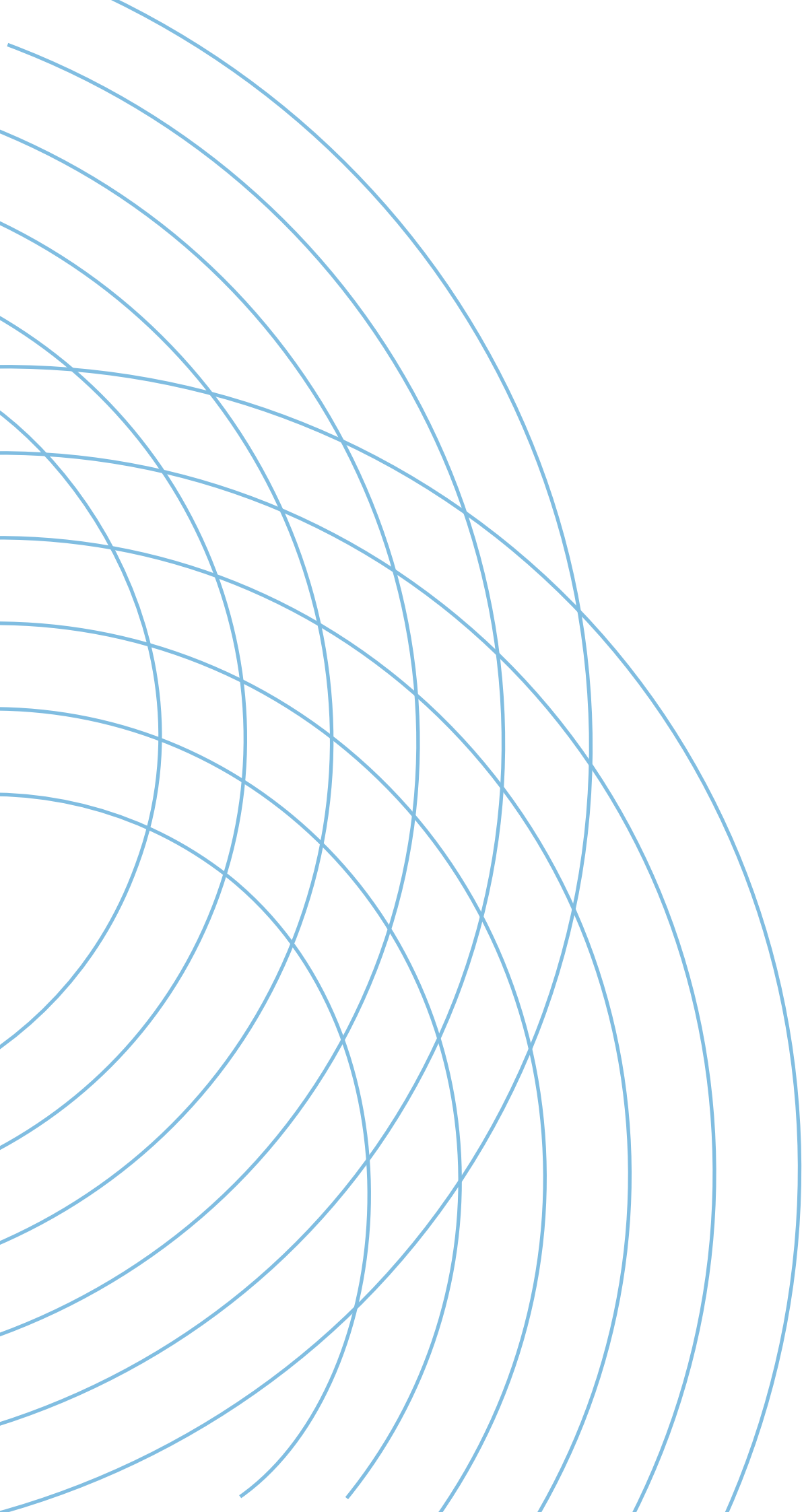
fell on export and import unit value, as proxies (Turkish Statistical Institute data). For the domestic final demand deflator, a price index was constructed averaging the change in the gross output price level and the import price index, reflecting the weight of domestic production and imports in total domestic demand. After converting all variables into real terms, the equality of equation 2 above was tested and the gap between total resources and uses was found to be below 4% in nearly all cases and the difference was split on the resources side according to each component's weight.

For China, the discrepancy between the WIOD value added growth and UNSTAT's number is smaller. So, we opted for the WIOD deflated data.

For Morocco, we drew from our previous paper[23], which applied the same methodology using Haut Commissariat du Plan HCP data.

For the United States, it presented particular data issues. WIOD data presents a trade surplus in the United States over 2001 and 2014, contrary to all that is known. As an alternative, we examined the sources and uses tables offered by the Bureau of Labor Statistics. Those tables classify manufactures according to the primary activity of the firm, so the total output of the domestic manufacturing sector differs from the total domestic supply of manufactured commodities, some of which are produced by firms not primarily engaged in manufacturing. For the purpose of our analysis we used the total supply of manufactured commodities, which turns out to be lower than the value added of the manufacturing sector. According to the BLS data. manufacturing Value added was stagnant in 2001-2008 and barely increased post-crisis. In contrast, data drawn from The Bureau of Economic Analysis (BEA) data for manufacturing value added displays sustained growth of 3.3% a year over 2001-2008 as does UNSTAT. We decided to show both calculations based on the WIOD and BLS.

23. Ait Ali & Dadush "Deindustrialization and Employment in Morocco" 2018



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