Productivity Dynamics in the Arab Economies: The Challenges of Generating Multifactor Productivity Estimates at Industry Level

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Abstract

The growth gap between the Arab countries and the rest of the world has been increasing since the 1990s, despite the economic and political transition in the Arab world. Against this background, the analysis of the empirics of growth in this part of the world becomes significant. Our attempts to quantify and examine the growth dynamics in the Arab world point to the lack of data for undertaking quality research. Reviewing the available information on three chosen countries- Egypt, Morocco and Tunisia from different international data sets, we explore the creation of an Arab KLEMS dataset which would allow examination of empirics of growth- both for the economy and sub sectors of the economy. In this light, we highlight the challenges that need to be overcome if multifactor productivity estimates can be created for three chosen countries- Egypt, Morocco and Tunisia.

JEL classification: 04, 014 and 057
Key words: Multifactor productivity, Arab countries, KLEMS datasets, Egypt, Morocco, Tunisia

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Productivity Dynamics in the Arab Economies- the Challenges of generating multifactor productivity estimates at Industry Level- Deb Kusum Das, Homagni Choudhury and Pilu Chandra Das

I. Introduction

The Arab world has witnessed major economic, political and social changes since the onset of the Arab spring in 2011. Despite the rapidly spreading and worsening political turmoil, as well as, in many cases, an unstable internal socio-political environment, many of the Arab Countries in transition, which include Egypt, Jordan, Libya, Morocco, Tunisia and Yemen, have more or less maintained macroeconomic stability (IMF, 2014). However, these countries have not been able to generate the kind growth rates required for a meaningful reduction in poverty and creation of jobs. Notwithstanding diversity of conditions, there is need to advance structural reforms to foster higher and more inclusive growth. It is well known that Arab countries do not rank very high in terms of global competitiveness[1]. Further, in some of the Arab countries, there has been uneven implementation of structural reforms carried out in the mid-1980s. The important question to pose is- *has growth delivered following such reforms in the Arab world?*

The role of multifactor productivity (MFP) improvements is catalysis for enhancing growth in the economy. Further, in recent times, the examination of sources of growth- the role of factor accumulation and MFP have assumed tremendous academic importance across the world- developing and emerging countries included along with developed world. Several authors have examined the growth and MFP aspects for Arab countries [See Pipitone V (2009)], and particularly the role of technological progress in select countries in the Mediterranean region. These studies concludes that physical capital is the key factor of economic growth. The contribution of human capital seems rather low, although it has a positive value. The role of MFP is particularly variable, but it is significant in many transition countries and in all the countries which have recorded the highest economic growth rates.

Given this backdrop, this paper aims to explore aspects of productivity dynamics in the Arab world and assess the challenges for estimating multifactor productivity using the North African countries of Egypt, Morocco and Tunisia as a particular case. Estimation of multifactor productivity is at the heart of understanding growth paradigm and the effects of economic reforms on growth and development. As such we attempt to explore the possibility of empirically estimating MFP using a KLEMS framework for the North African countries of Egypt, Morocco and Tunisia. This in turn will set the context for estimation of multifactor productivity for the Arab world and allow us to identify the challenges and lay a roadmap for an Arab KLEMS database.

Our choice of working with the three North African countries to explore challenges for estimation of MFP for the Arab world is conditioned by several factors. First, the choice of Egypt, Morocco and Tunisia lies in the fact that they have a similar economic, socio-political and cultural structure and therefore have, to some degree, relatively homogenous political economy factors affecting economic performance and manufacturing productivity. More specifically, these three countries have adopted market-oriented reforms in the recent past beginning in the mid-1980s. Economic growth, in all the three countries, is highly driven by services, and manufacturing sectors. The role

[1] According to the Global competitiveness index (2014-15), Morocco (72), Tunisia (87) and Egypt (119) rank lowly amongst a group of 144 countries (see Global competitive Report, World Economic Forum). We also find that United Arab Emirates UAE (12), Qatar (16) and Saudi Arabia (24) are the three top Arab countries in this list.

of agriculture has declined over the years in growth, but it still employs a large proportion of the workforce. Also, the three countries have similar trading partners and FDI sources, and they share common demographic characteristics such as language, religion, culture and have, to some degree, a similar history of macroeconomic events, policy regimes and level of development of the financial sector. Second, When it comes to economic policy, Egypt, Morocco and Tunisia have witnessed a gradual liberalisation of both the external sector as well as internal reforms resulting in a strong growing financial and economic system (Mühlberger and Semmelmann, 2010; Creane et al, 2006; Achy, 2005). Finally, an important common point to note for these three countries is that they are all non-oil dependent unlike other North African countries like Libya and Algeria, which are major exporters of oil. In addition, the geographical and strategic location of the North African region is of great significance. Lying in the northernmost part of the African continent, Egypt, Morocco and Tunisia occupy a unique position in the international community. They enjoy a favorable strategic position; they are advantageously located on the crossroads among three continents (Asia, Africa and Europe) and this important geographical location could benefit these countries to have a great potential to attract significant foreign investments and to access various markets, which clearly has implications for firm performance and manufacturing productivity.

The rest of the paper is structured as follows. In section 2, we present a background to understanding the growth dynamics in the Arab world in general and for the three North African countries under study, in particular. Section 3 outlines the KLEMS framework for estimation of multifactor productivity. We assess the practical challenges and requirements for estimating MFP for the Arab world by empirically examining the available data and literature for the three North African countries in Section 4. Section 5 presents some concluding remarks and lays the way forward for estimating multifactor productivity for the Arab world.

2. Understanding the growth dynamics in Arab world: the case of Egypt, Morocco and Tunisia

In this section, we present a background to the growth performance of the economies in our study in the context of growth dynamics in the Arab world. The countries of Egypt, Morocco and Tunisia are situated in the northern most part of the African continent. The geopolitical classification of these countries by the United Nations puts them under North Africa, along with Algeria, Libya, Sudan, and Western Sahara.[2] These three countries are also members of the Arab League (the League of Arab states), which is a regional organisation of 22 Arab countries in and around North Africa, the horn of Africa and Arabia. But when it comes to an academic discourse of these countries, they are generally studied under the umbrella of Middle East and North African Economies (MENA) – the MENA region is comprised of a range of Arab countries with diverse social and economic histories and resource base (Messkoub, 2008). In Table 2.1, we present selected macroeconomic indicators for the three countries that we consider along with the averages for all MENA and developing MENA countries for comparison. While both real GDP and per capita real GDP show positive trends since the 1980s, it is evident that growth has slowed down in the wake of ongoing political and social turmoil in the region in general and in these three countries in particular following the Arab spring of 2011. Since 2011, most Arab countries have been affected by social unrest, increase in energy (for oil importers) and commodity prices, recessionary impacts affecting both private and public sectors, increased uncertainty for investors and greater demands for expansionary expenditure for economic recovery and social justice. The unrest has already had a huge direct cost, and has also led to a fall in economic activity and increase in unemployment (ILO, 2012). Given this background, it is important to understand the growth paradigm in the Arab region in general and the three countries under study in particular. To this end, we first outline the current political economy of the Arab region, followed by a brief discussion of the macroeconomics aspects

[2] http://millenniumindicators.un.org/unsd/methods/m49/m49regin.htm

of growth in the Arab world. We then set out the macroeconomic profile of the three countries that we consider in our paper to assess the challenges of estimating multifactor productivity.

Table 2.1: Selected macroeconomic indicators for Egypt, Morocco, Tunisia and MENA

	Real GDP					Real GDP Growth					Per capita real GDP				
	1980	1990	2000	2010	2014	1980-89	1990-99	2000-10	2011-14	2013-14	1980	1990	2000	2010	2014
Egypt	29.10	49.50	75.40	121.02	131.40	0.0572	0.0423	0.0478	0.0206	0.0218	670.57	878.22	1,103.44	1,475.13	1,466.98
Morocco	22.50	35.30	46.70	75.50	87.10	0.0459	0.0292	0.0452	0.0358	0.0252	1,110.73	1,401.45	1,595.77	2,315.26	2,527.18
Tunisia	11.70	16.60	26.40	40.60	43.30	0.0345	0.0494	0.0434	0.0218	0.0249	1,830.03	2,033.42	2,758.46	3,847.59	3,979.43
MENA (All)	674.20	796.90	1,184.50	1,888.70	2,145.90	0.0123	0.0442	0.0472	0.0319	0.0216	3,642.74	3,133.23	3,758.55	4,906.30	5,140.46
MENA (Developing Countries)	271.50	368.60	526.70	826.80	853.00	0.0572	0.0423	0.0478	0.0206	0.0218	1,627.03	1,628.76	1,890.42	2,494.49	2,387.21

Source: Authors' calculations based on World Development Indicators, World Bank

Notes

1. Real GDP is in billions of 2005USD

2. 2014 figures not available for Tunisia, instead 2013 is reported under 2014 and 2011-13 and 2012-13 under 2011-14 and 2013-14 respectively

3. Per capita Real GDP is in 2005 USD

2.1 Political economy of the Arab region

The emergence of political economy balances in Arab countries is well documented in the region's political economy literature. Specifically in the MENA countries, colonial structures shaped regional and economic balances. Post-independence, most of these countries saw state-led growth and import substituting industrialisation strategies that led to the establishment of an extractive class of public company managers and rent-seeking entrepreneurs (Richards and Waterbury, 2007). This model of development crashed for the first time during the external debt crisis of the 1980's. This saw the adoption of IMF prescribed economic reforms based on macroeconomic stabilisation and liberalisation policies in most countries in the region. However, there is evidence that the implementation of these reforms were highly influenced by powerful lobby groups and economic elites which meant that a larger share of benefits from the reforms including privatisations, public works and services contracts, trade liberalisation and industrial deregulation were captured by those with political connections and economic status (Heydemann, 2004). While this did change the rent-seeking model that prevailed in the pre-reforms period, the new economic regime in the post reforms period replaced the old rent-seeking model with corporatist capitalism, which together with rampant nepotism and cronyism, became the main barrier of entry into the political economy space (Escribano, 2013). In fact, in the Arab world, the North African political economy, in particular, has traditionally been based on the incumbents' political networks of influence, and their ability to exploit economic reforms and renewing rent-extractive strategies (Greenwood, 2008).

Catusse (2006) notes that the military and trade unions are two other important economic players in the political economy of the Arab world and that the role they play varies quite significantly across countries. Specifically, in North Africa, the economic influence of the military is mostly restricted to Egypt. The control around a third of Egypt's national income and are involved in running of important strategic sectors like the iron and steel industry, construction, tourism and agro-food, among others (Alissa, 2007). Consequently, such agents are opposed to economic reforms and market led growth of the private sector, a case that was widely debated during the post-Mubarak regime of the provisional government in Egypt (Anderson, 2011). In Algeria, Martinez (2010) highlights that the army had significant influence and control over the hydrocarbon resources sector, and effectively opposed reforms to open the sector further to investment from abroad, which it feared will erode its political pre-eminence (Martínez, 2010). Similarly, trade unions are a powerful actor in Tunisia, both during and after the removal of Ben Ali, although their influence is much lower elsewhere in the North African region (Escribano, 2013).

There is growing support to the view that even if the pace of economic reforms in the Arab world have been slow and their effect very marginal, there has been a slight shift of the political economy equilibrium in favour of new players like small and medium enterprises (SMEs) and foreign investors and firms. The region has also seen gradual social change, which has facilitated the increased participation of new economic agents like the youth, Islamist political parties, and women. While the transformation of the economic regime and social environment has definitely facilitated the inter-play of new agents with the traditional ones, often resulting in new alliances or renewal of alliances across the North African region, the cross-country variations in these experiences are rather large and it is beyond the scope of this paper to outline such differences at an individual country level.[3]

A final point that we would like to highlight in this section is the aftermath of the Arab spring, that began with the Tunisian revolution in December 2010 and quickly spread to the rest of the Arab world in 2011 affecting both economic and socio-political conditions in Egypt, Libya, Syria, Yemen,

[3] For a more comprehensive review of the changing political economy of North African countries, see Escribano (2013), and the references therein, from which this section of the paper draws heavily.

Bahrain, Saudi Arabia, and Jordan, and resulting in political regime changes in some of these countries. The Arab Spring added to the already slowing economic growth of the Arab world caused by the international financial crisis and the Euro crisis of the late 2000's, and, in fact, growth rates diminished the most in the countries witnessing regime change (Escribano, 2013). It has been noted that the social unrest led to a deterioration of external inflows, especially due to fall in tourism and foreign investment due to rising uncertainty and chaos associated with heavy political repercussions of the events and riots and civil resistance that followed. The impact of the crisis has also been reflected by worsening macroeconomic balances caused by falling fiscal income and rising public expenditure on military intervention, subsidies and unproductive expenditure to contain social unrest and riots. Following the Arab Spring, most Arab countries (and specifically the North African countries) have attempted to raise public wages and employment, food and energy subsidies, and public works with a view to calm civil protesters challenging the prevailing political and economic regimes. With falling revenue and foreign investment, this has added to fiscal deficits.

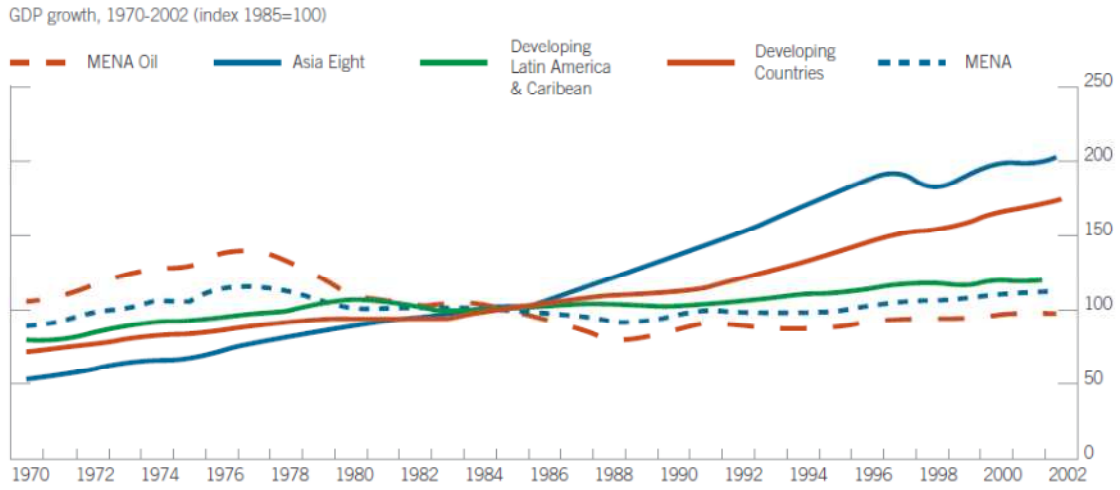
To conclude this sub-section, from a political economy perspective, the economic reforms of the past and the socio-political changes that the Arab region is currently undergoing in the aftermath of the Arab Spring has facilitated to some degree social mobility and diversification of economic as well as political power through expansion of the middle class and civil challenges to the economic dominance and political influence of incumbent regimes. Consequently, the political economy balances in the region have been permanently altered paving the way for decentralisation of economic power away from big entrepreneurs and public companies that tend to support the repressive and nepotistic governments in power. Despite these changes, the institutional framework in most of the developing countries in the Arab world remains clearly deficient, with extreme levels of corruption, nepotism and X-inefficiency in both public and private sector enterprises. As such, the most pressing need in the region is to initiate both institutional and microeconomic reforms, although plausible political economy scenarios are not uniform across the region, as the growth trajectories of these countries vary widely (Escribano, 2013).

2.2 Macro aspects of growth in the Arab world

The historic growth performance of the Arab world has been more or less disappointing. In comparison to other developing countries, the MENA region showed better performance in the 1970s, but since the 1980s, the region as a whole witnessed complete stall in growth and very slow growth since the mid-1990s (see Figure 2.1). Following the 'lost decade' of the 1980s, the rate of economic growth in the region showed some signs of improvement. While growth rate averaged 3.5 per cent per annum in the 1990s and further increased to over 4.5 per cent in the decade leading up to the Arab spring, which are significantly high by historical standards, the fact remains that the economic performance of the Arab countries remained poor in comparison to all world regions[4] (see, Figure 2.2). When population growth is factored in, the increase in per capita incomes is far less impressive (ILO, 2012).

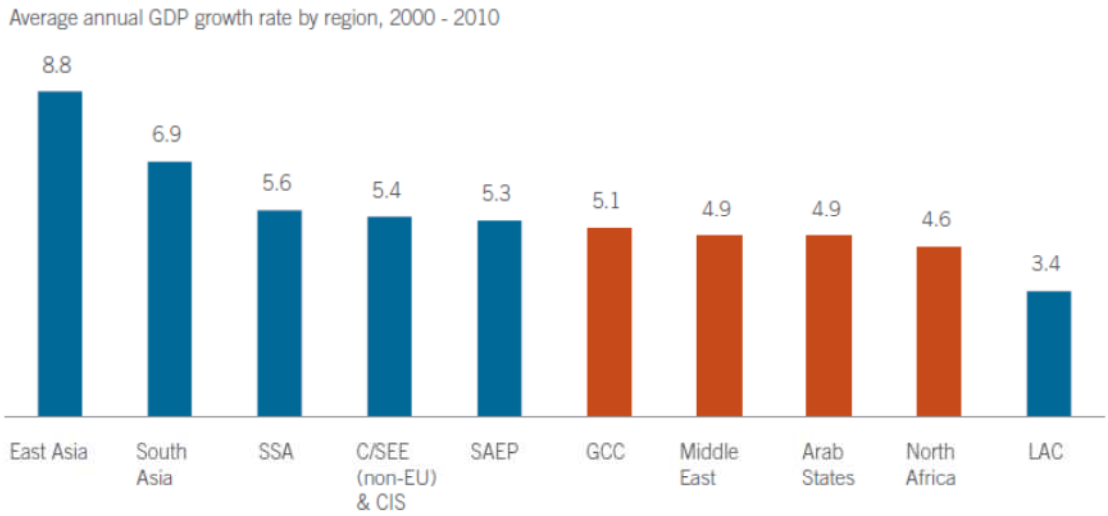
[4] With the exception of Latin America.

Figure 2.1: Arab countries had a low GDP per capita growth in the 1980s and 1990s



Source: ILO (2012):
Note: Original source of chart is Abed and Davoodi (2003), as cited in ILO (2013)

Figure 2.2: GDP growth in the Arab states (and three sub-regions) in the 2000s relative to the rest of the world



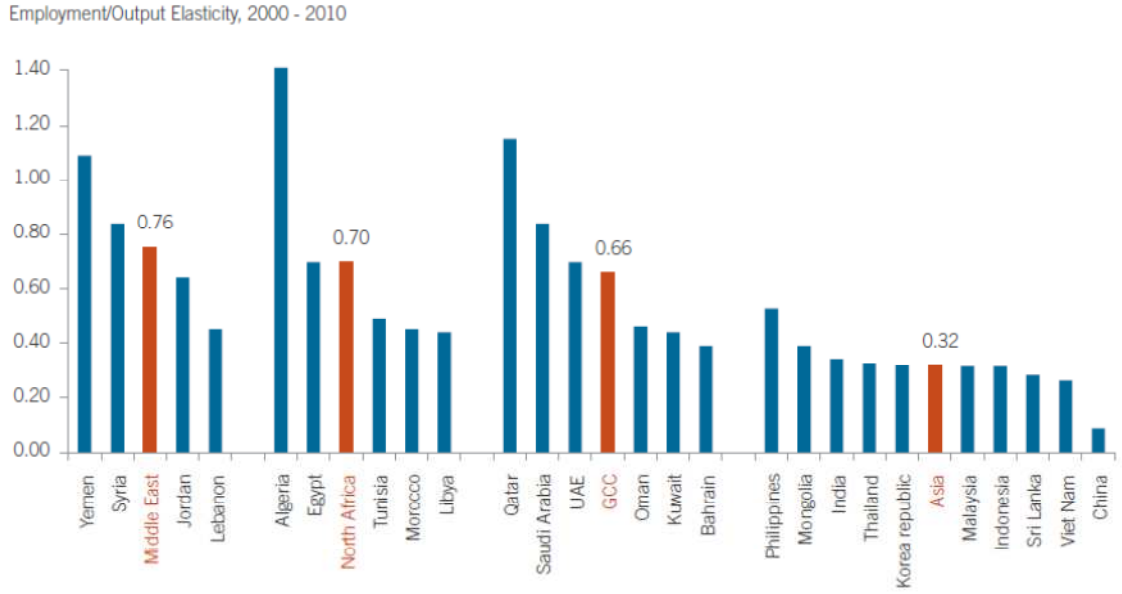
Source: ILO (2012)
Note: Original data sources of chart are IMF World Economic Outlook Database and 'Global Employment Trends 2010', ILO (2010), as cited in ILO (2012)

However, the employment scenario in the Arab world in comparison to the rest of the world, despite low levels of growth, has been substantially positive. The elasticity of employment with respect to output averaged 0.69 between 2009 and 2010 (ILO, 2012), which is not only high by historical standards[5], but also significant in the backdrop of the fact that this period saw a conscious

[5] However, the ILO notes: "The significance of the relatively high value of employment-to-output elasticity should not be overstated in a context where informality plays an important role. In the presence of rapidly increasing labour supply, it is not surprising to find high employment growth, to some extent irrespective of output growth. This is because in the end jobseekers need to be employed somewhere, and, if they end up in the informal economy, their contribution to output growth will be understated. Under such labour surplus

shift of the policy stance of the government on its role as employers of last resort, at least until the Arab spring of 2011. Figure 2.3 shows that the employment-output elasticity in each of the three Arab sub-regions (Middle-east, North Africa and Gulf Cooperation Council) was more than double that achieved by their Asian counterparts. Also worth noting is the fact that growth of employment in the Gulf states was less responsive to output growth, in comparison to the Middle East and North African states, despite the fact that employment strategies in the gulf have traditionally favoured labour-intensive activities and are still based on large numbers of migrant workers (ILO, 2012).

Figure 2.3: Employment elasticity with rest to output in the Arab World and Asia, 2000-10



Source: ILO (2012)
Note: Original data source is 'Global Employment Trends 2010', ILO (2010), as cited in ILO (2012)

The implication of relatively low economic growth rates but high employment elasticities in the Arab region is that productivity in the Arab world growth has lagged behind other regions (see, Figure 2.4). As a matter of fact, the Arab region had the lowest productivity growth compared to any other region (except Latin America) in the decade of the 2000s. ILO (2012) notes that North Africa achieved slightly higher productivity growth than the Middle East, with the respective annual rates being 1.5 per cent and 1.2 per cent, as against a world average of 1.8 per cent.

conditions, changes in the labour market take place mainly through low quality of jobs and employment at low wages." (ILO, 2012)

Figure 2.4: Productivity gains in the Arab region in the 2000s in comparison to the rest of the world

Source: ILO (2012)
Note: Original data source is 'Global Employment Trends 2010', ILO (2010), as cited in ILO (2012)

Given the preceding discussion on the historical economic performance of the Arab world, it is worthwhile to note that this period coincides with a period that saw the initiation of the economic reforms in most Arab countries starting in the late 1980s and gaining momentum in the 1990s. While this section does not attempt to outline country specific episodes of policy changes in the Arab world, it is important to emphasise that Arab countries resemble other developing countries in the sense that they had adopted widespread market based reforms including macroeconomic stabilisation, trade liberalisation and openness to FDI in line with the Washington consensus. There is a huge volume of literature that has reviewed the nature and effects of such reforms in the Arab world and the consensus is that the Arab countries have failed to fully exploit benefits from partial and half-hearted reforms [see, for example, Hoekman and Messerlin (2002), Abed (2003), Hoekman and Zarrouk (2000), Zarrouk (2002), Nunnenkamp (2004), among others]. Table 2.2 presents a list of policy variables that capture the outcomes of economic reforms in the 1990s and presents a comparison of economic indicators for the Arab countries and other developing countries.

Table 2.2: Policy related outcome variables for economic reforms in the Arab world and other developing countries (Median values)

Policy Outcomes	Variables capturing policy outcomes	Arab Countries		Other developing countries	
		1980-1983	***1998-2001***	***1980-1983***	***1998-2001***
Macro stabilisation outcome	Inflation	8.5	1.6	12.8	5.5
	Government consumption	17.8	17.3	14.6	13.2
Proxy for investment in physical and human	Grossed fixed capital formation	26.3	19.0	22.0	20.7
	Years of	2.9	5.5	3.4	5.1

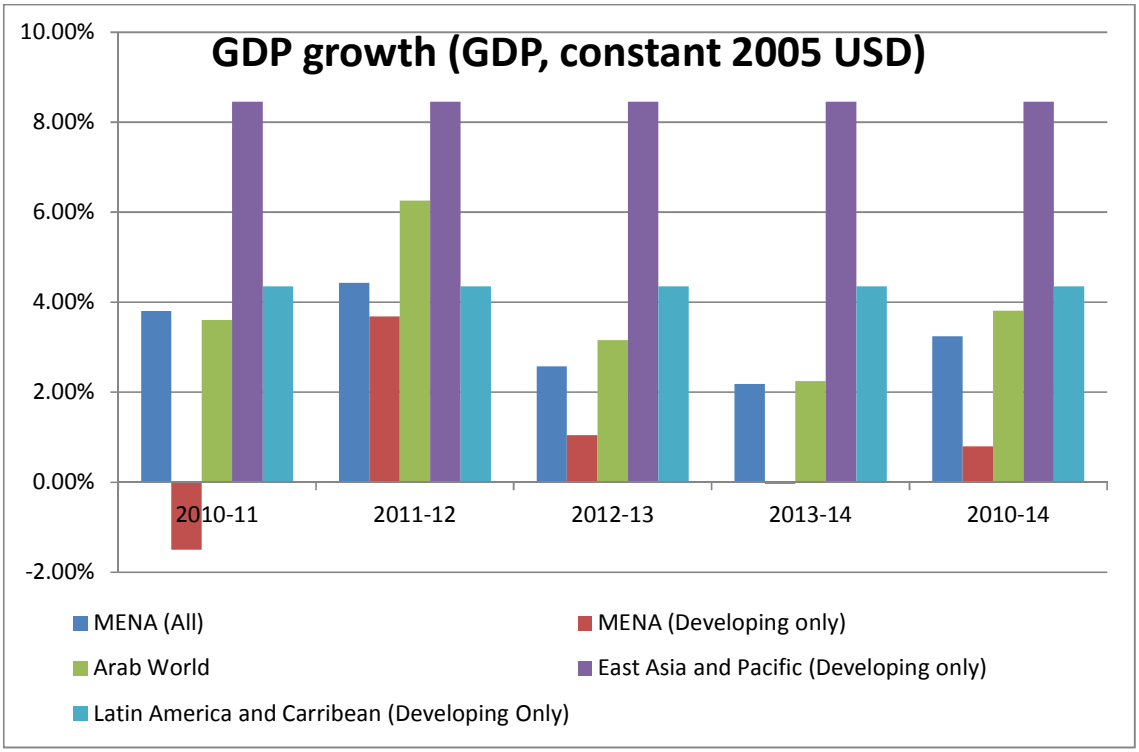
Policy Outcomes	Variables capturing policy outcomes	Arab Countries		Other developing countries	
		1980-1983	*1998-2001*	*1980-1983*	*1998-2001*
capital	schooling	(1980)	(2000)	(1980)	(2000)
Trade policy related outcomes	Imports	41.5	33.0	35.0	39.3
	Import tariff revenues	13.6	9.7 (1997-2000)	12.1	8.8 (1997-2000)
	Exports	38.8	36..6	23.2	30.7
Openness to foreign investment	FDI inflows	1.0	1.2	0.5	2.7
	Inward FDI stocks	1.0 (1980)	12.9 (2002)	4.9 (1980)	30.0 (2002)
Source: Based on Nunnenkamp (2004)					
Notes:					
1. For definition of variables and data sources, see Annex in Nunnenkamp (2004)					
2. The number of observations vary for the Arab countries from 8 in the case of import tariff revenue to 18 in the case of FDI stocks. The average number of observations is 11 – see, Nunnenkamp (2004), for more details.					
3. All figures are annual averages, if not stated otherwise.					
4. Original data and information sources are World Bank (2003), Barro and Lee (2002), and UNCTAD (2003), as cited in Nunnenkamp (2004).					

Table 2.2 shows that inflation in Arab countries was fairly low in the pre-reforms period in comparison to other developing countries and it was further reduced in the post reforms era. By contrast, government consumption as a share of GDP is higher for Arab countries relative to other developing countries both in the pre-reforms and post reforms period. The evidence on factor accumulation is mixed – while the share of GFCF has fallen drastically in the Arab countries over the reforms period, human capital formation (in terms of average years of schooling) seemed to have improved more pronouncedly for Arab countries over the reforms period when compared to other developing countries.[6] Finally, trade policy and FDI openness variables indicate that Arab countries has seen much slower integration with the world economy compared to other developing countries over the 1980s and 1990s, despite substantial reforms targeting the external sector.

Turning on to more recent economic performance, and in the backdrop of deepening and spreading social unrest and civil conflicts within the Arab region, the Arab countries in transition (Egypt, Jordan, Libya, Morocco, Tunisia and Yemen) seem to have maintained macroeconomic stability - growth has remained positive, inflation is in single digits (except for Egypt), and budget deficits in most countries have begun to decline in 2014 (IMF, 2014). In figure 2.5, we present the growth performance of Arab world as well as MENA countries in comparison to other developing countries between 2010 and 2014, which clearly show that the MENA-developing countries have witnessed a rebound of growth since it fell in 2010-11 following the Arab spring. However, GDP growth in the Arab world remains remarkably low in comparison to developing countries in East Asia and Latin America. Similarly, we present the growth in GDP per capita and inflation rates in the Arab and MENA regions between 2010 and 2014 in Table 2.3 and it is quite clear that the region as a whole has underperformed in comparison to other developing regions in the world.

[6] Nevertheless, Hoekman and Messerlin (2002) note that education in the MENA region lags behind the rest of the world. Eken et al (2003) highlights that MENA countries are ineffective in their education systems in that dropout and repetition rates are quite high, which offset high enrolment rates despite relatively high government spending on education.

Figure 2.5: Growth in GDP for Arab, MENA and other developing regions, 2010-14



Source: Authors' calculations based on based on World Development Indicators, World Bank

Table 2.3: GDP per capita growth and Inflation for Arab, MENA and other developing regions, 2010-14

Regions	GDP per capita growth (annual %, constant LCU)						Inflation (GDP Deflator, annual %)					
	2010	2011	2012	2013	2014	2010-14	2010	2011	2012	2103	2014	2010-14
MENA (All)	2.76	1.68	2.31	0.52	0.19	1.49	10.56	13.45	4.43	2.26	0.96	6.33
MENA (Developing only)	3.29	-3.30	1.75	-0.85	-1.90	-0.20	11.78	9.01	4.99	3.93	2.03	6.35
Arab World	2.12	1.27	3.91	0.92	0.08	1.66	11.08	15.29	4.43	1.64	0.79	6.65
East Asia and Pacific (Developing only)	9.10	7.69	6.67	6.41	6.05	7.19	4.12	4.38	2.50	1.85	2.61	3.09
Latin America and Caribbean (Developing Only)	4.80	3.12	1.94	1.59	0.61	2.41	5.55	5.68	3.93	2.72	3.68	4.31
Source: Authors' calculations based on based on World Development Indicators, World Bank												

Finally, to conclude this sub-section, most Arab countries in transition have by now either initiated or announced ambitious reforms targeting generalised energy subsidies and other current expenditures. These reforms are aimed to create space for better targeted social protection for the poor, and higher spending on infrastructure, healthcare, and education. While these are significant first steps in pursuing the medium-term growth agenda, the fact is that progress has been uneven across the Arab world, and reforms of tax policy, civil service and public financial management remain quite slow. Other areas of reforms including banking and financial sectors, governance, business climate, and labour markets also need immediate attention (IMF, 2014).

2.3 Macroeconomic profile of Egypt, Morocco and Tunisia

The three countries of Egypt, Morocco and Tunisia constitute the key members of the North African sub-region of the Arab world. Bordered on the north by the Mediterranean basin, these three countries have a favourable strategic location at the crossroads of three continents, namely, Africa, Asia and Europe. Arabic is the main official language in each of the three countries, although French is widely used in business and commerce in Tunisia and Morocco, while English is more common in Egypt. Despite having a common language and a similar cultural and religious background, the countries have considerable differences in terms of geographic size as well as sizes and composition of population and standards of living. Population growth has slowed down in all the three countries due to a combination of fall in fertility and infant mortality and increase in life expectancy for all the three countries over the last three decades. Table 2.4 below presents selected demographic indicators for the three countries and list them against all of Africa and North Africa for comparison.

The three countries have a shared colonial past in that Egypt was a British colony and Morocco and Tunisa were a French colony up to the first part of the 20th century. Egypt attained independence from the British in 1922 and became a republic in 1952, following the Egyptian revolution which overthrew the existing monarchy. In 1956, Gamal Abdel Nasser was elected the first president of the Arabic republic of Egypt, which he continued until his death in 1970. He was succeeded by Muhammed Anwar al-Sadat in 1970, who was assassinated in 1981. Following the assassination of al-Sadat, Hosni Mubarak succeeded the presidential office in 1981 and remained in power for 30 years, until he was removed during the Egyptian revolution in 2011, which was very much part of the Arab spring. While the overall political environment appears to have improved in Egypt over time with some changes in the political scene towards the end of the Egyptian revolution of 2011, there is still a lot of uncertainty surrounding governance and role of military in the state. Morocco achieved independence from France in 1956 and became a constitutional monarchy. It is the only monarchy in North Africa with an elected parliament and it has seen comprehensive constitutional reforms over time, but the most important constitutional change was in July 2011 as a response to the Arab spring. The recent constitutional changes indicate that the country faces a push in the direction of change towards a more open and democratic society and the beginning of a new era in its political development. Finally, Tunisa gained independence from France in 1956. The first president, Habib Bourguiba remained in office until 1987, until he was succeeded by Zine Al-Abidine Ben Ali. Ben Ali stayed in power for 23 years until he was ousted during the popular uprising in 2010, which sparked the Arab spring in 2011 across the Arab world. Following the Tunisian revolution of 2010-11, a new transitional government was put in place and there are signs of political reforms being carried out in the country (Aboukhdir, 2015).

Overall, following the Arab spring of 2011, there has been some unrest and political uncertainty in the three countries of our study. There is a significant change in the political scene and all three nations show positive signs of further changes towards more democratic and inclusive forms of government, which is desirable in the sense that stable and representative governments can provide the right set of institutions required for acceleration of growth and productivity.

When it comes to economic structure, the three countries are again quite similar in the sense that services has the dominant share in GDP for each (48.5 percent for Egypt, 55 percent for Morocco, and 59 percent for Tunisia in 2010 [Aboukhdir, 2015]). With regards to the services sector, financial services, tourism, transport, telecom and information services dominate the scene in each of the three countries. The share of manufacturing in GDP is also very similar for Egypt, Morocco and Tunisia - roughly 16-17 per cent in each of the countries. All the three countries are exporters of manufacturing goods and are non-oil dependent countries. Despite these commonalities in their economic structures, there is some evidence that Morocco and Tunisia are relatively more diversified economies than Egypt (see, Aboukdir, 2015 and references there in).

Like many other developing countries, Egypt, Morocco and Tunisia, in the 1970s adopted inward looking import substitution industrialisation (ISI) and development strategies actively planned and implemented by the state (Harrigan and El-Said, 2010; Yol, 2009). However, since the mid-1980s, these countries have continuously attempted to shift their restrictive ISI policy regime towards a more market-oriented regime by adopting trade and investment reforms. Foreign investment in the form of FDI and export-led growth replaced import substitution industrialisation as a result of these unprecedented market-based reforms (Aboukhdir, 2015). Since then, the governments in these countries have been undertaking economic reforms with the underlying aim to transform the economies from closed economies into open economies and to expand the role of the private sector. Dillman (2001) notes: "they started with stabilisation programmes, followed by structural adjustment, limited privatisation, and encouragement of foreign investment". Further, over the last three decades, these countries, along with pursuing a program of economic reforms based on the Washington consensus, have also seen an active role of the government in emphasising and encouraging a strong and growing financial system aimed to enhance overall economic growth and to complement the economic reforms by encouraging the strengthening of institutions that would facilitate financing of businesses and commerce (Achy, 2005; Mühlberger and Semmelmann, 2010).

Given this shared geo-political importance, similar demographic and socio-political environments, close economic structures and similar and coinciding episodes of economic reforms, the three countries of Egypt, Morocco and Tunisia make an interesting case from the Arab world for understanding productivity dynamics and challenges in estimating multifactor productivity for the Arab world.

Table 2.4 Selected demographic indicators for Egypt, Morocco and Tunisia, 1980 - 2010

Year	1980					1990					2000					2010				
Country	Africa	North Africa	Egypt	Morocco	Tunisia	Africa	North Africa	Egypt	Morocco	Tunisia	Africa	North Africa	Egypt	Morocco	Tunisia	Africa	North Africa	Egypt	Morocco	Tunisia
Population, total (million)	479.9	92.2	44.4	19.6	6.4	636.2	120.4	57.8	24.8	8.2	817.5	144.4	70.2	28.8	9.6	1020.4	156.4	81.1	32	10.5
Population growth (annual %)	2.96	2.76	2.44	2.56	2.67	2.73	2.34	2.40	2.34	2.43	2.46	1.36	1.89	1.22	1.13	2.33	1.5	1.75	1	1.04
Life expectancy at birth, total (years)	50.03	57.95	56.56	57.63	62.12	52.7	64.7	62.89	64.15	70.3	53.4	69.1	68.23	68.68	72.6	55.64	71.5	70.34	2.31	74.45
Fertility rate, total (births per woman)	6.54	5.89	5.61	5.65	5.33	5.9	4.41	4.56	4.03	3.63	5.08	2.95	3.32	2.7	2	4.58	2.56	2.82	2.31	2
Mortality rate, infant (per 1,000 live births)	114.28	104.59	120.10	94.6	69.1	102.56	60.57	65.50	66.8	39	91.42	38.28	37.50	46.2	23.8	74.43	22.84	18.60	30.4	13.8
School enrolment, primary (% gross)	…	…	66.35	101.21	101.21	73.26	…	112.6	67.68	112.6	86.12	…	93.09	115.33	115.33	97.67	…	99.67	107.4	108.17
Source: Aboukhdir (2015)																				
Notes: some years missing, see notes in Aboukhdir (2015). Original source is World Development Indicators, World Bank, as cited in Aboukhdir (2015)																				

3. Industrial productivity in KLEMS format

The present segment explains the economics of multifactor productivity measurement both from the perspective of overall economy and industrial sectors[7]. The traditional approach to productivity approach was challenged in a seminal paper by Jorgenson and Griliches 1967 which attempted to explain the productivity change. Further, seminal work by Jorgenson et al (1987) has been recognized as the new framework for productivity measurement. In the present section, next we underline the significance of a measure of industrial or multifactor productivity. The different methods of measurement- econometric as well as non econometric are outlined. The KLEMS framework for measuring productivity is described in section 3.4 and is followed by measurement of MFP growth in the new framework and its data requirements in terms of variables which define the MFP variable. The final section highlights the analytical usefulness of using KLEMS framework in empirical research in advanced and emerging economies.

3.1 Measuring MFP

Productivity is a mechanism to convert inputs into output-it is often addressed as a ratio of output to inputs. Further, productivity is a key indicator in the assessment of economic performance of the economy as well as sectors which comprise the economy. The part of economic growth that cannot be explained by increased utilization of capital and labour is measured by multifactor productivity (MFP). Therefore economics of productivity remains central to understanding of the forces driving the overall growth of a country.

There are many different productivity measures. The choice between them depends on the purpose of productivity measurement and, in many instances, on the availability of data. Broadly, productivity measures can be classified as single factor productivity measures (relating a measure of output to a single measure of input) or multifactor productivity measures (relating a measure of output to a bundle of inputs). Another distinction, of particular relevance at the industry or firm level is between productivity measures that relate some measure of gross output to one or several inputs and those which use a value-added concept to capture movements of outputs (OECD manual 2001).

3.2 Methods of MFP computation

The measurement of MFP involves several issues. Some of the concerns have arisen because the variables applied for the estimation of MFP and others in the required methodology in which MFP estimated. There are four main methodologies used by the various studies to measure MFP growth for the Indian manufacturing sector, (i) Production function Approach (PFA); (ii) Stochastic Frontier Approach; (iii) Growth Accounting Approach (GAA); and, (iv) Data Envelopment Analysis (DEA), which broadly classified into two groups – frontier approach and non- frontier approach. The frontier approach identifies the role of technical efficiency in overall firm performance, whereas the non-frontier approach assumes that firms are technically efficient. This difference results in different interpretation for MFPG for the two approaches. SFA and DEA are frontier approaches, while GAA and PFA non-frontier approaches. This approaches further categorized according to the estimation techniques: parametric and non-parametric methods. The parametric approach employs econometric technique and in this approach, the deviation of actual output from the maximum output is decomposed into two parts, viz., the statistical noise and inefficiency. In parametric method, an explicit functional form is specified for the frontier and the parameters are estimated econometrically using sample data for inputs and output. This implies that the accuracy of the

[7] Refer Stephan.Tangen (2009), for an understanding of productivity as a concept.

derived estimates is sensitive to the functional form specified. On the other hand the non-parametric method is parameter free and does not assume any functional form. The major drawback of this method is that no direct statistical tests can be carried out to validate the estimates. PFA and SFA are parametric approach and it directly estimates the parameters of the inputs, while GAA and DEA are non-parametric approaches. In recent time some researchers have used a modified semi-parametric approach developed by Olley and Pakes (OP) or Levinsohn and Petrin (LP) for estimating MFP. Kathuria et.al (2011) found that all methodologies have some limitations. They pointed out that the MFP estimates based on three different techniques; growth accounting (non-parametric), production function accounting for endogeniety (semi-parametric-LP) and stochastic production frontier (parametric) are vastly different from each other[8].

3.3 KLEMS framework

In this section, we discuss in detail the MFP growth estimation methodologies used in which will be used for estimation. A major advantage of growth accounts is that it is embedded in a clear analytical framework rooted in production functions and the theory of economic growth. It provides a conceptual framework within which the interaction between variables can be analysed, which is of fundamental importance for policy evaluation (Timmer et.al.2007). There are three main indices within the growth accounting approach for estimating MFP growth. These are Kendrick arithmetic Index, Solow geometric Index and Tornqvist Index. In the KLEMS framework it is desirable to estimate MFP growth using Tornqvist Index method. This method considers Trans Log (TL) production functional form. Basic assumptions of this methodology are perfect competition, constant return to scale and income shares of the intermediate inputs sum to unity. This method also does not assume that technological progress is Hicks-neutral.

Productivity estimates are also sensitive to measurement of variables, besides being sensitive to the specific methodology used. For every variable there are different possible ways to adapt the available data and each of these is liable for criticism. There has been a long debate over the appropriate measurement procedure of output and inputs. Studies on productivity either used gross value added or value of gross output as an appropriate measure of level of production. The choice between value added and gross output is critical, as the measures of output determined the factor input choices. Value added restricted the factors of production to labour and capital, while gross output broadened the sets by incorporating intermediate inputs (materials, energy and services). Different estimation techniques and measurement procedure of inputs and output have produced a great deal of variation in MFP growth estimates. On the basis of this, we can conclude that the methodology of variable measurement, the specified structure of the production function and MFP growth estimation techniques play a crucial role in productivity growth estimation process.

The MFP estimates were computed under the KLEMS framework using a gross output as a measure of level of production incorporating labour, capital inputs as well as intermediate inputs. One advantage of using value of gross output rather than gross value added is that it incorporates the fact that intermediate inputs (material, energy, services) are as important as factor inputs (labour, capital) in a production process [Gollop and Jorgenson (1980)]. KLEMS framework not only gives important to all the intermediate inputs but also it allows to estimates the individual contribution in growth process. It is relevant to mention that the methodology for the construction of factors of production in this framework is also different. KLEMS framework measures labour input adjusting composition information (age, gender and education) instead of total number of person engaged.

[8] Kathuria et.al (2012) discussed and compared different productivity estimation techniques on the basis of seven different key factors between two study periods 1994-2000 and 2001-2005, and found that all methodologies have some limitations.

Capital services in place of capital stock which incorporate inter industry as well as over the period asset wise versatility. The detailed discussion on variables construction has been provided in section 3.5 of this study.

3. 4 MFPG in KLEMS framework

The present section deals with the methodology of measurement of multifactor productivity (MFP) growth for individual industries in the KLEMS framework. The methodology developed by Jorgenson and his associates and presented in Jorgenson et al (2005) is adopted. This methodology has been followed recently in Timmer et al (2010) for the European Union and the US.

Let the production function for industry j be denoted by

$$\boldsymbol{Y_j} = \boldsymbol{f_j}(\boldsymbol{K_j}, \boldsymbol{L_j}, \boldsymbol{E_j}, \boldsymbol{M_j}, \boldsymbol{S_j}, \mathbf{T})$$

Where Y is industry gross output, K is capital input, L is labour input, E is energy input, M is material input and S is services input, and T is an indicator of technology, all for industry j. All variables vary over time t, but the t subscript is not shown explicitly, for the sake of simplicity. To estimate MFP growth, we begin with the fundamental accounting identity for each industry where the value of output equals the value of inputs,

$$\boldsymbol{P_{Y,j}Y_j} = \boldsymbol{P_{K,j}K_j} + \boldsymbol{P_{L,j}L_j} + \boldsymbol{P_{E,j}E_j} + \boldsymbol{P_{M,j}M_j} + \boldsymbol{P_{S,j}S_j}$$

P_Y denotes the price of output, P_K, P_L, P_E, P_M and P_S are the prices of capital, labour, energy, material and services, respectively.Under specific assumptions of constant returns to scale and competitive markets, we can define MFP growth as

$$\Delta \boldsymbol{ln\, A_j^Y} = \Delta \boldsymbol{lnY_j} - \boldsymbol{v_{K,j}^Y} \Delta \boldsymbol{ln\, K_j} - \boldsymbol{v_{L,J}^Y \Delta lnL_j} - \boldsymbol{v_{E,j}^Y \Delta lnE_j} - \boldsymbol{v_{M,j}^Y \Delta lnM_j} - \boldsymbol{v_{S,j}^Y \Delta lnS_j}$$

and $\boldsymbol{v_{i,j}^Y} = 0.5\,(\,\boldsymbol{v_{i,j,t}^Y} + \boldsymbol{v_{i,j,t-1}^Y}\,)$ is the two period average share.

3.5 Data requirements

As mentioned in the earlier sections, two types of output measures can be used to calculate MFP: Gross Value Added (GVA) and Gross Output. In the KLEMS framework all the participating countries measures the MFP using both types of output. The MFP estimates were computed using a value added production function incorporating labor and capital inputs, while the gross output production function also incorporates all the intermediate inputs. The relevant variables are therefore, GVA, GVO, capital (K), labour (L), energy (E), material (M) and service inputs (S).

***GVA*:** Gross value added of a sector is defined as the value of output less the value of its intermediary inputs. If GVA is used as a measure of output, nominal value-added needs to be converted into real value-added. This conversion can be done with either single deflation (SD) or double deflation (DD) method. It is desirable to use double deflation method as it separately deflated the output with output price index and intermediate inputs with appropriate deflators, while single deflation method deflates nominal value added by output price index.

Gross Output: The gross output of an industry is defined as the value of industry production using primary factors like labour, capital and intermediate inputs purchased from other industries. Nominal value of gross output deflated by suitable output price index to acquire real value of gross output.

Labour input: In order to construct the labour input series, majority of the earlier studies have used the total number of persons engaged in the industry as the measure of labour input, while few studies have used total man hours worked or wages and salary bills for estimating labour input. Some studies also made adjustment in labour input incorporating labour quality in terms of training, experience and education level. It is appropriate to estimate the labour input incorporating the composition information (age, gender and education). The measurement of labour composition is essentially an attempt to distinguish one labour type from the other taking into account the embodied human capital in each person. The contribution to output by each person also comes from this embodied capital.

Capital input: In the literature of productivity, measurement of capital in is always considered as most difficult and complex among all variables. There has been a long debate over the measurement approaches for nature of capital and its role in production. There is no universally accepted method for its measurement and, as a result, several methods have been employed to estimate capital input. Most of the studies followed perpetual inventory method for measuring the capital stock as capital input. In KLEMS framework capital services considers as measure of capital input for production. For the measurement of capital services we need capital stock estimates for detailed assets and the shares of capital remuneration in total output value.

Intermediate inputs: As in EU KLEMS, this study identifies three main categories of intermediate inputs, namely –Energy input (E), Material input (M) and services input (S). Intermediate Inputs are broken down into energy, material and services, based on input output transaction tables. Energy input includes coal, liquefied petroleum gas, petrol, diesel, electricity and lubricants. Materials input included the raw materials, components, chemicals and packing materials during an accounting year. Services input includes all the expenses related to services purchased, such as water supply, transport charges, storage and communication expenses, insurance charges and banking charges, medical and hotel bills, R&D and education fees. In the case of intermediate inputs, it is important to construct an appropriate deflator for deflating the nominal values of intermediate inputs.

3.6 KLEMS based productivity in developed and emerging economies

The KLEMS method of measuring multifactor productivity and the data set that it generates for this purpose is meant to support empirical and theoretical research in the area of economic growth as well as facilitate the conduct of policies aimed at supporting a revival of productivity and competitiveness in the both advanced economies as well as emerging markets around the world. These policies require comprehensive measurement tools to monitor and evaluate progress. The construction of the database should also support the systematic production of high quality statistics on growth and productivity using the methodologies of national accounts and input-output analysis.

In developed countries, studies using KLEMS technique have assessed the industry origins of US-Japan productivity growth (Jorgenson and Nomura 2007), productivity gap between Europe and US (Bart Van ark et al 2008), Information technology and Japanese growth (Jorgenson and Motohasi, 2005), Productivity in Japan, US and EU- Is Japan falling behind (Fukao and Miyagawa2007) and examination of sectoral gaps between US, Japan and Germany (Conrad and Jorgenson 1996). The sources of growth at the industry level in several developed countries have also been analyzed (Hak Pyo et al 2007 for Korea; Chi Yan Liang 2007 for Taiwan; and Jorgenson and Nomura 2005 for Japan; Jorgenson at al 2007 for US). For emerging markets like India, China and several economies of Latin America and East Asia, the development of the KLEMS dataset is still under construction or

refinements- notable papers in public domain include productivity growth under varying policy regimes in India (Das et al 2015), measurement and interpretation of China's Multifactor Productivity1980-2012 (Harry Wu, 2015); structural changes and productivity growth in Thailand (Srihuang 2015)[9].

We conclude that for developed world, several research papers have been published on international comparison of Japan and US, US and EU. These papers examine several aspects of the overall growth comparison-productivity gap between two countries or competitiveness across industrial sectors of two different countries thereby exploring the quality data set that exists for such comparisons. For emerging countries examining industry origins of overall growth is perhaps the first quality research on an important topic like this that is made possible by the construction of KLEMS dataset[10].

4. Growth and Productivity in Arab World- Egypt, Morocco and Tunisia

It is well known that economic growth in Arab countries have been weak when compared to other developing regions of the world. Further there is tremendous diversity in growth performance within the Arab world ruling out any single factor to account for the poor performance. It is important to figure out what specific factors can account for the regions poor growth record. We find that exogenous shocks, policy failures and institutional deficiencies [Nunnenkamp, P (2004] are some of the factors which have been highlighted, though economic policy failure seems to be strongly advocated for the underlying poor growth. However we also find the evidence of resilience of Arab countries to global financial crisis during the 2006-07 periods. A study by Hassan Y. Aly and Mark C. Strazicich (2011) finds that out of three selected African countries while Egypt and Tunisia experienced some transitory effect in economic growth during the financial crisis, Morocco had no significant impact on its economic growth.

In the following sections, we review the literature on growth and productivity in selected countries- Egypt, Morocco and Tunisia with a view to review the existing estimates of MFP and examine the deficiencies in the estimates of MFP. Section 4.2 we examine the available data sources for Arab world- in particular, we utilize information from Total Economy database (TCB) and UNIDO industrial data base to compute estimates of productivity and comment on the nature of available data. In the following section, we highlight the challenges in building a KLEMS type data set for Arab world and also prepare a list of minimum variables to have effective comparison of Arab countries in an international perspective.

4.1 Growth and Productivity in Morocco, Egypt and Tunisia- A Review of Available Estimates from select studies.

In this segment we review three country studies with respect- Egypt [Morsy et al (2014)], Morocco [Chemingui and Isaksson (2007)] and Tunisia [Chaffi et al (2006)] to examine the nature of estimates and their implications for analyzing growth and productivity. The three countries chosen belong to Arab Countries in Transition and despite challenging internal socio-political environment have broadly maintained macroeconomic stability.

The paper by Chemingui and Isaksson (2007) attempts to estimate and analysis productivity change at the economy level for Morocco. The time period extends till 2000 beginning 1960. Two

[9] For an update on country studies from Asia refer to the presentations made at the 3rd ASIA KLEMS conference in Taipei in August 2015.

[10] See the presentations made in the 2nd World KLEMS conference at Harvard University, August 2012 on selected LA countries to have an idea of research issues from emerging economies of Latin America.

measurements methods to compute MFP have been used- Solow sources of growth and DEA techniques. The study finds a significant contribution of MFP as a source of economic growth[11]. Further, capital grew much faster than labor input during the entire period. The paper also reports data on labor productivity, capital deepening and overall MFP –computed via growth accounting and DEA techniques. In addition, overall MFP computed by DEA method is decomposed into technical change and technical efficiency. Taking the full period into consideration, we find annual change in technical efficiency to be positive and outweighing the negative contribution of technical progress and accounting for positive MFP in the period. The paper further highlights several factors that could account for poor trends in productivity performance- policy failure, weak infrastructure, high tariffs and inefficient financial set up as possible determinants.

We have the following comments- (1) The use of outdated method for accounting and analyzing an important phenomenon like economic growth – The building of a KLEMS type data set allows for more sophisticated analysis of MFP (as well as sources of growth) both at the aggregate and disaggregate sectoral level, thereby allowing us to understand the industry origins of both MFP and Growth. (2) The paper does not undertake a detailed explanation of the sources of data for constructing the MFP estimates using two alternative methods. In addition, the construction of capital input is listed as a reference without any details, through some discussion of income shares of labor is made in the paper. (3) The paper does not undertake any rigorous econometric analysis of explaining the determinants of poor trends in observed productivity, except for a descriptive account of possible factors.

The study on Tunisian manufacturing (Chaffi *et.al* 2006) attempts to explain if MFP in manufacturing is converging or catching up with OECD countries. The period of study is from 1983-2002 and covers six manufacturing sub groups- food processing, electrical and metal products, chemical activities, textile clothing and leather, building materials and ceramics and misc products. The industrial sector covers around 18 percent of Tunisian GDP. THE MFP calculation is based on a basic neoclassical growth model with constant returns. The dataset is from *Institute National De la Statistique* (INS) and derives from National Accounts[12]. The MFP growth rates show varied performances amongst the sub sectors and changes in inputs have been important. The authors also undertake a decomposition of MFP into between sectors and within sectors (Bernard and Jones 1996) and find that within sector performance accounts for a large percentage of total manufacturing gains. The paper also makes an attempt to examine an international MFP convergence between Tunisia and other OECD countries.

The paper uses outdated Solow growth accounting for explaining economic growth. The data set is confined to only Labor and capital and thereby does not take into account the role of intermediate inputs – notable energy in accounting for observed MFP in manufacturing. The construction of capital input does not take into account the services of capital and uses perpetual inventory method. (2) The paper is weak in the estimation and analysis of observed productivity and does not make any attempt to use the industry origins of aggregate MFP growth thereby disregarding the benefits of a disaggregated approach. (3) The analysis of the observed MFP is undertaken with a narrow focus on studying whether there is a catch up to OECD levels- only four sectors show a decrease in MFP gap when compared to the efficient sub sets of OECD countries.

The final paper is on Egypt (Morsey *et al* 2014) attempts to understand why growth in Egypt failed to raise overall productivity Labor productivity (as a proxy for overall productivity) is used in the

[11] For capital measurement issues, the paper refers to Isaksson (2006). The labor input is measured as total labor force.

[12] A value added production function with L and K stock is used. The capital stock is computed using perpetual inventory method. The sensitivity of MFP to different depreciation rates have also been taken into consideration.

paper .For labor productivity calculations, real GDP data is from Ministry of Planning and International Cooperation (MPIC). Further, the annual employment data is obtained from Egypt's annual labor force survey carried out by CAPMAS[13]. The study covers 9 sectors of Egypt's economy covering agriculture as well as manufacturing along with selected services sub groups. The following observations hold significance- Egypt's productivity gaps across sectors are high thereby suggesting that structural transformation in the form of redistribution of labor is desirable. The decomposition of labor productivity growth shows large disparities between within sectors and re allocation effects. THE study concludes that no large scale labor reallocation from low to high productivity sectors have taken place within Egypt's economy, but at the same time some low value added sectors have expanded at the expense of more productive sectors thereby lowering overall productivity in the economy.

The paper attempts to identify the reasons why Egypt's economic growth has not been able to address issue of unemployment and poverty in Egypt's. The paper refers to weak productivity growth, yet the paper concentrates only on labor productivity estimates in explaining productivity and this forms a major drawback of the paper. (2) An attempt is also made to link structural transformation pattern observed in Egypt's economy to labor re allocation aspects using the decomposition of labor productivity to between and within sector effects. (3) An econometric evaluation of structural change is attempted with a few chosen indicators of macroeconomic environment.

In concluding the review, it may be pointed out that, these three countries have adopted market-oriented reforms in the recent past beginning in the early 1990s. Second, when it comes to economic policy, Egypt, Morocco and Tunisia have witnessed a gradual liberalization of both the external sector as well as internal reforms resulting in a strong growing financial and economic system (Mühlberger and Semmelmann, 2010; Creane et al, 2006; Achy, 2005). Overall, we conclude the following criticisms with regard to estimating and evaluating productivity in Arab region.

I. Given the background, understanding the sources of growth in these economies by a carefully executed method of MFP estimation becomes essential for a rigorous analysis of growth. In this respect most of the studies either uses a Solow growth accounting or DEA analysis based on labor and capital, thereby ignoring a gross output based KLEMS type production process which allows analysis on aspects such as labor quality, innovation and role of intermediate inputs in the growth process.

II. The questions of addressing industry origins of aggregate productivity growth have been largely ignored in the studies mentioned on account of non availability of detailed disaggregated information on the broad sectors of the economy. In this way, we could capture not only which industries contribute most to the aggregate productivity growth but also which industries contribute most to the increased use of labor and capital as well as intermediate inputs. In accounting for productivity improvements. However this forms a major limitation of the reviewed studies in analyzing productivity changes.

III. Estimates of productivity computed using sophisticated methods like the KLEMS approach helps understand the sectoral dynamics within the overall aggregate economy numbers. However except for Tunisia, none of the other studies focus on explaining manufacturing productivity. The papers on Morocco and Egypt confine the studies to aggregate economy,

[13] Several alternative sources are used for international comparison- GGDC-10 sector database; GGDC-African sector database for Sub Saharan Africa as well as socio economic accounts from World input-Output databases.

thereby ignoring many questions which are important to understanding the economics of observed productivity growth in Arab countries especially related to manufacturing activity.

IV. None of the studies elaborate on the data base they use to compute the productivity estimates. It is well known that productivity estimates are sensitive to measurement of labor and capital even when using a value added approach in the conventional growth accounting methods. In the paper on Egypt, mention is made of the CAPMAS and other data sources used to quantify labor productivity estimates, where as in the other papers on Morocco and Tunisia, some aspects of data base especially in the context of input measurement needs to be more explicit. The databases which forms the core of the research papers needs to be elaborated more in order to understand the extent of richness and quality that exists in data sources.

V. All the three papers outline possible determinants of observed productivity performance (economy level- Egypt and Morocco and manufacturing level- Tunisia), however none of them attempt a rigorous examination using a quantitative framework- econometric analysis to ascertain links between possible determinants on one hand and productivity on the other hand. This forms a possible drawback in evaluating the trends in observed productivity.

In concluding , it can be seen from the limited review of literature, that two core problems exist- one is methodology of estimating productivity- moving away from standard Solow aggregate function approach to a KLEMS based disaggregate production approach and secondly, exploring the data sources available to undertake such sophisticated MFP estimates. Unless these are resolved, there will remain a question mark on the studies examining the empirical dynamics of Arab countries economic growth.

4.2 KLEMS based Multifactor Productivity Estimates in Arab countries- Exploring the data availability

Analysis of growth relies on a good measurement of multifactor productivity- be it at economy level or sectoral level as it is often seen that productivity plays an important role in explaining economic growth. Further, it also allows comparison of growth slow down or enhancement between regions using estimates of multifactor productivity (Bart Van Ark et al 2008). In case of Arab countries, we find evidence that growth has been weak [Nunnenkamp, P (2004] and poor integration of the Arab world to the global economy has hindered its growth prospects and will continue to do so unless the quality of domestic policies improve allow integration to global world (Gamo *et al* 1997). Fundamental to increasing growth here, is the role of multifactor productivity and unless we have good measurement of productivity estimates, the foundations of any analysis of observed growth will have its limitations.

Our focus here is on the application of growth accounting (GA) methodology to estimate multifactor productivity growth. The GA methodology has undergone several sophistications since the 1950s since the seminal work of Tinbergen (1942), Solow (1958), Denison (1962) and Jorgenson and Griliches (1967). Jorgenson *et al (*1987) allocated the sources of U.S. economic growth to the level of individual industries, by allowing multifactor productivity estimation at the level of individual industries, based on a KLEMS production function. This in turn allowed growth contributions of capital (K), labour (L), energy (E), material (M) and services (S) inputs as well as the composition of these inputs to identify quality changes. This has opened avenues for comparative productivity comparison across countries based on disaggregated sectors. Further, it has also allowed examination of productivity gaps between regions (US and Europe, US and Japan) to

determine the drivers of productivity change at the sectoral levels across countries or group of countries.

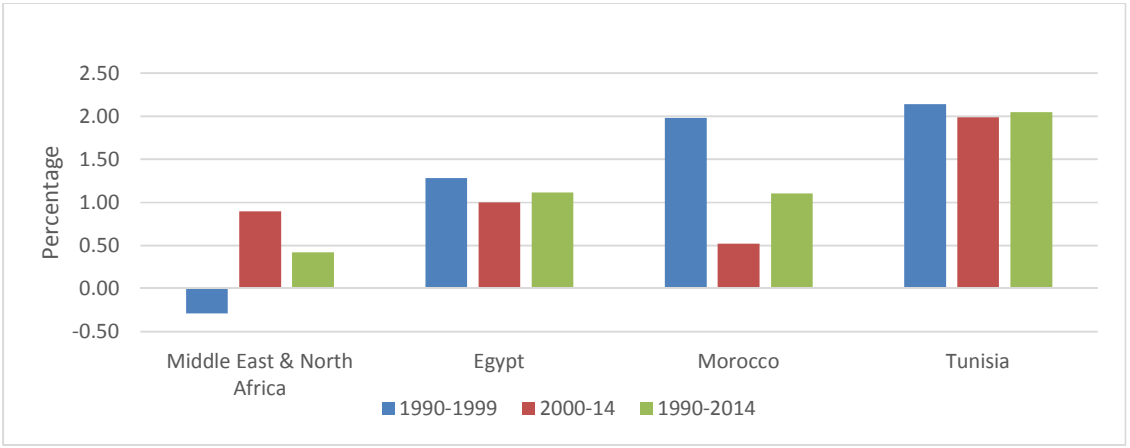
Our attempt in this section is to explore the databases available for Arab region to undertake estimating multifactor productivity estimates for Arab economies at the industry level. In addition, these estimates allow comparison across Arab countries as well as undertaking rigorous examination of drivers of productivity growth. To this effect, we list two data sources- The Total Economy Database provided for select Arab countries by The Conference Board **(hereafter TCB**) and the UNIDO database (**here after UNIDO**)[14]. The first set of estimates cover the aggregate economy and the second set of estimates cover industrial sectors at ISIC2,3 and 4 digit levels of disaggregation on major indicators of industrial performance.

TCB database: The TCB provides data on productivity at three levels- (1) labor productivity as captured by output, labor and labor productivity, (2) multifactor productivity based on growth accounting technique along with estimates of labor and capital contribution to observed GDP growth. The primary inputs are further classified into labor quality and labor quantity and capital services- ICT as well as non ICT and (3) regional information on GDP, Employment (and labor productivity) and multifactor productivity for 21 regions covering the period 1990-2015. Of the three different data sets, the longest time series is available for indicators on labor productivity, where as the other subsets confine to the period 1990-2015. The data base is for aggregate economy level estimates and covers several countries in Africa including Egypt, Morocco and Tunisia. We present below some estimates compiled from the TCB database below

For the aggregate economy as a whole we were able to present LP and MFP growth rates for the period 1990-2014 and sub periods- 1990-199 9and 2000-2014 for Middle East and North Africa region (MENA) and Arab countries- Egypt, Morocco and Tunisia. We find evidence of higher labor productivity growth in Tunisia amongst the three countries of Arab world. However in case of MFP both the region as a whole and Egypt and Morocco have poor growth performance, the exception being Tunisia. In Tunisia, also we experience a decline in growth rate in the second half of 2000s. The lack of industry level (as well disaggregated sectoral) information inhibits any serious examination of sources of low productivity growth at the aggregate level.

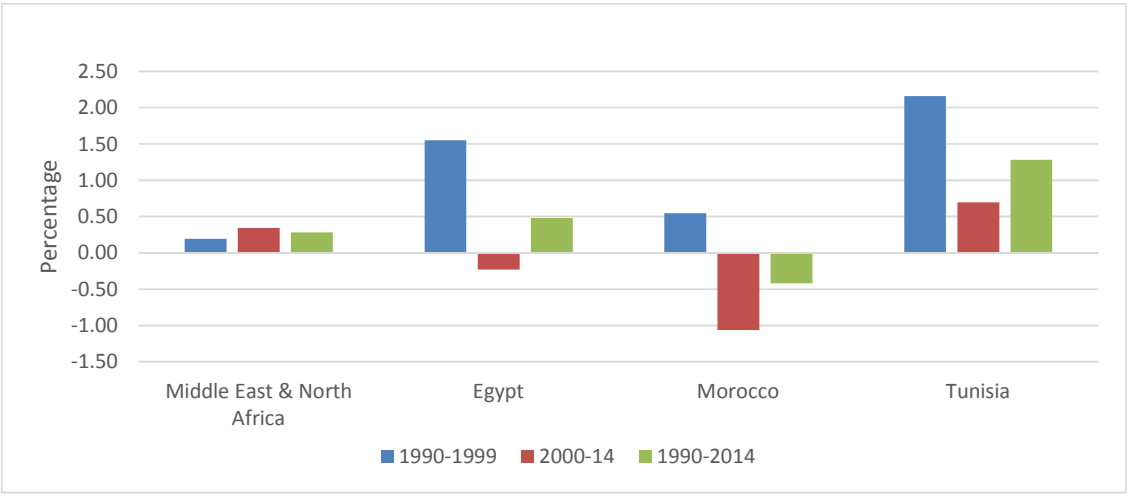
[14] UNIDO also publishes World Productivity indicators for around 40 countries of Sub Saharan Region. For Details refer Anders Isaksson (2009) The UNIDO World Productivity Database: An Overview, UNIDO, Number 18, Spring 2009

Figure 4.1: Decade wise labour productivity growth for Egypt, Morocco, Tunisia and Middle East and North Africa, 1990-2014



Source: Author's calculation based on TCB database

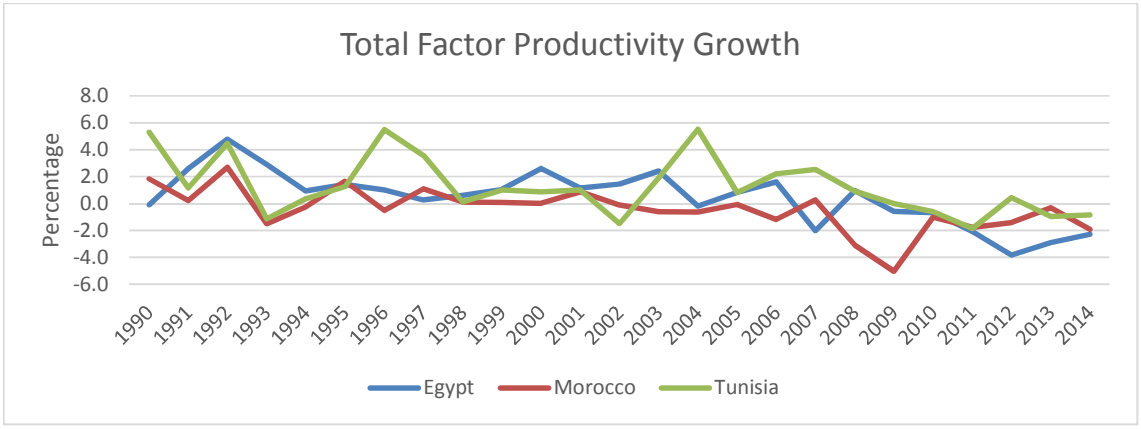
Figure 4.2: Decade wise multifactor productivity growth for Egypt, Morocco, Tunisia and Middle East and North Africa, 1990-2014

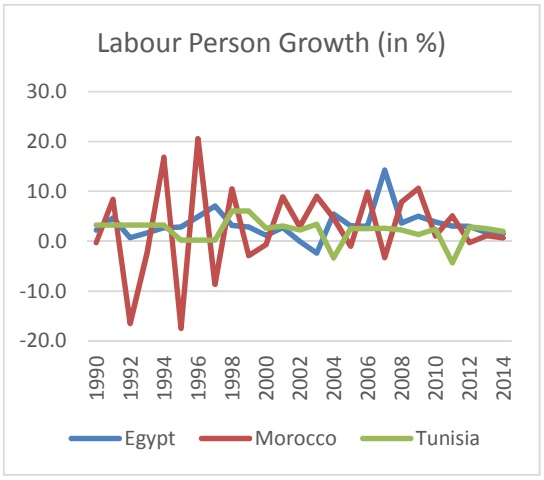


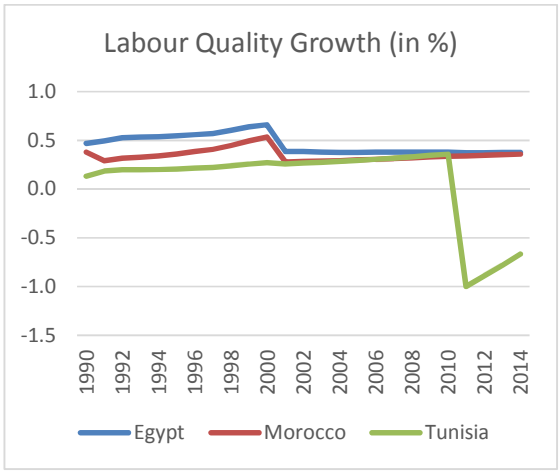
Source: Author's calculation based on TCB database

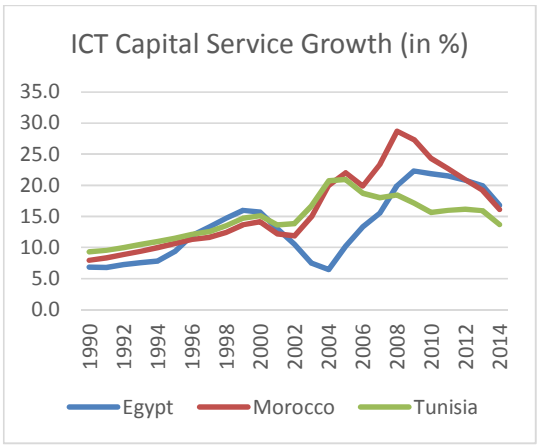
However, TCB database allows examining the economics of productivity change at the aggregate level by decomposing factor inputs into labor quality and employment and taking in considerations the role of ICT and non ICT capital inputs in accounting for aggregate value added growth at the economy level. Using the data available, we were able to construct graphs of yearly growth rate in the following variables- labor quality, employment proxied by labor persons and both ICT and non ICT capital services and multifactor productivity growth for selected economies of Arab world- Egypt, Morocco and Tunisia.

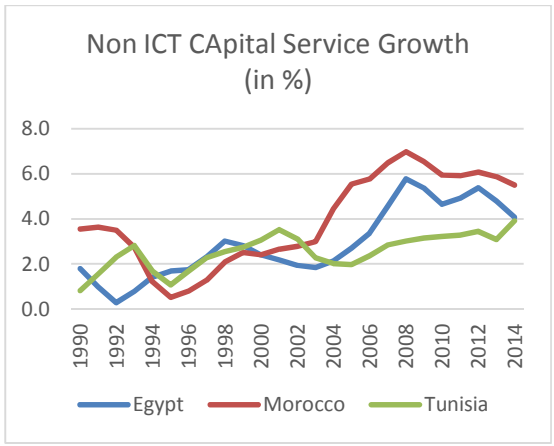
Figure 4.3: Multifactor productivity growth and input growth for Egypt, Morocco and Tunisia, 1990-2014











Source: Author's calculation based on TCB database

The following are observed- (1) for all the selected countries we find evidence of sharp year to year variations in growth rates across all variables. (2) In case of labor person growth while Egypt and Tunisia show same pattern of growth, there is tremendous jumps and decline in the Morocco employment growth rate. (4) All the 3 countries show decline in labor quality in the 2000s whereas for Tunisia the sharp decline occurs only around 2011, the trend for other two begins in 2000s and

stabilizes by end of 2010. (5) For capital services, it is evident that there has been a spurt in growth for all 3 countries, however non ICT capital services growth rates are better than ICT capital services for the countries. (6) As regards multifactor productivity, there is no discernible pattern available as there is evident of sharp yearly fluctuations across the three countries.

The TCB forms a rich and quality database encompassing the framework of productivity measurement; however growth accounting is based on value added approach and not on the KLEMS framework of productivity measurement (Jorgenson et al 1987). The estimates at productivity change at aggregate level do not allow any serious examination of sources of economic growth and especially assessing the industry origins of aggregate MFP growth.

UNIDO industrial database: This database is the only comparable database across countries of the world- developing, emerging as well as developing. It maintains database at ISIC (international standard industrial classification) – It is provides disaggregated data on industrial sectors for the following indicators- Number of establishments, Number of employees, Wages and salaries, Output, Value added, Gross fixed capital formation and Number of female employees. Further, these variables are available for more than 150 manufacturing sectors and sub sectors. It would be important to point out that data available does not allow for any sophisticated measurements of multifactor productivity. The only measure which perhaps can be constructed with the available information is the output/value added based measures of labor productivity. However this does not seem feasible unless one has price deflators for the disaggregated sectors/sub sectors of the industries. Further, it may not be available at detailed ISIC REV 3 or REV 4 for many countries present in the database thereby raising serious concerns for using UNIDO database for any serious research on aspects of productivity growth in developing and emerging world including African and Arab regions. We undertook a detailed examination of the data availability for few variables[15] – output, value added, number of employees and gross fixed capital formation (as a crude proxy for capital stock) and find that except for Morocco, the data availability for Egypt and Tunisia does not allow any examination of issues connected to growth and productivity.

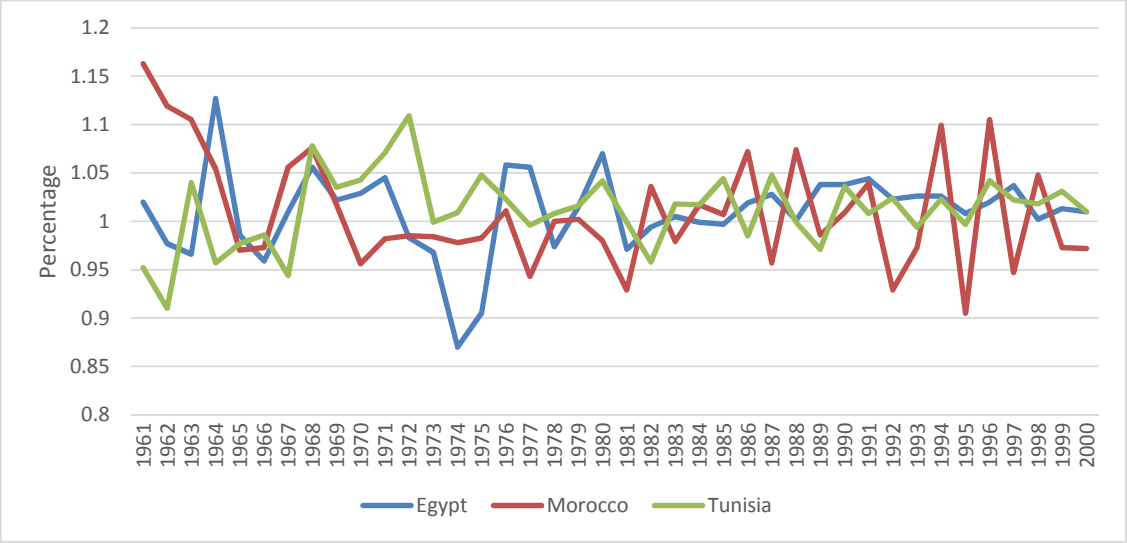
The UNIDO industrial statistics can be a rich data sources for comparative analysis of productivity performance at the industry level for various regions and countries, if some additional variables are constructed to allow meaningful estimates of multifactor productivity and partial productivities across countries on a selected industrial categories. We need sophisticated measurements of both primary inputs- labor and capital as well as intermediate inputs (energy, materials and services) as such inputs account for a significant role in MFP growth. The rich UNIDO database by industries can be a formidable data sources for our examination and understanding of issues connected related to aggregate growth and MFP at the economy level and finding linkages to industry details as possible explanations for sources of aggregate growth.

UNIDO productivity database: we now examine the third data source in our attempt to examine the data sources for undertaking MFP research in Arab countries. This new unique database for 112 countries contains variables which allow us to estimate levels and growth rates of aggregate productivity numbers. The three selected Arab countries are listed as developing countries in the database. Multiple measures of MFP growth are provided in the WPD- growth accounting, frontier analysis and regression analysis. We concentrate on the growth accounting method of measuring MFP in order to compare this with the TCB measures of productivity- Four measures are highlighted including Hicks and Harrod neutral technical change and dynamic growth accounting inclusive of

[15] See appendix table 1

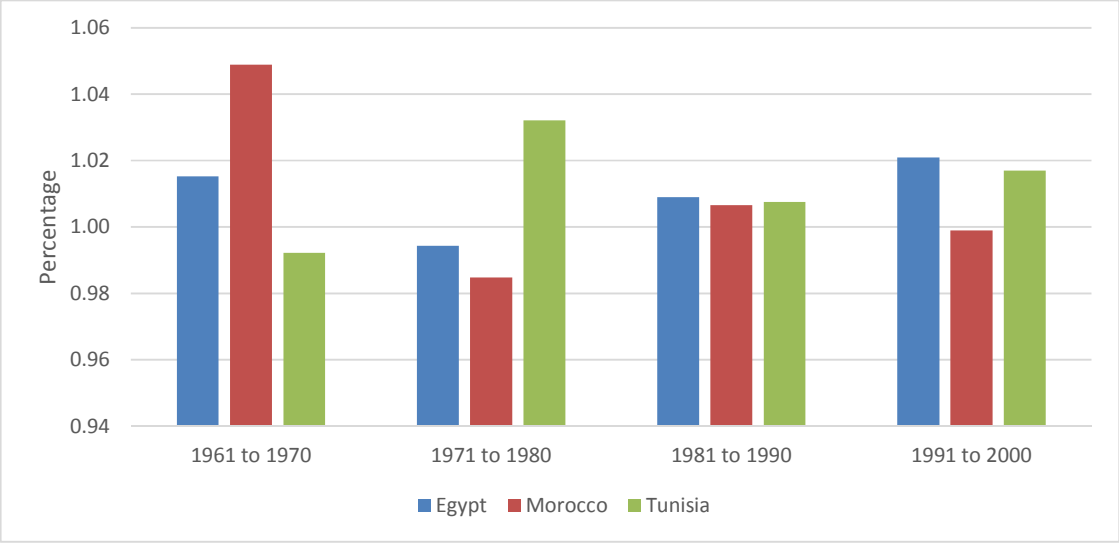
Hicks and Harrod technical changes[16]. We present some estimates of aggregate MFP using data for our chosen countries- Egypt, Morocco and Tunisia.

Figure 4.4: Multifactor productivity growth and input growth for Egypt, Morocco and Tunisia, 1960-2000



Source: Author's calculation based on UNIDO productivity database

Figure 4.5: Decade wise multifactor productivity growth and input growth for Egypt, Morocco and Tunisia, 1960-2000



Source: Author's calculation based on UNIDO productivity database

[16] For details refer to Anders Isaksson (2009) The UNIDO World Productivity Database: An Overview, UNIDO, Number 18, Spring 2009

In addition, we could also compile some crude measure of partial productivities- capital per workers and income per worker for selected countries. The data base for these variables is for large time points beginning 1960 and thus allows for a significant time series data base to observe how these measures have behaved over large periods of time for the countries. The details of the construction of labor input including schooling and health as well as capital input are covered in the overview of the database.

Our assessment of three different data sources in the context of measuring MFP for Arab countries at the disaggregate industry level indicates the dearth of quantitative as well as qualitative data base for undertaking any examination of the empirics of growth and productivity for developing world including Arab countries- the assessment of how input and MFP growth of each industry contributes to aggregate value added or even output. In particular absence of data pertaining to industry level for crucial variables like-employment and its division into age, gender and education; capital –machines and equipment and software/hardware does not allow us to know which industries contribute most to aggregate productivity growth or which industries contribute more to use of software/hardware (read ICT capital) and skills of labor. This information could be rich data sources for examing sources of growth especially in the context of Arab world- The seminal work by Angus Madison[17] on "The *Contours of African Development*" could be taken forward with the help of such data base which understands and allows for examination of aggregate productivity through its industry roots.

4.3 The challenges of building an ARAB KLEMS dataset

As indicated elsewhere in the paper, the KLEMS dataset comprises the new framework for understanding growth and productivity.[18] The genesis of KLEMS dataset started with the development of EU KLEMS database for understanding the productivity differential between US and Europe[19]. As of now such data bases are available for over 40 countries around the world comprising developing and emerging countries of Asia, Latin America and developed world-US, Japan, Canada, Korea and member countries of Europe. The EU KLEMS data base made it possible to analyze many issues which are pertinent to the modern world economy- role of high skilled labor as well as information technology in driving growth. In addition issues such as productivity growth versus capital accumulation in accounting for economic growth in developing world (Krugman hypothesis for East Asian countries) in emerging market economies like India and china.

The EU KLEMS database has largely been constructed on the basis of data from national statistical institutes (NSIs) and processed according to harmonized procedures. These procedures were developed to ensure international comparability of the basic data and to generate growth accounts in a consistent and uniform way. Cross-country harmonization of the basic country data has focused on a number of areas including a common industrial classification and the use of similar price concepts for inputs and outputs but also consistent definitions of various labour and capital types[20]. Importantly, this database is rooted in statistics from the National Accounts and follows the concepts and conventions of the System of National Accounts (SNA) framework, and its European equivalent (ESA), in many respects (*O' Mahony and Timmer, Economic Journal 2009).*

[17] See the seminal work by British Economist Angus Madison (2004) : *Growth and Modernity In World Economy- The Roots of Modernity*

[18] Refer to Jorgenson Dale (2009) for a brief history of productivity measurement

[19] See appendix table 2

[20] See appendix table 3

To develop a KLEMS data base[21], we need to construct the following variables in order to examine sources of growth and MFP. We need information on output and inputs for any estimation of productivity. KLEMS dataset provides measures of output both in terms of value added and gross output. This needs to be supplemented by constructing for inputs – labor, capital and intermediate inputs (energy, materials and services).The KLEMS database provides data at detailed industry level, but also for other breakups- total economy, market economy, market services, non market services, total goods production etc[22]. All aggregations of output and input volumes across industries use Tornqvist quantity index. The variables covered can be split into two main groups- (i) labor productivity variables and (2) multifactor productivity variables. The first category includes data needed to construct labor productivity (output per hour worked) – nominal and real series of output and employment. The variables belonging to the second category are also referred to as "*growth accounting variables*" and are not always directly available from national accounts data without additional assumptions- time series of capital services, labor services and multifactor productivity. These series are based on a theoretical model of production and require some additional assumptions.

There are several challenges to building an Arab KLEMS dataset- output measurement and input measurements. The output series is primarily taken from NA sources. It has been observed that measurement challenges are more severe for output from services than for goods production. Further, converting nominal values of outputs- both goods and services[23] lies in establishing a price series at disaggregate industry levels[24]. For construction of intermediate inputs, we need the supply-use tables (SUT) and the National Accounts information to arrive the estimates of material, energy and services inputs at the level of individual industries.[25]

Primary inputs- labor and capital offers multiple challenges in providing accurate measurement of these inputs. At the international level labour accounts in the EU KLEMS deal with information on the (a) quantity (persons and working hours), and (b) quality (distribution of quantities by age, gender and education level) of labour input by industry. In the backdrop of this requirement it would be important to assess the nature of data available on the quantity and quality of labour in the context of Arab countries. The capital flow accounts of the Arab KLEMS should be akin to that of EU

[21] See the chapter titled, The EU KLEMS database in Timmer et al (2010) Economic Growth in Europe, for an appraisal of data requirement for constructing a KLEMS dataset. One can also refer Mary O' Mahony and M Timmer (2009) Economic Journal Volume 119, for detailed aspects of KLEMS data creation.

[22] The EU KELMS database was constructed for a" Minimum List" of Industries. This was necessitated due to variations in level of details across countries, industries and variables due to data limitations in different countries. This minimum ensures comparison across countries. MFP information is provided for 14 EU countries and Hungary, Slovenia and Czech Republic (NEW EU countries) and Australia, Japan and US. The MFP dataset consists for 31 industrial sectors. For all other countries, labor productivity data base has been compiled for 62 industries. The minimum list information is reproduced in appendix 1

[23] See the discussion of services sector output measurement in O' Mahony and Timmer (2009).

[24] It may be noted that GDP for Arab countries is available by (a) total commodity producing sectors- agriculture, hunting, forestry and fishing, mining and quarrying, manufacturing, construction, and electricity, gas and water and(b) total productive services sector- trade, restaurants and hotels, transport, storage and communications, financing, banking and insurance and (c) total social services sectors- accommodation, government services and others. Refer Gabi El-Khoury (2012), National accounts of Arab countries: selected indicators, contemporary Arab Affairs.

[25] It may be a good idea to explore and understand the construction of intermediate inputs from different country perspectives. - EU KLEMS database, LA KLEMS database, India KLEMS as well as China KLEMS databases as different countries make an attempt to follow the EU KLEMS method while at the same time recognizing the limitations of SUT tables in their own countries.

KLEMS[26] and therefore these need to prepared using concepts and methods same as or similar to those adopted for EU KLEMS. Therefore, quantity indices of capital input have to be constructed and time series on the values of capital compensation (at current prices) have to be built for various industries comprising the individual Arab economies. A distinction is to be made between ICT (information and communication technology) capital input and non-ICT capital input and the corresponding capital compensation for these two categories of capital inputs, as done for EU KLEMS. Thus, six variables of interest are: (1) CAP: Capital Compensation (in local currency million); (2) CAPIT: ICT Capital Compensation (in local currency million); (3) CAPNIT: Non-ICT Capital Compensation (in local currency million); (4) CAP_QI: Capital services, volume index (2000=100) ;(5) CAPIT_QI: ICT Capital services, volume index (2000=100) (6) CAPNIT_QI: Non-ICT Capital services, volume index (2000=100)

Intermediate Inputs- A major objective of the KLEMS database is to provide productivity estimates at the industry level using the gross output production function with Capital, Labour and intermediate inputs as inputs and covering the entire economy of a country. For the construction of intermediate inputs- especially energy, material and services, it builds upon a time series of Supply and Use tables (SUTs). This time series of SUTs traces the supply and use of all commodities in the economy as well as the payments for primary factors, labour and capital. Jorgenson, Ho and Tiroh (2005) give a schematic presentation of the two tables (See page 100). The Supply or Make table indicates for each industry the composition of its output by product (or commodity). This table is used to derive industry gross output indices using the Tornqvist formula. The USE table indicates for each industry the product composition of its intermediate inputs and value added components. This data is used to calculate the intermediate input index and the input weights for growth accounting (See Timmer et al., 2006)

4.4 Arab KLEMS database in an international perspective- Minimum List of variables

The requirements of the Arab KLEMS database appears to be quite stringent compared to the available data in the public domain on one hand and on the other KLEMS based multifactor productivity where at the detailed industry, as the role of intermediate inputs in production is fully acknowledged is the most sophisticated estimation procedure. Further, 'Domar' aggregation of KLEMS productivity estimates across industries provides an accurate picture of the contributions of industries to aggregate MFP change. Finally, the benefit of developing a KLEMS framework is to be a part of the World KLEMS database net work and in turn be able to undertake international comparison of growth and productivity of the Arab world with other regions of the world as well as within the Arab economies.

Our first priority in building an Arab KLEMS dataset is to explore how many sub- sectors are feasible within the overall economy in order to capture industry details. KLEMS datasets have allowed disaggregation of the overall economy into sectors producing goods and services- and a further disaggregation of services into market services and non market services. The goods production industries have been further declassified as (1) consumer manufacturing (food products, textiles including leather and footwear, and manufacturing not elsewhere classified such as recycling;(2) intermediate manufacturing (wood, paper, coke, chemicals, rubber and plastic, non metallic products, basic metals); (3) investment goods (machinery, transport); (4) electrical machinery including post and communication and (5) other goods production- mining, electricity, construction

[26] Bart van Ark, Mary O'Mahony and Gerard Ypma (edited), The EU KLEMS Productivity Report: An Overview of Results from the EU KLEMS Growth and Productivity Accounts for the European Union, EU Member States and Major Other Countries in the World, Issue no. 1, March 2007.

and agriculture). We however find that different country KLEMS database have adopted this framework to create own industrial classifications.[27]

Second, we specify below the list of variables that we need to develop, in order to have meaningful estimates of multifactor productivity and an examination of the underlying estimates. Two types of estimates- labor productivity and multifactor productivity have been arrived at using the KLEMS dataset in various countries. For the first category, we need the following variables- (1) gross output in current and constant prices, (2) gross value added at current and constant prices, (3) compensation of employees, operating surplus and taxes minus subsidies in production; (4) number of persons engaged (thousands); (5) number of employees (thousands); (6) total hours worked by persons engaged (millions) and (7) total hours worked by employees (millions). In addition to construct measures of labor quality- we need information by gender (M or F), information by age (age classes can be decided), educational attainments (number of categories can be decided).

To construct measures of multifactor productivity- we need labor accounts as discussed in the earlier paragraph and also variables representing capital input- THE KLEMS capital accounts are in terms of capital services as opposed to capital stock (very widely used in productivity studies). The assets covered by EU KLEMS capital accounts are fixed assets as defined in ESA 95 with the exception of inventories, land and natural resources. To maintain consistency with EU KLEMS, the estimates of capital stock for industries should provide break-up into ICT and non-ICT capital and further break-up into seven types of assets: three types of assets belonging to ICT capital, (1) office and computing equipment, (2) communication equipment, and (3) Software, and four types of assets belonging to non-ICT capital, (1) transport equipment, (2) other machinery and equipment, (3) residential buildings and (4) non-residential structures. Considerable difficulties are likely to be faced in constructing capital stock series for various industries with this level of asset type details. Therefore, we need to explore the availability of information across different Arab countries and decide on some common asset type on which information may be easily available.

Further, KLEMS dataset also requires current and constant prices of intermediate inputs-energy, material and services as inputs. Whether it will be possible to construct series of intermediate inputs by industry groups will be dictated by the availability of Supply-Use Tables (SUTs). In EU KLEMS, these were generally available on a frequent basis from 1995 onwards for many countries but not in the period before. In many countries like India, SUT tables are only available for bench mark years and thus an interpolation is necessary to create a consistent time series of intermediate inputs.

In summary, we have identified in this section the variables that need to be constructed in order to have multifactor productivity estimates by industry for Arab economies. Towards this end, we suggest the following phase wise creation of the Arab KLEMS dataset

STEP 1: Identify all data sources within Arab world that are already in public domain in consultation with statistical agencies which prepare National Accounts.

STEP 2: Create a list of subsectors of overall economy within Arab economies and one that also allows international comparison at broad sectoral levels.

[27] The India KLEMS database consists for 26 sub sectors of the overall economy. However the number of sub sectors for which basic output, input and productivity data has been compiled varies across different countries. See EU KLEMS sub classifications- EU-25, EU-15, EU-10 and Euro zone. Similarly the different LA countries have different sub sectors for the overall economy.

STEP 3: Create estimates of Labor productivity by industry

STEP 4: Create multifactor productivity by industry using a value added specification of production function and incorporate sophisticated measurement of labor and capital inputs.

STEP 5: Create multifactor productivity by industry using a gross output specification of production function and incorporating sophisticated measurement of labor and capital inputs as well as intermediate inputs.

5. Conclusions

The paper attempted to explore aspects of productivity dynamics in the Arab world and assess the challenges for estimating multifactor productivity using the North African countries of Egypt, Morocco and Tunisia as a particular case. Estimation of multifactor productivity is at the heart of understanding growth paradigm and the effects of economic reforms on growth and development. Therefore we attempted to explore the possibility of empirically estimating MFP using a KLEMS framework for the North African countries of Egypt, Morocco and Tunisia. This in turn will set the context for estimation of multifactor productivity for the Arab world and allow us to identify the challenges and lay a roadmap for an Arab KLEMS database. Our review of select empirical papers points to use of old and outdated techniques for measuring multifactor productivity. This in turn does not allow a serious as well as a rigorous analytical examination of the empirics of growth- an issue we found to be of utmost significance in the context of Arab economies given their attempts at transition to a new socio- economic and politico economic order.

There are several challenges in attempting KLEMS type- multifactor productivity estimation. The core of this challenge lay in constructing a KLEMS data set- available now for more than 40 economies both developed and emerging markets like India and China. The requirements of constructing both primary and intermediate inputs for Arab KLEMS database appears to be quite stringent compared to the available data in the public domain. Majority of the countries where this dataset has been developed or work is in progress have drawn heavily from the National Accounts of all individual countries. In addition, these variables have been constructed in active association with the national statistical institutes.

We have outlined a phased manner of development of the Arab KLEMS dataset. It may be important to point out that the dataset may need to be structured around a few strong assumptions and also allow for building a time series when no consistent yearly data are available through the technique of interpolation, while there may be costs involved on those account which may question the quality and accuracy of the dataset, but the potential benefits in the long run through the availability of data which allows serious examination of growth dynamics in Arab world is enormous to be bogged down by some data shortcomings.

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Appendix Table 1: Data available for Egypt, Morocco and Tunisia in UNIDO database

Egypt

ISIC	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
151	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
152	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
153	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
154	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
155	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
160	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
171	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
172	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
173	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
181	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
182	V,O,K,L							V,L		V,K,L						
191	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
192	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
201	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,K,L						
202	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
210	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
221	V,O,K,L	V,O,K,L				O,K,L		V,O,L	V,O,K,L	V,K,L						
222	V,O,K,L	V,O,K,L				O,K,L		V,O,L	V,O,K,L	V,O,K,L						
223	V,O,K,L	V,O,K,L						V,L	V,K,L							
231	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
232	V,O,K,L	V,O,K,L				V,O,K,L		O,L	O,K,L	V,O,K,L						
233																
241	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
242	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						

ISIC	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
243	V,O,K,L	V,O,K,L				O,K,L		O,L	V,O,K,L	V,O,K,L						
251	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
252	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
261	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
269	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
271	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	K,L						
272	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
273	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
281	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
289	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
291	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
292	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
293	V,O,K,L	V,O,K,L				O,K,L		V,O,L	V,O,K,L	V,O,K,L						
300	V,O,K,L	V,O,K,L				V,K,L		L	V,O,K,L	V,O,K,L						
311	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
312	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
313	V,O,K,L	V,O,K,L				O,K,L		V,O,L	V,O,K,L	V,O,K,L						
314	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
315	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
319	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
321	V,O,K,L					V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
322	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
323	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
331	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
332	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
333	V,O,K,L	V,O,K,L				V,O,K,L										
341	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
342	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						

ISIC	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
343	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	O,K,L	V,O,K,L						
351	V,O,K,L	V,O,K,L				K,L		V,O,L	V,O,K,L	V,O,K,L						
352	V,O,K,L	V,O,K,L				O,K,L		V,O,L	V,O,K,L	V,O,K,L						
353	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L		V,O,K,L						
359		V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
361	V,O,K,L	V,O,K,L				V,O,K,L		V,O,L	V,O,K,L	V,O,K,L						
369	V,O,K,L	V,O,K,L				K,L		O								
371																
372		V,O,K,L				V,O,K,L		V,O,L		V,O,K,L						

Morocco

ISIC	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
151				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
152				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
153				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
154				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
155				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
160				V,O,K,L	O,K,L	O,K,L	V,O,K,L	V,O,K,L	O,K,L	O,K,L	V,O,K,L	V,O,K,L	V,O,L	O,K,L	O,K,L	V,O,K,L
171				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
172				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
173				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
181				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
182					V,O,L	L										
191				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
192				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
201				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
202				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
210				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L

ISIC	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
221				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
222				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
223																
231				V,O,K,L			V,O,K,L	V,O,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
232				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
233																
241				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
242				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
243				O,K,L	O,K,L	O,K,L	V,O,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,L
251				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
252				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
261				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
269				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
271				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
272				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
273				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
281				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
289				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
291				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
292				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
293				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
300				V,O,L	V,O,K,L	V,O,L	V,O,L	V,O,K,L	V,O,L	V,O,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
311				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
312				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
313				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
314				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
315				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
319				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L

ISIC	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
321				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
322				V,L	V,O,K,L	V,O,K,L	V,O,L	V,O,L	V	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
323				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	V,O,L	V,O,L	V,O,K,L		
331				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
332				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,L	V,O,K,L	V,O,L		V,O,K,L	O,K,L	V,O,K,L
333				V,O,L												
341				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
342				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
343				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
351				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L		O,K,L	V,O,K,L
352				V,O,K,L	L	V,O,K,L	V,O,K,L	V,O,L			V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
353									V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
359				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
361				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
369				V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,K,L
371																
372				V,O,L	V,O,L	V,O,L	V,O,L	V,O,L	V,O,L	V,O,L	V,O,L	V,O,K,L	V,O,L	V,O,K,L	O,K,L	V,O,L

Tunisia

ISIC	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
151							V,O,K	V,O,K	V,O,K	V,O,K	V,O	V	V	V	L	L
152																
153																
154																
155																
160							V,O,K	V,O,K	V,O,K	V,O,K	V,O	V	V	V		
171							V,O,K	V,O,K	V,O,K	V,O,K	V,O	V	V	V	L	L
172																

ISIC	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
173																
181											V,O	V	V	V		
182																
191											V,O				L	L
192																
201							V,O,K	V,O,K	V,O,K	V,O,K	V,O				L	L
202																
210											V,O				L	L
221											V,O					
222																
223																
231							V,O,K	V,O,K	V,O,K	V,O,K	V,O	V	V	V		
232																
233																
241							V,O,K	V,O,K	V,O,K	V,O,K	V,O	V	V	V	L	L
242																
243																
251											V,O				L	L
252																
261							V,O,K	V,O,K	V,O,K	V,O,K	V,O	V	V	V	L	L
269																
271							V,O,K	V,O,K	V,O,K	V,O,K	V,O					
272																
273																
281											V,O				L	L
289																
291											V,O				L	L
292																

ISIC	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
293																
300																
311											V,O	V	V	V		
312																
313																
314																
315																
319																
321											V,O					
322																
323																
331											V,O					
332																
333																
341											V,O				L	L
342																
343																
351											V,O					
352																
353																
359																
361											V,O				L	L
369																
371												V	V	V		
372																

Note: V: Value added, O: Gross output, K: Gross fixed capital formation, L: labour persons

Appendix Table 2: List of variables in a KLEMS dataset: EU KLEMS perspective

Values

Gross output at current basic prices (in millions of local currency)
Intermediate inputs at current purchasers' prices (in millions of local currency)
Intermediate energy inputs at current purchasers' prices (in millions of local currency)
Intermediate material inputs at current purchasers' prices (in millions of local currency)
Intermediate service inputs at current purchasers' prices (in millions of local currency)
Gross value added at current basic prices (in millions of local currency)
Compensation of employees (in millions of local currency)
Gross operating surplus (in millions of local currency)
Taxes minus subsidies on production (in millions of local currency)
Number of persons engaged (thousands)
Number of employees (thousands)
Total hours worked by persons engaged (millions)
Total hours worked by employees (millions)

Prices

Gross output, price indices, 1995 = 100
Intermediate inputs, price indices, 1995 = 100
Gross value added, price indices, 1995 = 100

Volumes

Gross output, volume indices, 1995 = 100
Intermediate inputs, volume indices, 1995 = 100
Intermediate energy inputs, volume indices, 1995 = 100
Intermediate material inputs, volume indices, 1995 = 100
Intermediate service inputs, volume indices, 1995 = 100
Gross value added, volume indices, 1995 = 100
Gross value added per hour worked, volume indices, 1995=100

Growth accounting variables

Labour compensation (in millions of local currency)
Capital compensation (in millions of local currency)
Labour services, volume indices, 1995 = 100
Capital services, volume indices, 1995 = 100
Growth rate of value added volume (% per year)

Contribution of labour services to value added growth (percentage points)
Contribution of hours worked to value added growth (percentage points)
Contribution of labour composition change to value added growth (percentage points)
Contribution of ICT capital services to output growth (percentage points)
Contribution of non-ICT capital services to output growth (percentage points)
Contribution of MFP to value added growth (percentage points)
MFP (value added based) growth, 1995=100
Growth rate of gross output volume (% per year)
Contribution of intermediate inputs to output growth (percentage points)
Contribution of intermediate energy inputs to output growth (percentage points)
Contribution of intermediate material inputs to output growth (percentage points)
Contribution of intermediate services inputs to output growth (percentage points)
Contribution of labour services to output growth (percentage points)
Contribution of capital services to output growth (percentage points)
Contribution of MFP to output growth (percentage points)
MFP (gross output based) growth, 1995=100

Additional variables
Capital compensation (share in total capital compensation)
Non-ICT capital compensation (share in total capital compensation)
Capital services, volume indices, 1995 = 100
Non-ICT capital services, volume indices, 1995 = 100
ICT capital services per hour worked, 1995
Non-ICT capital services per hour worked, 1995
High-skilled labour compensation (share in total labour compensation)
Medium-skilled labour compensation (share in total labour compensation)
Low-skilled labour compensation (share in total labour compensation)
Labour services per hour worked, 1995
Hours worked by high-skilled persons engaged (share in total hours)
Hours worked by medium-skilled persons engaged (share in total hours)
Hours worked by low-skilled persons engaged (share in total hours)
Hours worked by male persons engaged (share in total hours)
Hours worked by female persons engaged (share in total hours)
Hours worked by persons engaged aged 15-29 (share in total hours)
Hours worked by persons engaged aged 30-49 (share in total hours)
Hours worked by persons engaged aged 50 and over (share in total hours)

Source: EU KLEMS GROWTH AND PRODUCTIVITY ACCOUNTS Version 1.0: PART I Methodology, Groningen Growth and Development Centre, 2007

Appendix Table 3: Total Economy and Broad Sectors- A EU KLEMS perspective

TOTAL INDUSTRIES

MARKET ECONOMY

ELECTRICAL MACHINERY, POST AND COMMUNICATION SERVICES ELECOM
Electrical and optical equipment
Post and telecommunications

GOODS PRODUCING, EXCLUDING ELECTRICAL MACHINERY GOODS
TOTAL MANUFACTURING, EXCLUDING ELECTRICAL
Consumer manufacturing s
Food products, beverages and tobacco
Textiles, textile products, leather and footwear
Manufacturing nec; recycling
Intermediate manufacturing Minter
Wood and products of wood and cork
Pulp, paper, paper products, printing and publishing
Coke, refined petroleum products and nuclear fuel
Chemicals and chemical products
Rubber and plastics products
Other non-metallic mineral products
Basic metals and fabricated metal products
Investment goods, excluding high tech
Machinery, nec
Transport equipment

OTHER PRODUCTION
Mining and quarrying
Electricity, gas and water supply
Construction
Agriculture, hunting, forestry and fishing

MARKET SERVICES, EXCLUDING POST AND TELECOMMUNICATIONS DISTRIBUTION

Trade
Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel
Wholesale trade and commission trade, except of motor vehicles and motorcycles
Retail trade, except of motor vehicles and motorcycles; repair of household goods
Transport and storage

FINANCE AND BUSINESS, EXCEPT REAL ESTATE
Financial intermediation
Renting of m&eq and other business activities

PERSONAL SERVICES
Hotels and restaurants
Other community, social and personal services O
Private households with employed persons P

NON-MARKET SERVICES
Public admin, education and health
Public admin and defence; compulsory social security
Education
Health and social work
Real estate

Source: EU KLEMS GROWTH AND PRODUCTIVITY ACCOUNTS Version 1.0: PART I Methodology, Groningen Growth and Development Centre, 2007