SECTORAL ANALYSIS OF PRODUCTIVITY IN DEVELOPING AND DEVELOPED COUNTRIES OF ASIA-PACIFIC

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Abstract

The study empirically investigates the trends and determinants of labour productivity of the two broad sectors -industry, and services, and their components namely manufacturing and market services sectors in the case of major developing and developed economies of Asia-Pacific over the period 1980-2014 and make a comparison thereof. The study considers Bangladesh, China, India, Indonesia, Malaysia, Pakistan, Philippines and Thailand in developing set while Hong kong, Japan, South Korea, Singapore, Taiwan, Australia and New zealand in the developed set for the purpose.

Using econometric techniques of panel unit root tests, panel cointegration and group-mean FMOLS the study finds that while capital deepening, government size, institutional quality, productivity of the other sector, and financial openness affect productivity of all the sectors significantly, the impact of human capital and trade openness varies across sectors in the case of developing economies. Furthermore, the impact of technological progress becomes significant in the post liberalization reforms period in the developing economies. The study further finds that capital deepening, human capital, government size, institutional quality, productivity of the other sector, government size and trade openness are significant determinants of productivity of all sectors of developed economies under consideration. However, the impact of technological progress is stronger for manufacturing sector than services and its components.

Furthermore, while both equity and debt liabilities (as measures of financial openness) influence sectoral productivity of industry and manufacturing sectors positively and significantly in case of developed economies, only equity liabilities have a significant influence on the productivity of developing economies. This may indicate existence of more developed financial markets in the case of developed economies. Thus, the study identifies important structural differences in determinants of productivity both across sectors and across developing and developed economies of Asia-Pacific.

JEL Codes: C23, O32, O47, O53.

Keywords: Labour Productivity; Panel Cointegration; Group-Mean FMOLS; Financial Openness; Trade Openness.

1. INTRODUCTION

The emerging and developing economies of Asia-Pacific experienced a phenomenal rise in their share of world GDP (in PPP terms) from a mere 8.9% in 1980 to 31.6% in 2016 (*WEO, IMF, 2017).* At the same time, they have also seen a change in the sectoral composition of total GDP with a considerable decline in the share of agriculture and rise in that of services sector implying a differential contribution of the various sectors to the increase in aggregate GDP. These changes have been more pronounced in the case of developing economies as compared to developed economies of Asia-Pacific. One way to increase growth is via productivity increase that could also sustain growth in the long-run. In fact, the developing economies of Asia-Pacific have also experienced a rise in labour productivity both at the aggregate level as well as in various sectors.

A number of developing and emerging economies, including emerging economies of Asia-Pacific introduced major economic reforms in the decades of 1980s and 1990s while developed economies had introduced reforms much earlier in the 1960s and 70s These reforms included freer exchange of both goods as well as capital between these economies and the rest of the world leading to more trade and financial liberalization. Given that emerging Asia-Pacific economies have undergone a structural change with services sector accounting for the major share in GDP, it becomes imperative to analyse the contribution of various factors, in particular, increased trade and financial openness to growth in the productivity of various sectors. Further, it is important to examine if the impact of these factors varies across sectors and across developing and developed economies. While there exists a vast empirical literature investigating the long-run determinants of labour productivity at the aggregate level, few studies have conducted a sector-wise analysis and most of these pertain to the developed economies[1].

Against this backdrop, the trends in labour productivity[2] of two sectors – industry and services and their components are examined for the major emerging and developing economies, viz., Bangladesh, China, India, Indonesia, Malaysia, Pakistan, Philippines and Thailand and the developed economies, viz., Australia, New Zealand, Hong Kong, Japan, Korea, Singapore and Taiwan of the Asia-Pacific region over the period 1980-2014. The components of the two sectors industry and services include overall manufacturing and the market services viz. distributive trade, transport and communication and financial intermediation services respectively. Dua and Garg (2019) examine determinants of labor productivity of developing and developed economies of Asia-Pacific at the aggregate economy level and find that there are significant differences across the two sets of economies highlighting

[1] See for instance, Gehringer (2015).

[2] We consider labour productivity instead of total factor productivity as our measure of productivity owing to the non-availability of consistent data on total factor productivity across countries in our sample especially developing economies) at a disaggregate level.

important structural differences across the two. The current paper investigates and makes a comparison of the determinants of productivity across these sectors for both developing as well as developed economies of the region.The study further makes a comparison of these determinants across the developing and developed economies of the Asia-Pacific region. Both sectoral as well as aggregate level variables are included as potential determinants of labour productivity.These include sectoral capital stock per worker, sectoral trade openness, sectoral inflation and human capital, domestic technological progress and macroeconomic variables. We use panel cointegration and Group-Mean FMOLS techniques to conduct the analysis.

The rest of the paper is structured as follows. Section 2 briefly discussses stylized facts about major emerging and developing economies and the developed economies of Asia-Pacific over the period 1980-2014. Section 3 elaborates the theoretical and emprical literature followed by a description of the econometric methodology and data definitions in section 4. Section 5 reports the results and makes a comparison of results across developing and developed economies. Section 6 gives the conclusions.

2. STYLISED FACTS

While emerging and developing Asia-Pacific economies have been undegoing structural shift away from agricultural sector towards services sector since 1980s, developed economies had undergone this structural change before 1980. In fact, agriculture accounted for not more than a tenth of the GDP of most of the developed economies in 1980 while for most of the emerging and developing economies, agriculture accounted for more than a fifth of GDP. (See Figures 1a and 1b).

While the share of agriculture has declined considerably in developed economies of Asia-Pacific (a little more than 1%), it still has a sizeable share in GDP of emerging and developing economies as of 2014 (more than 10%). However, industry and services sectors account for the maximum of the GDP in both the sets of economies as of 2014. Thus, we consider industry and services sectors of both developing and developed economies of Asia-Pacific in the study.

Furthermore, industry sector can be divided into manufacturing and non-manufacturing sectors wherein manufacturing sector accounts for the major proportion of GDP of industry (ranging from 50% to 83%) for most of the economies under consideration. On the other hand, services sector consists of market[3] services and non-market services with market services constituing the maximum proportion of aggregate services in terms of GDP (ranging from 63% to 86%).Thus, we also consider the major components of industry and services sectors namely manufacturing and the market services respectively. We further consider the three broad components of market services namely distribtutive

[3] OECD defines market services to be all those services that are produced for sale on the market at a price intended to cover production costs and to provide a profit for the producer. Thus, by definition non-market services are those that are produced for non-monetary benefits and hence estimating their output may not be accurate that in turn may affect the productivity estimates for these services adversely.

trade, tarnsport and communication and financial intermediation, real estate and renting services (*see Figure 2*). We discuss the trends in labour productivity of these sectors for both the developing and developed economies of Asia-Pacific over the period 1980-2014 in the subsequent section.

2.1. Trends in Labour Productivity of Industry and Services sectors and their components: Developing Asia-Pacific Economies

The trends in labour productivity for the industry sector show a sharp increase in the level of labour productivity in the case of Malaysia, China, Thailand and India over the period 1980-2014 (*see Figure 3a*). On the other hand, Bangladesh, Pakistan, Philippines and Indonesia show moderate rise in their levels of productivity over the same period. It is further noteworthy that most of the economies show a sharp rise in the level of labour productivity in the case of manufacturing sector over the period 1980-2014 (*see Figure 3b*). Indeed, China started at a very low level of productivity in the beginning of the period and showed remarkable rise in its productivity that enabled it to catch up with South-East Asian economies of Thailand and Indonesia.

As for the aggregate services sector, all the economies show a sharp rise in the levels of labour productivity especially in the 1990s and later except for Philippines[4] where the increase is modest (*see Figure 3c*). This may be attributed to the liberalization reforms introduced in these economies that deregulated services sectors and introduced more competition. In fact, many of these economies also experienced a sharp rise in the number of patent applications filed in the post 1995 period[5]. Thus, it can be concluded that as compared to the industry and manufacturing sectors, services sector has seen more consistent growth in its level of productivity across all the emerging and developing Asia-Pacific economies over the period 1980-2014.

The trends in labour productivity of disaggregate services sector indicate that while level of productivity has been very high in the case of financial intermediation services as compared to distributive trade and tarnsport and communications serbices for all the economies, the sector doesn't show much growth in its productivity over the period 1980-2014.The trends further indicate that most of the economies show a sharp rise in the level of productivity in the transport and communications sector while some show considerable rise in distributive tarde services as well. More notable, economies of India and China show signs of catch up in these two market services with the South-East Asian countries.

[4] Philippines experienced a dramatic fall in its levels of labour productivity across sectors in the mid-80s owing to a foreign exchange crisis that led to recession in 1984-85 and then a political crisis. While the economy started recovering in the latter half of 1980s with the introduction of major economic reforms, the recovery was not sustained due to economic and political instabilities until the beginning of the 20th century (*Llanto, 2012*).

[5] For instance, both India and China introduced amendments to their patent laws in the mid-1990s with which there was seen a sharp rise in the number of patent applications filed within these economies. Please refer to Table 1 for a summary of trends in patent applications filed in the developing economies of Asia-Pacific over the period 1980-2014 in the Appendix.

Thus, the examination of trends across broad sectors of developing Asia-Pacific economies show that while services sector shows more growth in its labour productivity across all the economies over the period 1980-2014, there are variations across components of services themselves.

2.2. Trends in Labour Productivity of Industry and Services sectors and their components: Developed Asia-Pacific

The trends in labor productivity of industry of developed Asia-Pacific economies as shown in Figure 4a suggest that while Australia and the East Asian tigers viz., Hong Kong[6], Singapore, South Korea and Taiwan experience a considerable rise in the labor productivity levels of the industry sector over the period 1980-2014, Japan and New Zealand show only a modest increase. As for manufacturing sector, all the developed Asia-Pacific economies show sharp ris in their labour productivity except for New Zealand that shows moderate rise over the period 1980-2014 (*see Figure 4b*).

On the other hand, some economies show sharp rise while others display a moderate rise in the levels of productivity of their aggregate services over the period 1980-2014 (*see Figure 4c*). Further, while all the developed Asia-Pacific economies show considerable rise in the labour producivity levels of transportation and communications sector (Figure 4e), only some of them show sharp rise in the productivity of distributive trade and financial intermediation services over the period under study (see Figures 4d and 4f). It is noteworthy that while developed Asia-Pacific economies also have very high levels of labour productivity of fianncial and business services, the trends are not as volatile as for developing economies.

Thus, a comparison of trends in the labour productivity of the sectors across developing and developed countries suggests that while the absolute levels of productivity are higher in developed economies as compared to those of developing ones, the labour productivity of services and its components[7] has shown rise across all the developing Asia-Pacific economies as compared to some of the developed economies over the period 1980-2014.

2.3. Trends in trade intensities of goods and services sectors of Asia-Pacific Countries

We now briefly discuss trends in trade in merchandise and services sectors as a percentage of total trade in both developing as well as developed economies of Asia-Pacific considered in the study over the period 1980-2014[8].These ratios indicate the relative trade intensities of the two sectors. The trends

[6] Note that the data for Hong Kong is available only from 1995 onwards.

[7] Although for the transportation and communications sector, both sets of economies show consistent rise in labour productivity. This may be attributed to the IT sector boom that was experienced across the globe by both developed as well as developing Asia-Pacific economies in the mid-1990s.

[8] The data for the variables are drawn from UNCTAD statistics which provides data on trade indicators either for the period 1980-2013 or for 2005-2016 because of the change in definitions in BOPs. We consider data from 1980-2005 from the previous database and use growth rates for the data for 2005-2017 to extrapolate data from 2005 onwards to get a continuous series. However, due to discrepancy in the data for Philippines across the two Balance of Payments Manuals, we consider data till 2013 only for the Philippines.

for the developing Asia-Pacific economies as reported in Figure 5a suggest that the percentage of merchandise in total trade has been quite high as compared to the services sector since 1980 for all the economies and it has been further increasing. However, the share of services has started increasing that indicates a rise in trade intensity of services vis-a-vis merchandise. In fact, India experiences a sharp rise in the share of services in trade from 21.1% in 1980 to 24.2% in 2014.

As far as developed economies are concerned, it is evident from Figure 5b that the share of merchandise is much higher as compared to that of services throughout the period under study. Moreover, both the shares are much higher in absolute terms for developed economies than for developing economies. This may be indicative of the fact that developed economies opened up themselves much before 1980 while developing economies introduced economic reforms in 1980s or later. However, for developed economies, the share of merchandise has increased over 1980-2014 in some of the economies while in others, the share of services has risen over the same period. On the other hand, in the case of all (except Bangladesh) the developing economies, share of services sector has increased over the period 1980-2014.

Thus, on the basis of above discussion, we can conclude that there are significant structural differences across developing and developed economies of Asia-Pacific in terms of the shares of the broad economic sectors in GDP. Furthermore, while industry sector has been much more trade intensive and has a higher level of productivity than services sector in both developing and developed economies, there has been an increase in the contribution of services sector in both GDP as well as trade in the Asia-Pacific economies over the period 1980-2014.

3. THE MODEL

Labour productivity is defined as output per unit of labour input and may be determined by a number of variables including physical inputs, technology, institutions and additional variables like inflation, policy variables and openness of an economy. These variables have been suggested both by economic theory and empirical studies. We discuss the economic theory and empirics behind the determinants of labour productivity of a sector subsequently.

3.1. Theoretical Model

Assuming that each sector of an economy has a neoclassical production function with two inputs, capital (K^j) and labour ($L^j{}_{it}$), a combination of employment ($E^j{}_{it}$) and skills of the workforce or human capital ($HK^j{}_{it}$) , labour productivity(Y/E^j) in sector j can be derived as the function of capital deepening ($k^j = K^j/E^j$), workforce skills or human capital (HK^j) and total factor productivity (T^j) in sector j as follows:

$$(Y/E)^j{}_{it} = T^j{}_{it} HK_{it}^{a_j} k_{it}^{1-a_j} e^{\epsilon^j{}_{it}} \quad (1)$$

where ${Y^j}_{it}$ is Value Added in sector j of country i in year t, ${A^j}_{it}$ denotes technological progress, a_j and $1 - a_j$ are the elasticities of output with respect to labour and capital respectively in sector j and ${\epsilon^j}_{it}$ is the stochastic error term. Converting eq. (1) above in natural log terms, we obtain:

$$Ln\left({Prod^j}_{it}\right) = a_j Ln({HK^j}_{it}) + \left(1 - a_j\right) Ln\left({k^j}_{it}\right) + {A^j}_{it} + {\epsilon^j}_{it} \quad (2)$$

Further, total factor productivity may itself be influenced by the creation of knowledge base in an economy. (*Romer, 1990; Grossman and Helpman, 1994*). In particular, innovative activities undertaken by firms in the form of more R&D expenditure[9] may lead to an increase in the knowledge base in a sector and may thus cause more technological progress which in turn may lead to increase in labour productivity of that sector. A number of studies have shown a positive and significant impact of rise in R&D expenditure on total factor productivity or labour productivity[10].

Thus, on the basis of discussion above, we can write labour productivity of a sector as a function of capital deepening, human capital and technological progress in that sector as follows:

$${Prod^j}_{it} = f(k^j_{it}, HK^j_{it}, Tech^j_{it}) \quad (3)$$

Certain studies examine the impact of variables mentioned in eq. (3) on the labour productivity of various sectors and find that the impact may vary across the sectors. For instance, Efthyvoulu (2012) find a stronger impact of an increase in capital deepening on production sectors as compared to services sectors which may be because production sectors like manufacturing, industry etc. are more capital intensive as compared to services sectors. Some studies examine the impact of human capital across sectors and find that the impact varies across sectors (See for instance, Ayuso et al., 2010).

Further, Sondermann (2014) finds a stronger impact of R&D expenditure on manufacturing sector than on the services sector of EA-12 economies over the period 1970-2009. This may be because manufacturing sectors are much more R&D intensive as compared to services sectors and hence manufacturing sectors may be expected to have higher impact of additional R&D activity on its productivity as compared to services sectors.

Apart from these basic physical inputs and domestic technological progress, labour productivity of a sector may be determined by other factors as explained below:

3.2. Additional Variables based on Empirical Literature

[9] Certain studies have also used patents stock instead of R&D expenditure as a measure of knowledge base or technological progress and have shown a positive and significant impact of it on productivity. See for instance, Ang and Madsen (2013), Kim et al.(2009), Mumtaz and Smith (2017) and Dua and Garg (2018).

[10] See for instance, Coe and Helpman (2008), Luintel (2014) and Barrel et al. (2010). Certain studies even consider R&D expenditure as a proxy for Total Factor Productivity (TFP). See for instance, Miyagawa et al. (2018).

While there exists a plethora of studies examining determinants of productivity at an aggregate level, the literature examining productivity at a disaggregate level is scant, especially for developing and emerging economies. Further, the studies that examine determinants of produtcivity at a sectoral level suggest differences in the impact of these determinants across sectors. These studies suggest additional determinants of productivity of a sector. We review these studies and the variables they suggest briefly in the subsequent section:

3.2.1. Sectoral Inflation (π^j)

Several studies have shown inflation to be an important determinant of productivity. An increase in inflation leads to uncertainties which in turn may lead to delays in investment decisions adversely affecting capital accumulation and productivity (*Jarrett and Selody, 1982)*. Thus, an increase in inflation is expected to have a negative impact on productivity.

While aggregate inflation is expected to affect productivity negatively, the empirics suggest that the sign and significance of the impact may depend upon the structure of an industry when examining the impact of sector-specific inflation. For instance, the industries that are characterized by higher concentration of larger firms may experience a significant and negative impact of inflation on productivity as compared to industries that don't have low concentration as compositional effects may dominate the within firm effects in the case of industries that are less concentrated (Bulman and Simon, 2003). Further, Narayan & Smith (2009) don't find a strong evidence of impact of inflation on labour productivity of manufacturing sector of G7 economies over the period 1960-2004.

3.2.2. Sectoral Trade openness ($Tradeopen^j$)

Trade openness of an economy is widely recognized as an important determinant of productivity of an economy. It is argued that imports of capital goods facilitate adoption of advanced technologies in the host economy, thereby increasing productivity. On the other hand, firms that are export oriented may engage in better competition that in turn makes them more productive. While the impact of trade openness on productivity is expected to be positive in general, the impact may not be uniform across sectors. Thus, we also consider trade openness of a sector as additional determinant of its labour productivity.

While a plethora of studies[11] have examined the impact of trade openness on productivity and have found mixed conclusions, studies examining impact of sectoral trade openness on productivity across sectors find that the impact of trade openness may vary across sectors. For instance, it is argued that goods sectors are more trade intensive than services that in turn may cause the impact of trade openness on goods sectors to be stronger as compared to that on services, therefore considering sectoral trade openness may bring out the differential impact of trade openness on each sector's

[11] See for instance, Barrell et al. (2010), Ang and Madsen (2013), Gehringer (2015) and Bakaert et al. (2010).

productivity better than aggregate trade openness. (*Park and Shin, 2010*). Abizadeh and Pandey (2009) on the other hand find that impact of sectoral trade openness is higher on the productivity of services sector as compared to that of agriculture and industry in the context of 20 OECD member countries over the period 1980-2010.

Timmer & Vries (2013) find a positive and significant impact of imported inputs of a sector on the productivity of goods sectors but not that of services sectors for 30 developing economies (including 11 Asian economies) over the period 1960-2010.

3.2.3. Quality of Institutions ($Inst.$)

Acemoglu (2009)[12] argue that economic institutions, such as the structure of property rights and the presence of markets may be important for productivity and economic growth as they influence the structure of economic incentives in society. In other words, a stronger system of property rights incentivizes individuals to undertake more investment, both physical as well as human capital which in turn increases productivity. Thus, as quality of institutions improves in an economy, it increases productivity. Hence, we consider quality of institutions as another potential determinant of productivity.

3.2.4. Positive Feedback Mechanism and Productivity of the other sector

There exist backward and forward linkages between various sectors of an economy that in turn enhances their productivity and hence overall growth of an economy. For instance, manufacturing sector may use output of services sector as an input into its production process and may in turn supply some of its output to the services sector as its input. Rodriguez-Clare (1997) discuss various models that were developed to incorporate possible feedback from one sector to another in the process of economic development.

More recently, Balakrishnan et al. (2017) develop a theoretical model drawing upon endogenous growth theory where two sectors namely manufacturing and services are interdependent for the demand and supply of their outputs. Given such interdependence, an exogenous positive shock to the supply of services sectors enhances the productivity of manufacturing sector that in turn leads to more production in manufacturing, in turn affecting the productivity and hence growth of services sector. Thus, we consider another variable, namely productivity of sector k into our model of labour productivity of sector j.

The literature on examining the inter-sectoral linkages suggest mixed conclusions on the impact of productivity and growth of one sector on that of another sector. For intance, Kazekami (2017) find a significant impact of feedback from manufacturing to services sectors of Japanese economy over the period 1995-2014. On the other hand, Balakrishnan et al. (2017) find significant evidence of existence

[12] See also Acemoglu et al. (2004).

of mutual feedback mechanism between manufacturing and services sectors of Indian economy over the period 1965-66 to 2009-10 although the feedback is found to be stronger from services to manufacturing than the other way around.

There are other studies which find a strong impact of services sector on the productivity or growth of manufacturing sector (See for instance, Banga and Goldar, 2007; Mukherjee, 2018; Arnold et al., 2011 and Hoekman and Shepherd, 2017). Thus, it can be concluded that most of the studies have examined the existence of feedback from services to manufacturing while a very few have investigated the existence of feedback in the reverse direction.

3.2.5. Policy Variables

The fiscal and monetary policy variables are considered as important determinants of productivity. It is argued that an increase in government size ($\boldsymbol{G}$), a fiscal indicator may be complementary to private business investment in certain sectors and thus may enhance investment and productivity in those sectors. On the other hand, if government expenditure is not done efficiently and therefore crowds out private investment, then it may even have an adverse impact on productivity. Thus, an increase in government size may have both a positive and negative impact on productivity of a sector depending upon which effect is dominant (*Loko and Diouf, 2009).*

Further monetary policy in an economy may also influence productivity in an economy and in various sectors. For instance, increase in money supply ($\boldsymbol{M}$) leads to fall in interest rate which in turn may lead to rise in investment and therefore more capital per unit of labour that in turn may enhance productivity of labour in an economy. On the other hand, a rise in interest rate may cause fall in investment leading to fall in productivity.

3.2.6. Financial Openness ($\boldsymbol{Finopen}$)

Financial openness may be defined as a situation when an economy's financial system is open to the rest of the world and thus the financial systems of various economies are integrated with each other. Thus, it involves an exchange of capital across nations. An increase in financial openness may increase productivity both directly as well as indirectly. More financial liberalization in terms of higher foreign direct investment directly brings in more advanced technology in the host economy which in turn improves its productivity. On the other hand, economies that are financially more open tend to have better domestic financial markets, instituions and macroeconomic policies which may enhance their productivity.*(Kose et al., 2009; Mishkin, 2006).*

As far as financial openness is concerned, very few studies consider the impact of financial openness across sectors and find that the impact is not uniform. For instance, Gehringer (2015) finds a stronger impact of financial openness on the labor and total factor productivity (TFP) of manufacturing than that of services sectors in the context of EU-8 economies over the period 1980-2009. Efthyvoulu

(2012) finds varied impact of financial stress across production and services sectors 12 OECD economies over the period 1981-2007. Tondll & Fornerro (2010) find that the impact of sectoral FDI and its spillovers varies across labor productivity of various economic sectors in the context of 14 Latin American economies over the period 1991-2006.

Further, empirical studies examining the impact of financial openness also examine the impact of composition of financial flows on productivity of an economy. For instance, while equity capital inflows are expected to have a positive impact on the productivity of both developing and developed economies, debt inflows may have a negative impact on the productivity of developing economies. This may be because debt inflows may be inefficiently allocated in developing economies that are charaterised by underdeveloped financial markets (*Kose et al., 2009*). Thus, we consider several possible measures of financial openness in our model.

Recently, Dua and Garg (2019) examine the determinants of aggregate productivity in the context of developing and developed economies of Asia-Pacific over the period 1980-2014.They incorporate most of the variables discussed above in section 3.1 and find that capital deepening, human capital, technological progress, openness, fiscal policy and institutional quality are significant determinants of productivity of both developing and developed economies of Asia-Pacific.

Thus the review of literature on sector-level studies reveals that either the studies have been done on developed economies or a mix of developing and developed economies. In fact, very few studies have been done on Asia-Pacific economies. Secondly, most of the studies are either based on manufacturing sector and or the broad services sector. Very few studies[13] examine the components of services sector. Given that the components of services sector are so diverse, examining the aggregate services sector may hide certain important distinctive characteristics of these sub-services. Hence, it becomes imperative to examine the determinants of productivity of sector and its components.

3.3. Empirical Model

The theoretical literature suggests various determinants of productivity at a sectoral level that include sector-specific variables and aggregate variables. A number of studies have been devoted to empirically test the significance of these variables on productivity. However, the conclusions of the studies are at best mixed. Moreover, very few studies have examined the impact of financial openenss and its composition on productivity across various sectors[14]. While Dua and Garg (2019) consider a comprehensive model of productivity incorporating most of the variables discussed above in section 3.1, their study is at aggregate level. We extend their model to incorporate inter linkages across sectors and examine the determinants of labour productivity at a sectoral level for the major developing and developed economies of Asia-Pacific. The model based on the above discussion of

[13] See for instance Timmer and Vries (2013) and Tondll and Fornerro (2010).
[14] Gehringer (2015) and Tondll and Fornerro (2010).

theory and empirics that the current study estimates for the broad sectors- industry and services and their components is as follows:

$$Prod^{j}{}_{it} = \alpha_{it} + \beta k^{j}{}_{it} + \lambda HK^{j}_{it} + \delta Tech^{j}_{it} + \sigma\pi^{j} + \omega G_{it} + \mu M_{it} + \rho \mathrm{Inst}_{it} + \varphi Finopen_{it} + \theta Tradeopen^{j}_{it} + \gamma Prod^{k}_{it} + \epsilon_{2it}. \quad (4)$$

As explained above and mentioned in Table 2, we expect $\beta, \gamma, \delta, \theta, \varphi, \rho, \mu > 0$ and $\sigma, \omega > 0$ $or < 0$.

The study estimates a long-run macro econometric model of labour productivity using panel cointegration techniques. Clearly, if all the variables on the left hand side and the right hand side are integrated of order one i.e. I (1), we can expect existence of a long-run equilibrium relationship amongst the variables. All variables are measured in natural logs and therefore coefficients of variables on the R.H.S. may be interpreted as elasticities of productivity with respect to variables on the R.H.S. We briefly discuss recent empirical studies that have examined productivity of various sectors of economies in the next sub section.

4. DATA AND ECONOMETRIC METHODOLOGY

4.1 Data

The paper uses data for the eight largest[15] emerging and developing economies of the Asia-Pacific region namely Bangladesh, China, India, Indonesia, Malaysia, Pakistan, Philippines and Thailand and the developed economies of the region namely Australia, New Zealand, Hong Kong, Japan, Korea, Singapore and Taiwan over the period 1980-2014. The choice of the time period is determined by the availability of data. Labour productivity defined as GDP per unit of total employment is taken as the dependent variable in the study.

The data for GDP[16] and employment is drawn from Asian Productivity Organization (APO)[17] 2017 database. APO database provides data on Gross Value Added[18] and employment for ten economic sectors namely agriculture, manufacturing, mining and quarrying, electricity, gas and water supply,

[15] The emerging and developing economies considered under the study account for more than 95% of the GDP of the Emerging and Developing Asia (*WEO, IMF, 2018)* and hence are representative of the region.

[16] The data for GDP and capital stocks are in terms of PPP so as to make them internationally comparable. We are aware that one should ideally use sector-level PPPs while considering examining sector across countries but in view of the non-availability of data on sector-specific PPPs, we use aggregate GDP PPP (2011 ICP).

[17] It needs to be mentioned here that the data on services sector provided by APO database may not be comparable to that on manufacturing in terms of quality as censuses for services are not as frequent as those for manufacturing for various nations and because of difficulties in measurement of output of services as compared to that on manufacturing sector.

[18] While data on Gross value added is available at both the national prices as well as US dollars (both in exchange rate terms and PPP terms), we consider the data measured in terms of PPP since we are dealing with levels or productivity. Although ideally one should use sector-specific PPPs to transform GVA data to make it internationally comparable for various sectors, the lack of data on sector-specific PPPs prevented us to do that.

construction, distributive trade, financial intermediation, transport, storage and communications and personal, community and social services[19] for 32 Asian[20] economies. Thus, the APO database provides consistent data on all countries considered in the study at a disaggregate level and is thus preferred to other databases[21]. We construct the capital stock for the industry and services sectors and their components using data on aggregate capital stock from Penn World Tables (PWT9.0) and sectoral shares of GDP from APO database Due to non-availability of data on human capital and technological progress at the sectoral level, the study uses aggregate level data for the two variables.

The study considers stocks of patent applications as well as of R&D expenditure as measures of technological progress. Both these measures are constructed from their flow measures using perpetual inventory method.

We measure quality of institutions by the Economic Freedom Index[22] released from Fraser Institute. The Index is scaled from zero to ten, zero implying lowest amount of freedom in an economy. Thus, a higher value of the index signifies more freedom in an economy, reflecting better quality of institutions. Government size is proxied by general government final consumption expenditure. Trade openness is defined as the ratio of exports and imports in a sector as a ratio of its GDP. We consider de facto[23] measures of financial openness (*see Table 3*) by Lane and Milessi-Ferretti (2017) because they not only indicate the actual capital flows across nations but also show much more variation over time.

The definitions of variables used and sources of data are reported in Table 3. The next section briefly discusses the econometric methodology used to estimate the model set out in section 3.1.

4.2 Econometric Methodology

The paper uses techniques of panel cointegration and group-mean FMOLS in order to estimate the model developed in section 3. We first conduct the panel unit root tests and then the panel

[19] It needs to be mentioned here that the data on services may not be comparable to that on manufacturing in terms of quality as censuses for services are not as frequent as those for manufacturing for various nations and because of difficulties in measurement of output of services as compared to that on manufacturing sector.

[20] While the data for all the countries in our sample is drawn from APO database, it doesn't provide data for New Zealand, so we take data on GDP and employment of various sectors of New Zealand from OECD Stan database.

[21] Although one can use KLEMS type data for various sectors covering both manufacturing and services obtainable from WORLDKLEMS or other sources, this data is confined only to a few economies (India, China, Australia, New Zealand, Japan, S.Korea and Taiwan) considered under the current study. Hence, we prefer to use data provided by Asian Productivity Organization (APO).

[22] Economic Freedom Index is a combined index measuring the degree of freedom in five major areas namely size of the government, legal system and security of property rights, sound money, freedom to trade internationally and regulation. See https://www.fraserinstitute.org/economic-freedom/approach for details. There are other studies also that use Economic Freedom Index as a measure of quality of institutions (See for instance, Loko & Diouf (2009)).

[23] We also considered Kaopen Index by Chinn and Ito (2008) as the measure of de jure index but didn't use it because the index didn't show variation for most of the countries in the sample over 1980-2014.

cointegration tests. Finally, we estimate the elasticities using group-mean FMOLS technique. We briefly discuss each of these techniques subsequently.

4.2.1 Panel Unit Root Tests

In order to check the stationarity properties of the variables considered in the paper, we employ both the first generation as well second generation panel unit root tests. Among the first generation tests, we use two tests by Im, Pesaran and Shin (2003) (IPS) and Maddala and Wu (1999) 's ADF Fisher-type tests. Both these tests allow for heterogeneity of cross-sections and hence are less restrictive. However, they don't allow for cross-sectional dependence across the cross-section units. The literature suggests that cross-sectional dependence may lead to biased results especially in case of cross-country studies. We therefore also employ Pesaran (2007)'s CIPS test that allows for cross-sectional dependence as well and hence gives robust results.

4.2.2 Panel Cointegration Tests

If variables are non-stationary and integrated of order one, existence of a long-run equilibrium relationship can be tested using panel cointegration tests. The study uses Pedroni (2004)'s panel cointegration tests for the purpose. Pedroni (2004)[24] considers two different classes of the test statistics: (i) the 'group-mean' statistics that are based on pooling the data across the within dimension of the panel implying that these statistics are constructed by summing the numerator and denominator terms separately for the analogous conventional time series statistics and (ii) the 'panel statistics' that are constructed by first computing the ratio for each time series and then computing the standardized sum of the entire ratio over the N dimension of the panel.

4.2.3 Group-Mean FMOLS Estimates

After we confirm the existence of a long-run equilibrium relationship between the variables, we use Pedroni (2000, 2001)'s group-mean FMOLS (GM-FMOLS) technique to estimate the long-run coefficients of independent variables. These techniques have an advantage over OLS since they correct for endogeneity and serial correlation in the errors and hence the estimates are not biased. Further, group-mean FMOLS technique also allows for heterogeneity across cross sections and doesn't restrict the cointegrating vector to be same across all units.

5. RESULTS

The econometric results of the estimation of the Model set out in section 3 above are reported and discussed in section 5. First, we report and discuss results for the emerging and developing economies and then for the developed economies of Asia-Pacific.We make a comparison of the results across the two sets of economies subsequently.

[24] Pedroni (2004) considers seven statistics namely called as Panel-variance, Panel-t, Panel-rho, Panel-ADF and Group-rho, Group-t and Group-ADF test statistics.

5.1. Emerging and Developing Asia-Pacific Economies

It is well known that a number of developing and emerging economies introduced major liberalization reforms in 1990s that led to significant structural changes.Thus, in order to check the robustness of our results, we divide the entire period under study into two sub-periods, viz., 1980-1996 and 1997-2014 and reestimate the model set in section 3 for these two sub-periods as well. We discuss the results for overall period as well as the two sub-periods subsequently.***5.1.1. Results for the period 1980-2014***

The panel unit root test results[25] suggest that both the aggregate economic variables namely technological progress, human capital, government size, institutional quality and financial openness and all the sector-specific variables namely labour productivity, capital stock per worker and trade openness except inflation turn out be non-stationary in levels while stationary in first differences as indicated by majority of the three tests conducted. Thus, these variables are integrated of order one. Next, we check for the existence of a long-run equilibrium relation for each sector separately according to the model set out in section 3 above. We start with the largest possible combination of variables and try all possible combinations of all the I(1) variables and select a model that fits the best in terms of signs and significance of all the variables. The various models tried also vary by the measure of financial openness as discussed in section 4.1 above.

Industry sector and its sub-sectors

The results for the **industrial** sector as reported in Table 4a suggest that there exists a cointegrating relationship between productivity, capital stock per worker, human capital, technological progress, openness[26], government size,productivity of services sector and institutional quality. We next proceed to estimate this relationship using GM-FMOLS technique by Pedroni (2000, 2001). The results indicate that all the measures of financial openenss have a postive and significant impact on productivity of industrial sector. However, only one of the measures of financial openness (Gross FDI liabilities as a ratio of GDP) works the best in terms of overall robustness of the fit. Thus, the productivity of the industrial sector is signficantly affected by capital deepening, human capital, technological progress, trade openness, goverenment size, financial opennss, productivity of other sector and institutional quality *(See Table 4b*).

We then do the panel cointegration test in the case of manufacturing sector and results reported in Table 4a suggest that there exists a long-run equlibrium relationship between labour productivity,

[25] The results on panel unit root tests are not reported here for the sake of brevity but are available upon request from the authors.

[26] We tried combinations with financial openness and trade openness separately but in all the models with productivity of services sector as additional variable, the sign of either of these variables turned out to be negative. Hence for both industry and manufacturing, we combined financial openness and trade openness using principal component analysis and used that as a measure of openness in the model and thus the model that turne out to be robust in terms of overall fit was selected.

capital stock per worker, human capital, openness, government size, cross-sectoral variable and institutional quality.The group-mean FMOLS results further suggest that the coefficients of all the variables conform with economic theory and are statistically significant at conventional levels of significance.

Aggregate services and its sub-sectors

The panel cointegration test results for the **aggregate services** sector as reported in Table 4a suggest strong evidence of a long-run equlibrium relationship between labour productivity, capital stock per worker, human capital, technological progress, financial openenss, trade openness and institutional quality. The results from GM-FMOLS indicate that labour productivity of services sector is influenced positively and significantly by capital deepening, human capital, financial openness, trade openness and institutional quality (see Table 4b). However, the coefficient of technological progress is not statistically significant.

We then proceed to find long-run equilibrium relationship between labour productivity and other variables as set out in section 3. for the three components of market services namely distributive trade, transport and communications and financial intermediation, real estate and renting services. The results for the distributive trade as reported in Table 4a suggest a strong evidence of a cointegrating vector between labour productivity, capital stock per worker, institutional quality, financial openness and inter-sectoral variable.

The results from GM-FMOLS estimation (*Table 4b*) further suggest that all the coefficients conform to economic theory as set out in section 3 above and are statistically significant. Thus, the labour productivity of distributive trade services is positively and significantly affected by capital deepening, institutional quality, financial openness and inter-sectoral spillovers as measured by productivity of manufacturing sector.

The results on the transport and communications services sector as reported in Tables 4a and 4b suggest that labour productivity is affected by capital deepening, human capital, trade openness, financial openness, institutional quality and productivity of manufacturing sector.The results further suggest that signs of all the coefficients conform to economic theory and are statistically significant. Further, the panel cointegration test results for the financial intermediation sector suggest that there exists a long-run equlibrium relationship between labour productivity, capital deepening, insitutional quality, trade openness, financial openenss and productivity of manufacturing sector. While the signs of all the coefficients are as expected and statistically significant, trade openness is not significant.

Thus, the results indicate differences in the impact of determinants on labour productivity across sectors as follows:

First of all, the results suggest that while human capital is a positive and significant determinant of both industry and its sub-sector manufacturing, it is a signficant determinant only for transport and communications under the services sector. One plausible explanation for this result could be that services like distributive trade and financial services are not as skill-intensive as transport and communication because of which one may expect a weak impact of human capital in these sectors. This result corroborates with the finding of Tondll and Fornerro (2010) who also find a weak impact of education on labour productivity of distributive trade and financial services in the case of Latin American countries for the period 1991-2006.

Secondly, the results indicate that trade openness is a postive and significant determinant of labour productivity of all the sectors except distributive trade and financial services. Given that services of wholesale and retail trade, food, accommodation and financial and business services are not very tradable as compared to the services of information and communications, this result seems plausible. Moreover, we notice the trade to GVA ratio of the transport and communication sector has been very high and the highest for the Asian economies as compared to that for other sectors which further reinforces this result.

Moreover, the results indicate that there exist positive and statistically significant cross-spillover effects from manufacturing sector to services sector and from services sector and its sub-sectors to manufacturing sector, the magnitude of the impact as indicated by the elasticities is stronger from services to manufacturing than the other way around. Balakrishnan et al(2017) also find similar result in the context of manufacturing and services sectors of the Indian economy over the period 1965-66 to 2009-10.

Finally, while institutional quality positively and significantly influences the productivity of all the sectors, government size has a positive and significant impact on the productivity of only the industrial sector. This result may be explained by the fact that government expenditure is complementary in nature to the goods produced by industrial sector and hence an increased role of government is beneficial for the industrial sector[27].

5.1.2. Results for the sub-period 1997-2014

It is well known that some of the Asia-Pacific economies introduced major economic reforms in the decade of 90s and underwent major structural changes. Moreover, most of the Asian economies were also hit by the Asian financial crisis in 1997. Thus, in order to further check the robustness of our

[27] In all of the models that we tried for the services sector, we either got an insignificant coefficient for the government size or a negative one. This may be due to regulations on the services sector.

results to the occurrence of these two historic events, we re-estimate our results for the sub-period 1997-2014[28].

The results on panel cointegration and GM- FMOLS as reported in Table 4c and 4d respectively suggest that while the results with respect to most of the variables are retained in the sub-period chosen, impact of some variables has become stronger in the sub-period. In particular, the impact of technological progress becomes significant in the post 1997 period than in the overall period across all the sectors.

Given that there was an exponential surge in the number of patent applications in the developing economies like India and China in the late 1990s and early 2000s following their liberalization reforms and entry of China in WTO in 2001 (also intellectual property reforms), the impact of increase in patent applications (our measure of technological progress) may be expected to show up late. The result also corroborates with the findings of a study by Nomura (2018) that shows that Total Factor Productivity (TFP) growth has been much higher in 2000s than in 1980s and 1990s before it for Asian economies. Goldar (2018) also find that TFP growth in India was much higher in the period 2003-11 than in the period 1980-2002.

Finally, we notice that the impact of trade openness becomes stronger in the second sub-period as trade openness appears as a significant factor even in the case of distributive trade and financial intermediation services also. It is further noteworthy that capital deepening, financial openness and inter-sectoral variable remain significant determinants of productivity of all the sectors even in the sub-period.

5.1 Developed Asia-Pacific Economies

Using panel unit root tests by IPS (2003), Maddala and Wu (1999) and Pesaran (2007), we find that both the aggregate variables namely technological progress, human capital, government size, institutional quality and financial openness and the sector-specific variables of labour productivity, capital stock per worker and trade openness except for inflation (which is stationary in levels) turn out be non-stationary in levels while stationary in first differences[29] . We then check for the existence of a long-run equilibrium relation between the I (1) variables for the two sectors and their sub-sectors separately.

Industry sector and its sub-sectors

[28] We also estimate our results for the sub-period before 1997 also and find that the results are mostly robust. Although we don't report our results due to brevity of space but they are available upon request from the authors.

[29] The results for unit root tests are not reported here for the sake of brevity but are available from authors upon request.

The results for the industry as reported in Table 5a suggest that there exists strong evidence of a long-run equilibrium relationship between labor productivity, capital stock per worker, human capital, technological progress, trade openness, government size and productivity of services sector in the case of industrial sector. When we estimate the elasticities using GM-FMOLS technique, we notice that the signs of all the elasticities conform to the economic theory and are statistically significant as reported in Table 5b.

We further notice that the labour productivity of manufacturing sector is cointegrated with capital deepening, human capital, technological progress, trade openness, government size and productivity of services sector. The GM-FMOLS results further indicate that the signs of all the coefficients are as expected and are statistically significant also. Thus, the labour productivity of both industry and manufacturing sectors are affected by the capital deepening, human capital, technological progress, trade openness, government size and productivity of services sector. Given that manufacturing sector accounts for most of industry sector in developed economies, the similarity of results across the two sectors may be expected. (*See Tables 5a and 5b).*

Aggregate services sector and its sub-sectors

As for services sector, the results indicate labor productivity is significantly influenced by capital stock per worker, human capital, trade openness, government expenditure and productivity of manufacturing sector. Further, the signs of all the elasticities conform to economic theory as set out in section 3 (*see Table 5a*). Thus, the results of the study suggest that capital stock per worker; human capital, trade openness, government size and productivity of manufacturing sector are significant determinants of productivity of industry, manufacturing and services sectors. (*See Table 5b*).

However, technological progress turns out to be an important determinant of productivity of only industry and manufacturing sectors. This result may be explained by the fact that industrial sector undertakes more research and development activities and therefore files more patent applications as compared to the services sector and thus any additional act of such R&D is expected to benefit industry more than the services. However, another explanation for this result could be aggregation of different types of services[30] like distributive trade to sectors, transport and communication and financial intermediation that vary in terms of their level of technological progress. Thus, we re-estimate the model for each of the three components of market services namely distributive trade, transport and communications and financial intermediation services.

The results for the distributive trade services suggest that there exists a long-run equilibrium relationship between labour productivity, capital deepening, technological progress, government size,

[30] Although aggregate services also include community, personal and social services but we focus only on market services. Please refer to section 2.1 for details.

trade openness and productivity of manufacturing sector. The results on GM-FMOLS further indicate that while capital deepening, technological progress, trade openness and productivity of manufacturing sector affect labour productivity of distributive trade positively and significantly, the impact of government size is negative but significant (*Tables 5a and 5b*).

As for the transport and communications sector is concerned, the results suggest that labour productivity is cointegrated with capital deepening, human capital, technological progress, institutional quality, trade openness and government size. Further all the coefficients conform to the economic theory and are statistically significant[31].

Finally, the results for the financial services sector indicate strong evidence of a long-run equilibrium relationship between labour productivity, capital deepening, technological progress, institutional quality, trade openness, government size and productivity of the manufacturing sector. The results on GM-FMOLS further suggest that the coefficients of all the variables have expected signs and are statistically significant[32].

The results suggest differences in the impact of variables on labour productivity across sectors. In particular, elasticity of productivity with respect to trade openness is much lower for the aggregate services sector and its components as compared to that for industry. This implies that while increased openness to trade leads to higher productivity of both services and industry, the impact is higher on industry as compared to the services sector. Given that the trade to GDP ratio in the goods sectors of developed economies of Asia-Pacific is as high as 300% while that of services sectors is less than 100%, the magnitude of the impact of trade openness on productivity may be expected to be higher for industry than for services.

Further, while technological progress is a significant determinant of productivity of all the sectors, the elasticity of productivity with respect to technological progress is much higher for industry and manufacturing than for services and its components. This result is similar to the finding of Sondermann (2014) who find a stronger impact of R&D expenditure on the labour productivity of manufacturing than for services sector in the context of 12 EU economies for the period 1981-2009.

It is well known that a number of developing economies undertook economic reforms, and in particular, financial sector reforms in the decades of 1980s and 1990s and almost every economy had introduced reforms by mid-1990s. Thus, we also check the robustness of our results in the more recent

[31] We also tried a model including cross-sector productivity and found strong evidence of a cointegrating vector. However, including this variable turned the sign of technological progress perverse which could be due to multicollinearity between the two. Hence, we retained the model that was robust in terms of the overall fit.
[32] The coefficient of institutional quality is significant at 20% level of significance.

period of post 1997[33]. The results for the sub-sample as reported in Table 5c and 5d suggest that changing the sample doesn't affect the results except that the in the sub-period both the measures of openness are found to be significant determinants of productivity of all the sectors. A plausible explanation for this result could be that since in the latter sub-period under the study, almost all the economies especially the largest emerging economies of India and China had opened up themselves both in terms of trade and capital, this may have spillover effects on developed economies as well in terms of the impact of financial openness on productivity of developed economies in the second sub-period.

Furthermore, the impact of technological progress becomes stronger in the sub-sample for all the sectors as shown in higher magnitudes of the elasticity of productivity with respect to technological progress for all the sectors. A plausible explanation for this could be that greater use of computers and information technology has pervaded in all the sectors across the globe that has in turn led to higher productivity.

In order to further check the robustness of our results, we replace patents stock with R&D[34] stock as a measure of technological progress and find that R&D stock is also a significant determinant of productivity of all the sectors.(*see Tables 5e and 5f*). Thus the results are robust to the inclusion of alternative measures of technological progress for all the sectors[35].We now make a comparison of our results across developing and developed economies of the Asia-Pacific in the next section and discuss their implications.

5.3 Comparison across Developing and Developed Countries

The results as reported in section 5 above suggest a number of important differences in the determinants of productivity of industry and services sectors and their sub-sectors across developing and developed economies of Asia-Pacific. We summarise the results on the two sets of economies as follows and discuss the differences subsequently (*also see Tables 6a and 6b)*:

Capital deepening, human capital, government size, trade openenss, financial openness, intituitional quality and productivity of services sector are significant determinants of both industry as well as its sub-sector, manufacturing in the case of developing Asia-Pacific economies.

The aggregate services sector is signficantly influenced by capital deepening, human capital, insitutional quality, trade openness and financial openenss.

[33] We don't do the estimations for pre-1997 period for these economies because the data for Hong Kong starts in 1995.

[34] R&D stock is not included in the analysis for overall period because of non-availability of its data for countries in our sample for period before 1997. We consider 1997 as the cut-off to break the sample in order to maintain consistency with results on developing countries.

[35] It may be noted over here that in transport and communications sector, including R&D in place of patents makes human capital insignificant. This could be because of multicollinearity between the two variables.

Amongst the disaggregate services sector, distributive trade services and financial intermediations ervices are significantly influenced by capital deepening, institutional quality, financial openness and productivity of manufacturing sector.

Capital deepening, human capital, insitutional quality, trade openness, financial openness and productivity of manufacturing sector significantly influence productivity of transport and communications sector.

Further, the impact of technological progress and trade openness becomes stronger in the sub-period 1997-2014.

As far as developed Asia-Pacific economies are concerned, the results suggest that capital deepening; human capital, technological progress, government size, institutional quality, trade openness and productivity of services sector are significant determinants of industry and its sub-sector, manufacturing.

The productivity of aggregate services sector is influenced significantly by capital deepening, human capital, government size, trade openness and productivity of manufacturing sector.

The productivity of distributive tarde services is significantly affected by capital deepening, human capital, technological progress, government size, trade openness and productivity of manufacturing sector.

While capital deepening, human capital, technological progress, government size, trade openness and institutional quality affect productivity of both transport and communications and financial intermediation services significantly, the impact of productivity of manufacturing sector is significant only in the case of financial intermediations services.

Further, the impact of financial openness also becomes significant for both the sectors and their sub-sectors in sub-period 1997-2014 for these economies. The results are robust to alternative measures of technological progress and financial openness.

Thus, a comaprison of above results across the two sets of economies indicate that while the impact of government size is negative and significant for all the sectors and their sub-sectors of developed ecoomies, it is positive and significant for the industry and manufacturing sectors of developing economies and negative and insignificant for services sector and is components.. A plausible explanation for this could be that since industry and manufacturing sectors sectors are dominated by private participation, therefore additional government expenditures may act as complementary to this sector in the case of developing economies while services sector has been under regulation for long in

these economies and so further increase in government size may not be recommended for the growth of services sector.

Furthermore, the results indicate that for developed economies financial openness becomes is significant only in the post 1997 period while it is significant in bth the overall period as well as sub-period for developing economies. both equity as well as debt liabilities as a ratio of GDP as measures of financial openness have positive and significant impact on productivity of developed Asia-Pacific economies while for developing economies only equity liabilities have positive and significant impact.

The result on developed economies finds support from a study by Gehringer (2015) that shows that both equity and debt liabilities have a positive and significant impact on the productivity of manufacturing and services sectors of EU economies. This may be explained by the fact that developed economies have a well developed financial system and institutional set up as compared to developing economies that helps to allocate all types of capital flows efficiently which in turn leads to positive impact on productivity.(*Kose et al., 2009*).

Finally, the impact of technological progess is stronger for developed economeis in both overall period as well as sub-period as compared to developing economies.

6. CONCLUSIONS

The current study examines the trends and the determinants of labour productivity of industry and services sectors and their components of the major emerging and developing and developed economies of Asia-Pacific over the period 1980-2014. The study further makes a comparsion of these determinants across the two sectors and across the developing and developed economies of Asia-Pacific. Considering both trade openness and financial openness, along with other variables including capital stock per worker, human capital, technological progress, government size, productivity of the other sector and institutional quality, the study uses panel cointegration and group-mean FMOLS to estimate the model.

The study further examines the determinants of labour productivity of these sectors of both the sets of economies for the period 1997-2014 owing to the introduction of major economic reforms in emerging economies in the 1990s. The results on developing economies indicate that capital deepening, human capital, trade openness, financial openness, productivity of the other sector and institutional quality significantly affect productivity of both industry, manufacturing and aggregate services sectors., Moreover, the results indicate that an increased role of government is beneficial for the industry and manufacturing sectors.

Further, while human capital and trade openness are significant determinants of productivity of transport and communications, this is not so for distributive trade and financial services.The results indicate that the impact of technological progress becomes significant only in the sub- period of post 1997 for all the sectors as compared to the overall period. Moreover, the impact of trade and financial openness is not sensitive to the time period under study.

The results for developed economies suggest that capital stock per worker, human capital, technological progress, trade openness, productivity of the other sector, intitutional quality and government size[36] are significant determinants of productivity of all the sectors.. Moreover, the impact of capital deepening (as measured by capital stock per worker) is much stronger (as reflected by estimated elascticities) for both industry and manufacturing sectors than for aggregate services. However, this is not the case for the various components of services, if taken at the disaggregated level. the result doesn't hold any longer. Thus, the results indicate that capital deepening signifcantly affects services sector as well.

The results for the sub-period 1997-2014 further indicate that financial openness also influences productivity of all the sectors positively and significantly. Further, results of the estimation are robust to alternative measures of technological progress.

Thus, the results indicate that while the impact of government size is negative and significant for both the sectors of developed economies, it is positive for the industry sector of developing economies.. It may be attributed to the fact that industry sector is dominated by private participation in the developing economies and therefore increased role of government is beneficial for the industry.

Furthermore, the results indicate that for developed economies various measures of financial openness are significant for the productivity of both industry and manufacturing sectors while for developing only one of the measures (indicating Equity liabilities as a ratio of GDP) is a significant determinant of productivity of industry and services sector. A comparison of the results across developing and devloped economies indicate that the results are broadly similar to findings of Dua and Garg (2019) for the aggregate economy in the context of developing and developed economies of Asia-Pacific over the epriod 1980-2014.

FinallyThe impact of technological progress is stronger in the case of developed economies as compared to developing economies. Thus, the results of the study identify important differences in the

[36] The effect of government size is negative on the productivity of both sectors.

factors influencing productivity across various sectors and across developing and developed economies of the Asia-Pacific. These differences in turn, highlight structural differences across various sectors and economies. By identifying these differences, the study highlights the need for different policies to promote different sectors.

Acknowledgements

The authors are grateful to Dr. Deb Kusum Das, Prof. Surendar Kumar and Dr. Dibyendu Maiti and the participants of the "Growth and Productivity of Indian Economy: Contemporary Issues", a UGC-SAP conference held at Delhi School of Economics for their valuable comments and feedback that helped improving the paper a lot. The authors are also indebted to Prof. Jacob Madsen for kindly providing the historical data series on patent applications in China.

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