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Pattern and Determinants of Structural Transformation in Africa

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Pattern and Determinants of Structural Transformation in Africa

Raghbendra Jha and Sadia Afrin

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ABSTRACT

This paper models the evolution and determinants of the shares of agricultural, manufacturing and services sectors' value added for 53 African countries for 1970-2014 years. A number of alternative estimation techniques were used. These included pooled OLS with clustered standard errors, quantile regressions and panel data techniques. However, the quantile regressions do not provide much additional traction over and above the OLS estimates. There are large gaps in the data for many countries for several variables. Policy conclusions are derived from the viewpoint of increasing the shares of the services and, particularly, the manufacturing sector in value added.

Keywords: Africa, Structural Transformation, Pooled OLS, Quantile regression, Panel

JEL Classification Code: C22, C23, O11

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I. Introduction and review of the literature

Historically economic growth has been involved with a change in the composition of gross domestic product (GDP). Over long periods of time most of the developed countries of today went from being primarily agricultural economies to primarily manufacturing and, then, primarily services. This was accompanied and, to some extent, caused by increases in labour productivity in the areas to which the structure of domestic production moved. Thus, manufacturing productivity increased vis a vis that in the agricultural sector which induced labour and capital to migrate to manufacturing. Later services sector productivity rose relative to manufacturing inducing a move from manufacturing to services. This has been well explored in a number of contributions starting with the pioneering work of Simon Kuznets.[1] Other notable contributors to this literature include Hollis Chenery and Arthur Lewis.

Thus, there are two school of thoughts in the literature on the links between economic growth and structural composition of output and/or employment. On the one hand the neoclassical school of economic growth would argue that the structure of output hardly matters for economic growth. On the other hand several economists, most famously Simon Kuznets and others, have argued that economic growth has been involved with a change in the composition of gross domestic product (GDP) and/or employment. Indeed this change is essential for sustained economic growth and rising incomes.

There is widespread consensus now that these two schools of thought are not mutually contradictory. In this context Echeveria (1997) builds a dynamic general equilibrium model to show that growth affects sectoral composition of output and vice versa. Thus, there is a mutual cause and effect relation between economic growth and composition of aggregate output.

In more recent times Timmer et al. (2012) underscore the fact that structural transformation is both the cause and effect of economic growth. They define structural transformation as a process by which (a) the shares of agriculture in GDP and employment fall over time, (b) there is increased migration as people move from rural to urban areas, (c) an agriculture and rural sector based economy is replaced by an industrial and urban sector based economy, and (d) a demographic transformation whereby high birth and death rates are replaced by low birth and death rates. Any existing dualism between the agricultural and the non-agricultural sectors gradually disappears over time.

[1] The principal work of Simon Kuznets on structural transformation during economic growth was completed in the 1950s. A lucid summary is available in his Nobel Memorial Lecture (Kuznets, 1971).

This view of structural transformation views economic growth as a process that changes the composition of output as well as the pattern and distribution of employment across different sectors of the economy. Traditional agriculture is thought of as the base for less developed countries (LDCs). In such societies land and labour productivity are low and not much surplus is saved for investment. With the improvement of labour productivity however, some labour is freed up for employment in the manufacturing sector which has higher labour productivity and, hence, higher wages. Higher incomes lead to increased savings and, hence, investment. This then further spurs up economic growth and the accompanying rise in labour productivity facilitates movement of labour from manufacturing to services. A key characteristic of this narrative is that economic growth is viewed as a long-term phenomenon which engineers structural change in the economy and is, in turn, affected by these changes. This is to be differentiated from annual or even quarterly growth figures which are widely reported in media and other outlets.

Many developed countries have followed this pattern of structural change. Even the Newly Industrialized Countries of Asia (including China) have experienced structural changes along these lines. All these countries raised their per capita incomes manyfold during short periods of time and are now in or close to being post-industrial societies.

However, this pattern of sectoral transformation has not been followed in a number of developing countries. In particular, in large parts of Africa, the relative decline of the share of agriculture in GDP has been accompanied by a huge rise in the share of the services sector whereas the manufacturing sector has more or less stagnated. However, since the mining sector has boomed in several parts of Africa, the share of the industry sector (manufacturing + mining and quarrying) has increased somewhat, although the share of manufacturing has stagnated.

It would be desirable to alter the sectoral share pattern towards greater share of manufacturing given unrealised higher productivity in manufacturing. Furthermore, excessive concentration on mining can be deleterious to manufacturing growth in the short-term and economic growth in the medium term because of Dutch disease type effects involving the appreciation of the real exchange rate.

Of late there has been considerable emphasis on facilitating such transformation in Africa. The African Union has explicitly stated such structural transformation to be an overarching objective of its agenda for 2063. The extant pattern of development with concentration of activity in agriculture and mining cannot be sustained for too long in view of the fact that with a young and rapidly growing population (estimated to become 1.2 billion by 2050) Africa needs a large number of productive jobs. Agriculture cannot provide for this necessity, nor can mining alone for reasons described earlier. Hence, the need to understand structural transformation in economies – in particular the role of policy measures in facilitating such transformation.

UNECA (2015 b) emphasizes the importance of international trade in this process. In particular, it stresses the necessity of encouraging intra-African trade (which is at a low level) and arriving at an African consensus on international trade policy including on tariffs, domestic protection for infant industries and the like. Other policy measures considered include the rapid development of human capital, infrastructure development, stimulating FDI flows into the manufacturing sector and capital accumulation.

The role of these and other policy measures in facilitating this structural transformation can be best understood in a formal model of the determinants of the shares of the value added of various sectors in total value added. Taking a cue from Dabla-Norris et al. (2013) the present paper examines the determinants of the sectoral share of value added in the African continent. The sectors considered are agriculture, manufacturing and services. We introduce a number of additional policy variables on the right hand side in order to better understand possible policy levers to affect transitions in sectoral shares in the continent. The use of quantile regression with various shares of the three sectors in GDP per capita helps us to understand how this transformation is occurring depending on the level of various sectoral shares to total GDP across countries.[2] Because quantile regression allows the coefficients to vary across the distribution of the dependent variables.

The plan of this paper is as follows. Section II discusses data and methodology whereas section III presents all the results. Section IV concludes.

II. Data and Methodology

Table 1 provides descriptive statistics for the variables used in the analysis. We use annual data for 53 African countries for the 45 year period (1970 to 2014). The data are from World Development Indicators of the World Bank and UNECA.

Table 1 about here.

Notation for the variables used in the analysis is as follows.

cid = country code; $Time$ = year; $agri$ = ratio of agricultural value added to total value added; $manuf$ = ratio of manufacturing value added to total value added; $service$ = ratio of service sector value added to total value added; $lland$ = log(land area); $lpop$ = log(population); $arable$ = arable land (as percentage of total land); *ageo* = ageo (age dependency ratio, old (>64 years) to total population; *agey* = agey (age dependency ratio, young (<15 years) to total population); *lgdp* = log(GDP per capita constant $2005); *lgdpsq* = Square(log(GDP per capita constant $2005)); *educs* = education (gross secondary enrolment, percentage); open = trade openness (exports+imports)/GDP); credit = Domestic credit to private sector (percentage of GDP); *fdi* =fdi (Net FDI

[2] We would have liked to conduct this analysis with shares in employment as well. But the data on this variable was too scant to conduct regression modelling.

inflows as percentage of GDP); *capital* = Gross capital formation as percentage of GDP; *extdebt* = external debt (as percentage of GDP); *pubinv* = public investment as percentage of GDP; *DumSAP* = Dummy for Structural Adjustment Program implementing year (1991, middle of the period).

The countries are organized into five groups for purposes of regression analysis.

Eastern Africa consisting of Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, , Mozambique, , Rwanda, Seychelles, Somalia, United Republic of Tanzania, Uganda, Zambia, Zimbabwe is the base.

The other regions are **Middle Africa:** Angola, Cameroon, Central African Republic, Chad, Congo (Brazzaville), Democratic republic of the Congo, Equatorial Guinea, Gabon, Sao Tome and Principe.

Northern Africa: Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Sudan, Tunisia,.

Southern Africa: Botswana, Lesotho, Namibia, South Africa, Swaziland.

Western Africa Benin, Burkina Faso, Cape Verde, Cote d'Ivoire (Ivory Coast), Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo.

These variables are grouped into three different categories: (a) Country fundamentals (lland, lpop, arable, ageo, agey, lgdp and lgdps); (b) Policy variables (educs, open, credit, fdi, capital, extdebt, pubinv); and (c) Regional Dummies with East Africa as base. DSouth, Dnorth, Dmiddle and Dwest are dummies for Southern Africa, Northern Africa, Central Africa and Western Africa respectively. Since pubinv is part of capital investment they are not used together in the same equation.

It is important to point out here that there are large gaps in the data. Out of a possible limit of 2,385 (53*45) observations for each variable observations drop to as low as 1,098. In particular, there are substantial data gaps in the policy variables used in the analysis. When policy variable are introduced the number of data points sometimes comes down to below 500.

Pooled summary statistics for the variables are depicted in Table 2 whereas Table 3 denotes panel variation in the data.

Tables 2 and 3 about here.

"Overall", "between" and "within" variations for each variable are depicted in Table 3. In Table 2, N refers to the total number of observations across countries and across time, *n* refers to the number of countries for which observations are available and T refers to time period for which the data are available. Clearly, $N = n * T$. For those variables for which data is not available for all time periods and/or all counties $N = n * T - bar$ where T-bar again refers to the time period for which data are available. Table 2 summarizes the data gaps in the variables be they through insufficient observations for time periods or countries or both. Thus, for the variable "$agri$" data are available only for 50 countries and an average of 38.66 time periods.
In this paper we estimate several different versions of the model in order to check for the robustness of the results and establish the role of policy variables.

The panel data representation of the model to be estimated in its general form is:

$$y_{it} = x_{it}'\beta + z_i'\alpha + \varepsilon_{it} = x_{it}'\beta + c_i + \varepsilon_{it} \qquad (1)$$

where y_{it} is share of value added of sector i (i=agriculture, manufacturing, services) in total value added. There are *k* regressors in x_{it} but this does not include a constant term (Greene, 2008). z_{it} consists of a constant term and other individual (i) specific variables.

If all the z_i are observable then (1) becomes a standard regression model. In this case we are justified in running a pooled OLS regression. This will be the case if

$$E(x_{it}'\varepsilon_{it}) = E(x_{it}'c_i) = 0 \quad for\ t=1,2,...T \qquad (2)$$

According to Greene (2008) this yields consistent estimates.

However, this assumption is difficult to satisfy for many samples. Several reasons for this can be cited. Thus, McManus (2011) suggests that this may be because of (i) hierarchical data sampling methods, (ii) multistage probability samples that incorporate cluster based sampling designs which have errors that are correlated within clusters, (iii) time series data can exhibit serial correlation and (iv) panel data can be correlated within the unit of observation, in this case countries.
Hence, the pooled OLS estimates may not be efficient. In this paper we follow the route of Fixed Effects Panel regressions which yield estimates with robust statistical properties as indicated by Hausman specification tests. These results are reported in Table 4.
Furthermore, given the vast spatial differences within Africa (UNECA, 2011, 2015a, 2015b) we use quantile methods on the pooled model to distinguish threshold effects. The OLS estimator minimizes the sum of squared residuals and, thus, gives large weightage to large deviations from the mean. If the sample size is small then the results can be very sensitive to a small number of outlier observations. To tackle this minimizing absolute

deviations from the mean has been suggested and is referred to in the literature as Least Absolute Deviation (LAD). The idea is to minimize the absolute deviations from the median. This is a special case of the quantile regression

$$\Pr ob[y_{it} \leq x_{it}'\beta] = q$$

where q = 50 % in the case of LAD.

The method of qreg2 (a statistical technique in STATA that permits quantile regression to be estimated with robust and clustered standard errors) was followed in this paper (Machado et al., 2011). Quantiles are differentiated by shares of three sectors in GDP.

If we want to justify the quantile regression, we need to compare the estimated coefficients across quantiles with the respective OLS estimates.[3] If the quantile coefficient is outside the OLS 95 per cent confidence interval, then we have significant differences between the quantile and the OLS coefficients**.** If the coefficients for the quantile regression lie within the 95 per cent confidence intervals around the respective OLS estimates then there is not much advantage of opting for the quantile regression.

Finally, some recent literature suggest quantile regression on panel data but this issue is far from settled and there is not consensus on the relative performance of those estimators. However, there is consensus on the efficacy of the qreg2 method. Hence, we adopt this method along with clustered standard errors for pooled data.

III. Results and Discussion

Figure 1 provides scatter plots of sectoral value added (y-axis) against log of GDP per capita (x-axis) for Africa as a whole as well as for regions for all years.

Figure 1 here.

For Africa as a whole and regional groupings there is a clear negative relation between the share of agricultural value added and log GDP. However, this relationship is weak for Central Africa and Southern Africa.

In the case of manufacturing there is an inverted U-type relation for Africa as a whole. The share of manufacturing rises with GDP, reaches a peak and then, actually, declines. For east Africa this same pattern is visible but the association is much weaker than that for Africa as whole. For North, West and Central Africa

[3] However, mean (average) and median estimate may not be the same.

there does not appear to be any significant association between the share of manufacturing value added in GDP and GDP.

For Africa as a whole the share of the services sector rises with GDP. This is also true for East and West Africa, although the association is much weaker. For North and Southern Africa there does not appear to be a robust link between services and GDP.

Thus, evidence for a Kuznets-type structural transformation in Africa appears weak, at best. It may be true for some countries for some periods of time but not for the continent as a whole and major country groupings.

Panel regression results

In Table 4 we present results of the panel fixed effects regressions of the sectoral shares for the model for the principal model (henceforth PM). An alternative version of the model was estimated with capital investment replaced by public investment. Both are not used in the same regression since public investment is a part of total investment. Results for the alternate model (henceforth AM) are presented in an Appendix. In every model estimation, we include time dummy. The Hausman test for use of fixed effects models is satisfied in our case but, as Clark and Linzer (2012) the show, the Hausman test is neither a necessary nor a sufficient condition for deciding between fixed effects and random effects.

Table 4 about here.

Agriculture

In the PM the share of agriculture rises with land, population and old age dependency. It has no significant relation with GDP per capita. Among the policy variables it rises with secondary education enrolment, external debt and resource rent . The structural adjustment program also seems to have increased the share of agriculture. In the AM the share of agriculture rises with $lland$, falls with the young dependency ratio and has an inverted U-shaped relation with GDP per capita. Among the policy variables it rises with secondary school enrolment and $totren$t and falls with $openness$ and the dummy for the SAP program.

Manufacturing

In the PM the share of the manufacturing sector rises with population but does not have a significant relation with GDP per capita. Among the policy variables, secondary school enrolment lowers the share of manufacturing whereas FDI raises it. External debt, total resource rent and capital investment all reduce the share of manufacturing. The structural adjustment program in this region did not contribute to raise the share of

manufactures. In the AM the share of manufacturing also rises with population and falls with arable land. It does not have a significant relationship GDP per capita. Among the policy variables it falls with educs, pubinv and totrent and rises with FDI.

Services

In the PM the share of services falls with land and rises with arable land and old age dependency ratio. Once again GDP per capita does not have a significant effect on the share of services. Among the policy variables it rises with secondary enrolment, external debt and capital investment. It falls with FDI and totrent. The structural adjustment program also seems to have negatively impacted the share of services. In the AM the share of services falls with lland, rises with arable, ageo and agey and has a U-shaped relation with GDP per capita. It falls with FDI, pubinv and totrent and rises with external debt.

An alternative model was estimates with capital investment replaced by public investment.

There are several important takeaways from this analysis. First, after controlling for other factors there is no Kuznets type relation for any of the sectors in the PM. In the AM there is an inverted-U-shaped relation for agriculture and a U-shaped relation for services. Second, mining activity is hurting the non-agricultural sectors in African economies. The contributions of secondary education enrolment, FDI, investment and external debt have already been discussed above. The Structural Adjustment Program by the IMF appears less effective in transforming African economies from agricultural based to manufacturing based.

Quantile regression results

In Table 5 we present results on the quantile qreg2 estimation for the 0.1, 0.25, 0.5, 0.75 and 0.9 quantiles along with the pooled OLS estimates for the three sectors for the PM. Time dummies are included during estimation of the models. Table A2 reports the same for the AM. If the quantile estimation coefficient is outside the 95 per cent confidence interval of the OLS estimate then we consider it significantly different from the pooled OLS estimator. A ^ indicates significant difference from the pooled OLS estimate whereas a * indicates significant difference from zero. We find several coefficients in the agriculture and services are significantly different from the OLS estimates for the PM. However, there is no coefficient with both a ^ and a * indicator. This implies the marginal effects of country fundamentals and various policy variables across the distribution of the dependent variables are same as their mean estimates (OLS) in the PM. On the other hand, if we look at the AM, we find marginal effects of several variables are different from their mean estimates and also statiscally significant. For instance, in countries, where contribution of agriculture to GDP is lower (0.10

quantile), both country size and arable land have different significantly positive effect than higher quantiles and OLS. Similarly for manufacturing equation, arable land, SAP dummies, both appear with * and ^ sign. The marginal effect of SAP dummy is also statistically significant and different from OLS for service sector. Hence, there is not much gain from using a quantile regression approach.

Table 5 here.

IV. Concluding remarks

This paper models the evolution and determinants of the shares of agricultural, manufacturing and service sectors' value added for 53 African countries for 1970-2014. While a number of alternative estimation techniques were used, the paper reports results on panel effects, pooled OLS and quantile regressions. Two variants of the model were estimated – one with capital investment (PM Model) and the other with public investment (AM Model) as one of the determinants of sectoral shares.

Key results from the panel analysis are as follows. First, after controlling for some fundamentals and policy factors there is no Kuznets type relation for any of the sectors in the PM. In the AM there is an inverted-U-shaped relation for agriculture and a U-shaped relation for services. Second, rent from mining activity increases the share of agriculture and lowers the shares of manufacturing and services in both PM and AM. Hence, mining activity is hurting the non-agricultural sectors in African economies. In both the PM and AM secondary education helps growth in the agricultural and services sectors but reduces growth in the manufacturing sector. In the PM FDI raises the share of manufacturing but reduces that of services. In the AM FDI increases the share of agriculture and manufacturing and reduces that of services. In the PM capital investment raises the share of services but lowers that of manufacturing. In the AM pubinv lowers the shares of manufacturing and services. In the PM external debt raises the shares of agriculture and services but lowers that of manufacturing. In the AM external debt raises the share of agriculture. In the PM the structural adjustment program raises the share of agriculture and lowered those of manufacturing and services whereas in the AM it lowers the share of agriculture.

The quantile regressions do not provide much traction beyond the pooled OLS results. The only variables significant in their own right and significantly different from pooled OLS estimate were lland (-ve) for 0.25 quantile, pop (+ve) for 0.10 quantile and external debt (+ve) for 0.10 quantile for the manufacturing sector in the PM model. For the services sector in the same model arable land had a significant negative coefficient for

the 0.90 quantile. For the agricultural sector in the AM model the coefficient for lland was +ve and significant at the 0.10 quantile and arable was +ve and significant at the 0.10 level. Thus, land availability was a determinant of agriculture's share in output at the lower quantiles. For the manufacturing sector there was an inverted-U relation with GDP per capita for the 0.25 quantile and a negative relation for the 0.10 quantile. Arable land negatively affected manufacturing share at the 0.90 quantile. For the services sector only DumSAP is significant and that too at the 0.90 quantile.

From a policy perspective we are interested in how the shares of services and, particularly might be boosted. In this context it is a matter of concern that secondary school enrolment raises the share of agriculture and services but lowers that of manufacturing. This indicates that a reorientation of the secondary education program may be needed. Concern has been expressed about the large and growing numbers of children out of school in Africa as well as about the quality of the education imparted (Fleet et al. , 2012). An effective program of elementary and secondary education should be complemented with a rigorous program of tertiary education and skilling with the objective of servicing an expanding manufacturing sector. Policy measures to stimulate entrepreneurial activity on a large scale should be initiated.

However, FDI raises the share of manufacturing and lowers that of services. More disaggregated FDI data may enable us to understand what particular forms of FDI need to be stimulated. FDI into Africa has been low. In the manufacturing sector it has been even lower and largely been market driven (Chen et al., 2015). Furthermore, considerable new FDI including South-South FDI (largely from China and, to a lesser extent, India) has largely been in the mining and extractive industries and in agribusiness and agriculture. The spillover effects of such FDI inflows should be capitalized on to make FDI into manufacturing and services more attractive, e.g., by facilitating downstream production activities.

Greater openness lowers the share of agriculture but has had no significant effect on manufacturing and services sectors. Thus, there is need to reorient Africa's trade policy. UNECA (2015 b) has commented extensively on trade policy reforms that could stimulate growth of the manufacturing sector in Africa. It mentions that during 2010-12 primary commodities accounted for 82 per cent of Africa's exports. This could have a feedback effect in that Africa could get locked into a pattern of primary production and exports. This could be true for final products as well as for production for global value chains (GVC) since entry into GVCs is possible at any level of value added. African countries show high level of participation in GVCs but at low levels. In this context entry into preferential trade agreements that are beneficial to Africa would be essential. These should not be crafted under the implicit assumption that African industrialization does not matter. A pan-African rather than

country-specific trade policies may become necessary. The increasing importance of services to manufacturing should be exploited to encourage expansion of both these key sectors.

Better trade administrative practices should also be part of the policy mix. UNECA (2015 b) mentions that between 2000-09 illegal outflows through trade mispricing amounted to nearly all the development assistance. Hence, there needs to be close monitoring of trade data, sharing of trade data with partner countries and swifter prosecutions in case of infringement.

What is really stark is the role of mining revenue. Increasing totrent has lowered the share of manufacturing and services and raised that of agriculture. Thus there is a classical "Dutch disease" type effect operating in Africa. There is urgent need for a move away from mining and greater diversity in Africa's production basket.

Hence, policy measures other than those discovered by the regression analysis in this paper may be useful for the promotion of structural transformation in Africa. Rigorous analysis of the design of such initiatives is a pressing imperative for policymakers.

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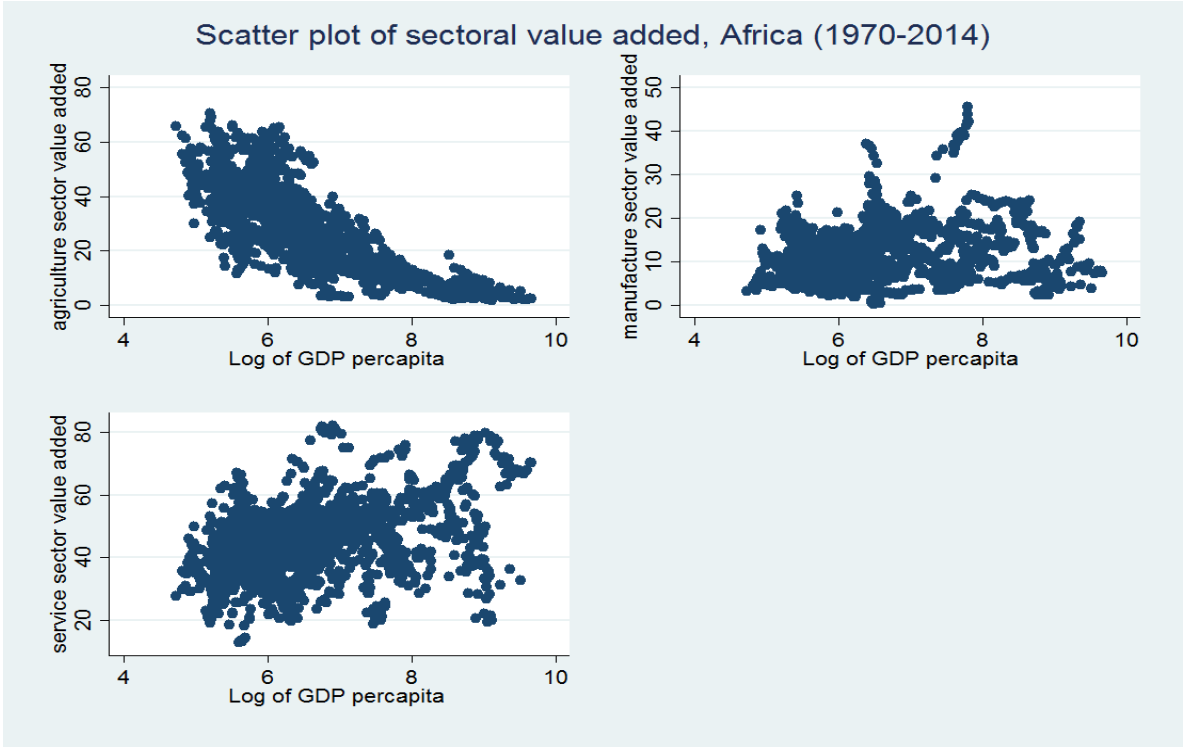
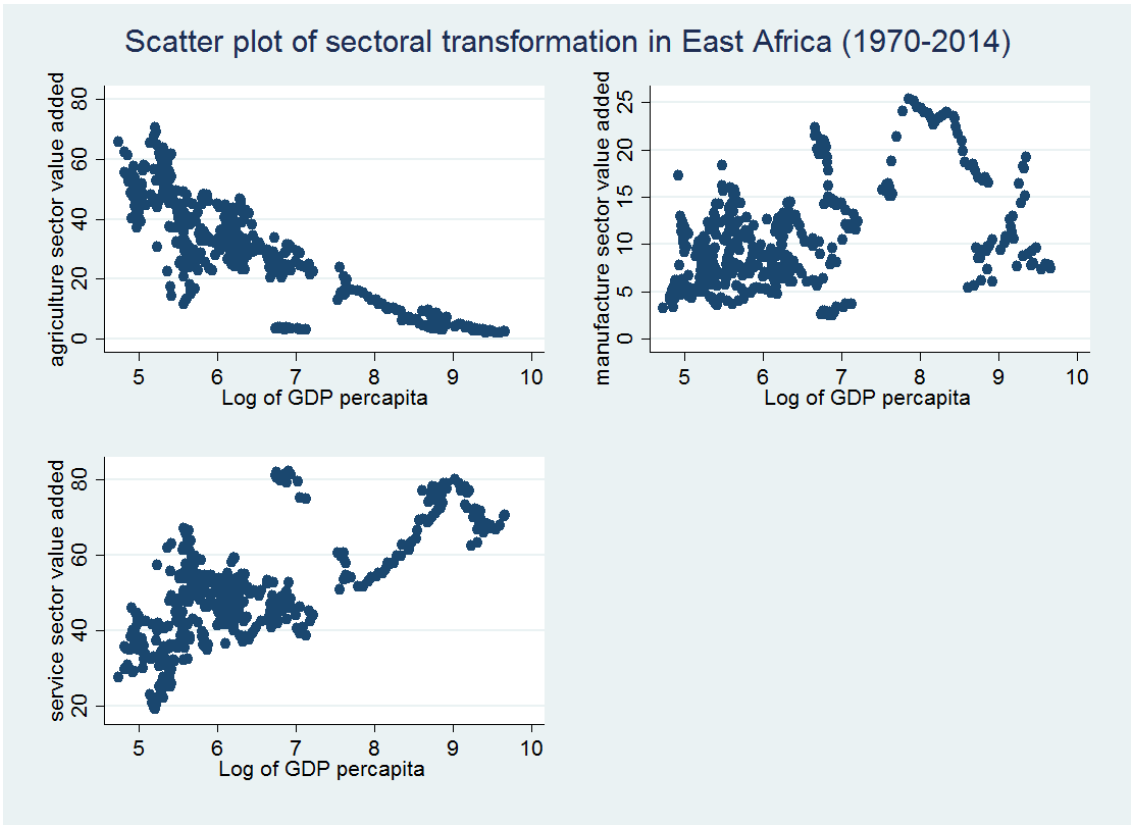
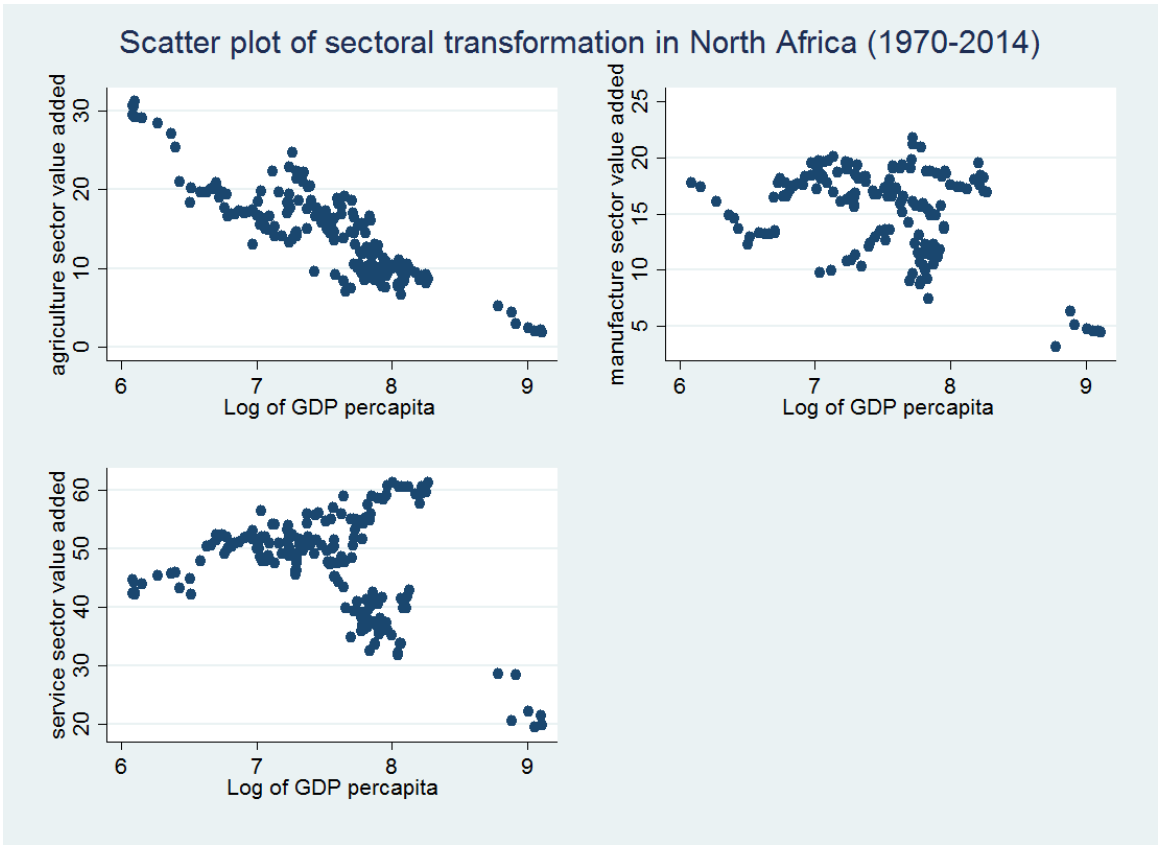
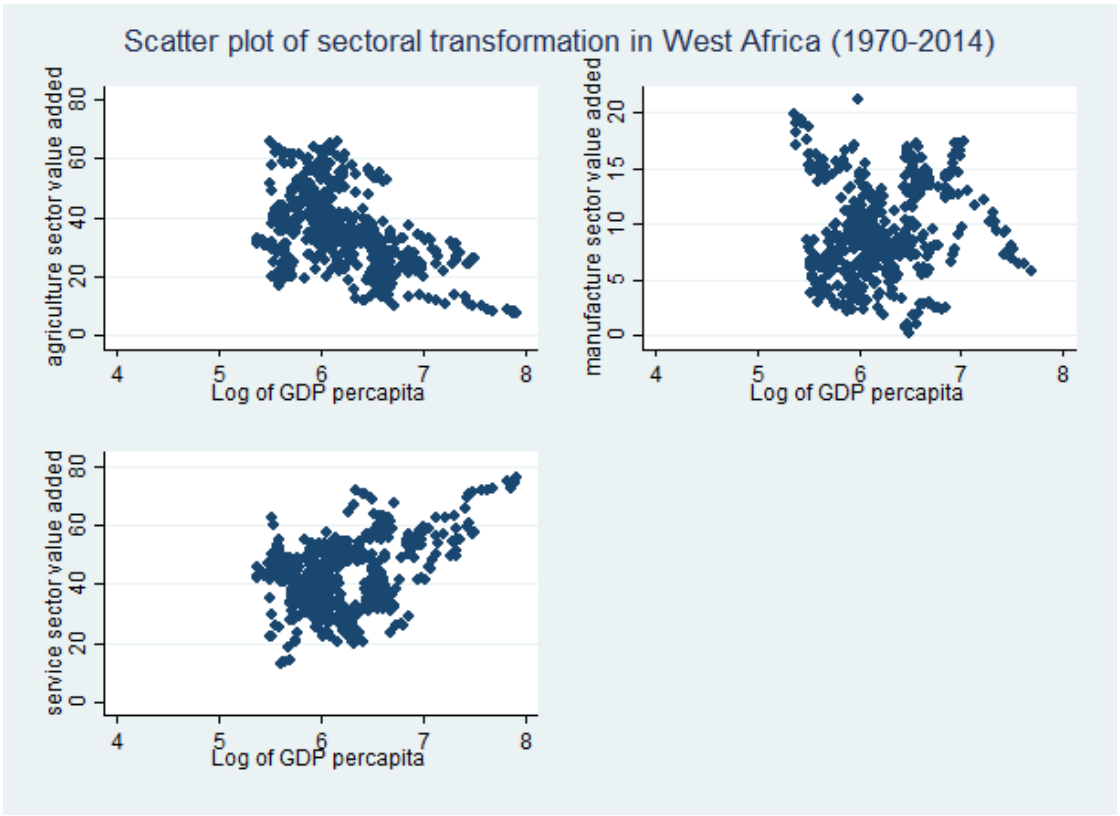
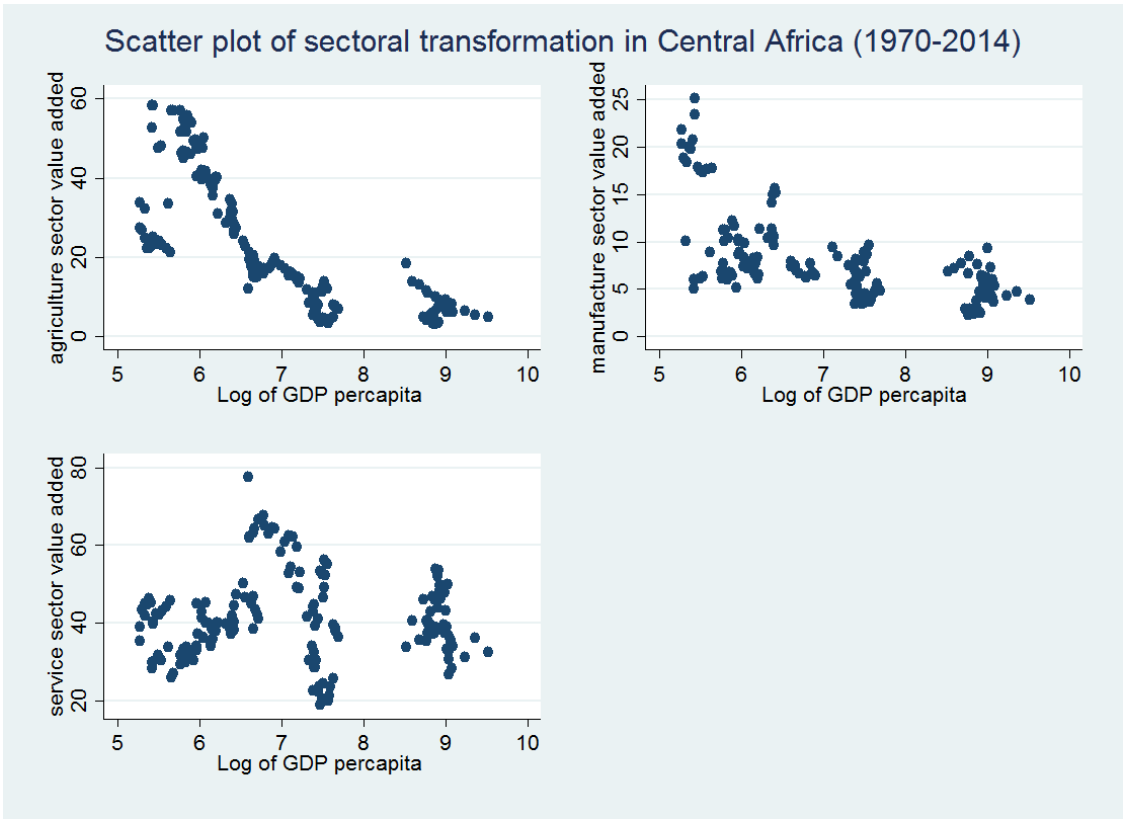
Figure 1: Scatter plot of sectoral value added (53 countries for 1970-2014)






Scatter plot of sectoral transformation in North Africa (1970-2014)
agriculture sector value added
0
10
20
30
6
7
8
9
Log of GDP percapita
manufacture sector value added
5
10
15
20
25
6
7
8
9
Log of GDP percapita
service sector value added
20
30
40
50
60
6
7
8
9
Log of GDP percapita


Scatter plot of sectoral transformation in West Africa (1970-2014)
agriculture sector value added
0
20
40
60
80
4
5
6
7
8
Log of GDP percapita
manufacture sector value added
0
5
10
15
20
4
5
6
7
8
Log of GDP percapita
service sector value added
0
20
40
60
80
4
5
6
7
8
Log of GDP percapita


Scatter plot of sectoral transformation in Central Africa (1970-2014)
agriculture sector value added
0
20
40
60
5
6
7
8
9
10
Log of GDP percapita
manufacture sector value added
0
5
10
15
20
25
5
6
7
8
9
10
Log of GDP percapita
service sector value added
20
40
60
80
5
6
7
8
9
10
Log of GDP percapita

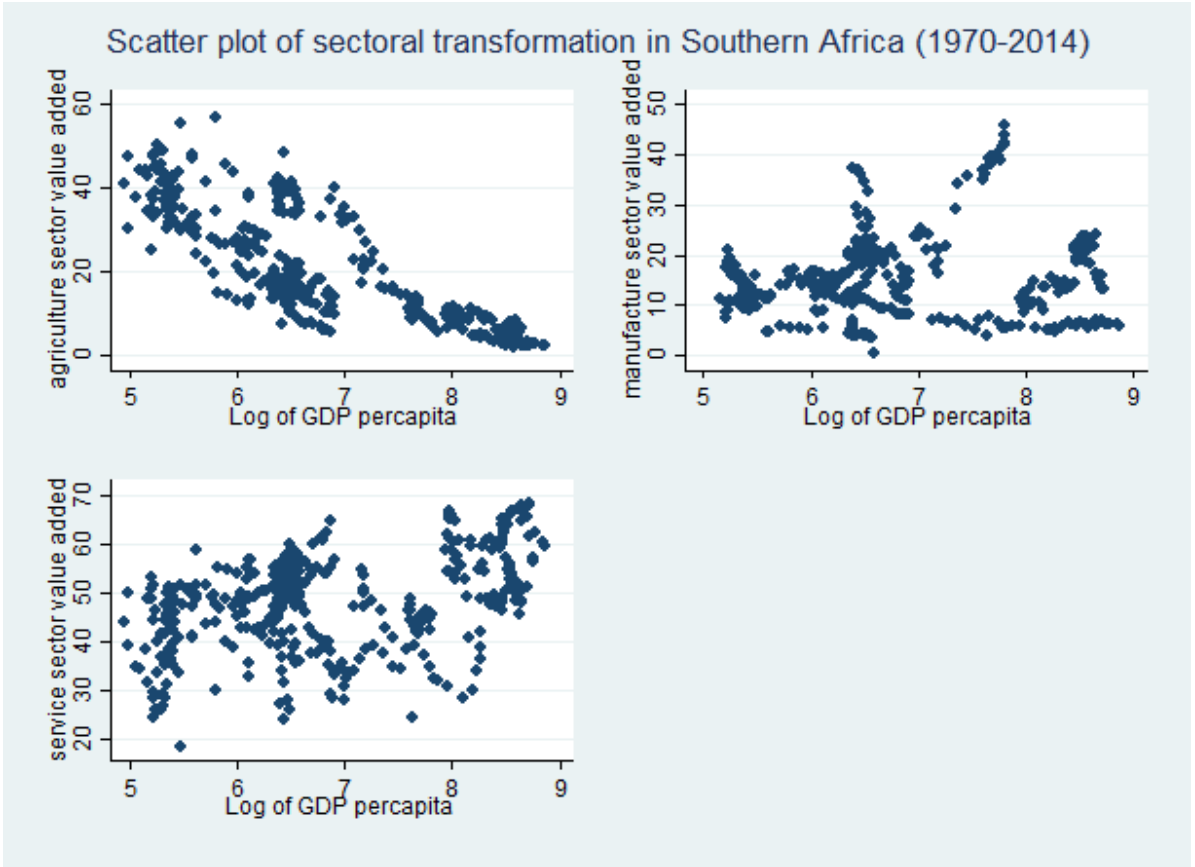

Scatter plot of sectoral transformation in Southern Africa (1970-2014)
agriculture sector value added
0
20
40
60
5
6
7
8
9
Log of GDP percapita
manufacture sector value added
0
10
20
30
40
50
5
6
7
8
9
Log of GDP percapita
service sector value added
20
30
40
50
60
70
5
6
7
8
9
Log of GDP percapita

Table 1: Description of model variables

Variable name	Description
cid	Country Code
Time	Time (years)
agri	agriculture sector value added to total value added
manuf	manufacturing sector value added to total value added
service	Service sector value added to total value added
lland	Log of total land area
lpop	Log of total population
arable	arable land (% of total)
ageo	age dependency ratio old > 64
agey	age dependency ratio young < 15
lgdp	Log of GDP per capita (constant 2005 USD)
lgdpsq	Square (log of GDP per capita)
DSouth	Regional dummy, South
DNorth	Regional dummy, North
Dcentral	Regional dummy, Central
DWest	Regional dummy, West
edus	Gross secondary school enrolment (%)
open	Trade openness (X+M)/GDP
credit	Domestic credit to private sector % of GDP
extdebt	Total External Debt % of GDP
totrent	Total natural resource rent % of GDP
capital	Gross capital formation % of GDP
pubinv	Public investment % of GDP
Dum SAP (1991)	SAP implementing year

Table 2: Summary Statistics of Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
cid	2,385	27	15.30027	1	53
Time	2,385	1992	12.9899	1970	2014
agri	1,933	27.99755	16.18522	1.865156	74.2691
manuf	1,772	11.1161	6.433824	.2370618	45.66581
service	1,929	45.68269	11.97367	12.87196	82.25964
lland	2,385	12.07128	2.096684	6.120297	14.68334
lpop	2,385	15.40707	1.591675	10.8893	18.99435
arable	2,309	11.46243	11.71027	.0431406	49.26108
ageo	2,385	6.362629	1.636385	3.038813	12.86019
agey	2,385	82.61258	14.084	27.93548	107.2108
lgdp	2,081	6.60985	1.047435	4.242465	9.674838
lgdpsq	2,081	44.78671	14.81924	17.99851	93.60249
Dsouth	2,385	.2075472	.4056357	0	1
Dnorth	2,385	.0943396	.2923619	0	1
Dcentral	2,385	.1132075	.3169128	0	1
Dwest	2,385	.3207547	.4668646	0	1
educs	1,502	29.62685	24.12598	1.05622	122.2017
open	2,309	68.67385	38.40216	1.861819	263.8773
credit	1,984	20.16152	19.56162	.1982856	160.1249
fdi	1,943	3.225043	8.540847	-82.8921	161.8238
extdebt	1,960	74.91466	105.7813	.896155	1829.488
totrent	2,038	13.23324	14.42666	.003384	86.168
capital	2,289	21.66994	11.02588	1.250447	113.3061
pubinv	1,446	8.165071	5.520323	0	43.0115
dumSAP	2,385	.5333333	.4989923	0	1

Table 3: Panel Variation in the Variables

Variable		Mean	Std. Dev.	Min	Max	Observations
cid	Overall	27	15.3	1	53	N=2385
	Between		15.44	1	53	N=53
	Within		0	27	27	T=45
Time	Overall	1992	12.9899	1970	2014	N=2385
	Between		0	1992	1992	N=53
	Within		12.9899	1970	2014	T=45
Agri	Overall	27.9975	16.18	1.865	74.269	N=1933
	Between		15.46675	2.9722	62.32	n=50
	Within		6.601	1.611	62.50	T-bar=38.66
manuf	Overall	11.1161	6.433824	.2370618	45.66581	N=1772
	Between		5.42555	5.42555	31.402	n=50
	Within		3.265645	-7.7859	31.086	T-bar=35.44
Service	Overall	45.682	11.973	12.871	82.259	N=1929
	Between		11.559	22.971	79.866	n=50
	Within		6.491	23.246	74.565	T-bar=38.58
Lland	Overall	12.071	2.096	6.120	14.683	N=2385
	Between		2.116	6.130	14.683	n=53
	Within		0.0066	12.0221	12.18	T=45
lpop	Overall	15.407	1.591	10.889	18.994	N=2385
	Between		1.568	11.189	18.420	n=53
	Within		0.343	14.262	16.184	T=45
Arable	Overall	11.462	11.71	0.043	49.261	N=2309
	Between		11.425	0.047	45.812	n=53
	Within		2.838	-2.562	32.943	T=43.566
ageo	Overall	6.362	1.636	3.038	12.860	N=2385
	Between		1.493	3.519	11.340	n=53
	Within		0.696	3.323	11.489	T=45
agey	Overall	82.612	14.084	27.93	107.210	N=2385
	Between		10.663	47.230	98.512	n=45
	Within		9.317	44.346	116.976	T=45
lgdp	Overall	6.609	1.047	4.242	9.674	N=2081
	Between		1.017	5.081	0.059	n=52
	Within		0.344	4.834	8.584	T-bar=40.019
lgdpsq	Overall	44.786	14.819	17.998	93.602	N=2081
	Between		14.380	25.886	82.202	n=52
	Within		4.900	18.272	76.773	T-bar=40.019
DSouth	Overall	0.207	0.405	0	1	N=2385
	Between		0.409	0	1	n=53
	Within		0	0.207	0.207	T= 45
Dnorth	Overall	0.094	0.292	0	1	N=2385
	Between		0.295	0	1	n=53
	Within		0	0.094	0.094	T=45
Dcentral	Overall	0.113	0.316	0	1	N=2385
	Between		0.319	0	1	n=53
	Within		0	0.113	0.113	T=45
Dwest	Overall	0.320	0.466	0	1	N=2385
	Between		0.471	0	1	n=53
	Within		0	0.320	0.320	T=45

Table 4: Panel Data (Fixed Effects) Regression

Variables	agriculture	Std. Err.	P>t	manufacturing	Std. Err.	P>t	services	Std. Err.	P>t
Country fundamentals									
lland	**129.87	56.83	0.02	-41.72	29.256	0.2	**-126.67	51.46	0.0
lpop	**-12.7	3.42	0.00	**11.45	1.822	0.0	3.26	3.10	0.3
arable	0.088	0.078	0.26	**-0.41	0.041	0.0	**0.29	0.07	0.0
ageo	**-1.26	0.293	0.00	*0.25	0.161	0.1	**2.14	0.27	0.0
agey	-0.006	0.031	0.85	-0.019	0.018	0.3	0.024	0.03	0.4
lgdp	-6.453	6.174	0.30	-4.88	3.434	0.2	-1.34	5.59	0.8
lgdpsq	-0.193	0.464	0.68	0.30	0.256	0.2	0.12	0.42	0.8
Dsouth	0			0			0		
Dnorth	0			0			0		
Dcentral	0			0			0		
Dwest	0			0			0		
Policy variables									
educs	**0.07	0.024	0.00	**-0.026	0.013	0.0	*0.10	0.02	0.0
open	**-0.066	0.015	0.00	**0.019	0.008	0.0	0.003	0.01	0.8
fdi	-0.012	0.041	0.77	**0.077	0.022	0.0	**-0.12	0.04	0.0
extdebt	**0.013	0.006	0.02	*-0.0062	0.003	0.1	**0.013	0.01	0.0
totrent	*0.055	0.030	0.07	**-0.17	0.017	0.0	**-0.31	0.03	0.0
capital	-0.011	0.027	0.69	**-0.065	0.014	0.0	0.001	0.02	1.0
dumSAP	*8.79	5.409	0.10	**-8.14	2.845	0.0	-0.017	4.90	1.0
cons	*-1300.95	695.63	0.06	369.57	357.33	0.3	1520.93**	629.78	0.0

Note: Time dummies are included in estimation. ** denote less than 5% and * denote 5% and upto 10% level of significance.

Table 5: Quantile and Pooled OLS results

Agriculture	OLS	0.1	0.25	0.5	0.75	0.9
Country fundamentals						
lland	*2.07	3.48	2.75	1.64	0.35	^-0.89
lpop	-2.12	-2.00	-1.81	-0.79	0.00	-1.36
arable	*0.201	0.39	0.30	0.12	0.01	^-0.13
ageo	0.210	1.08	0.82	0.37	-0.08	-0.63
agey	-0.036	-0.01	-0.04	-0.09	-0.09	-0.11
lgdp	*-31.80	-26.62	-36.59	*-38.5	*-37.70	-22.59
lgdpsq	*1.58	1.34	1.98	*2.06	*1.95	0.72
Dsouth	-3.49	-4.45	-4.74	*-5.31	-3.30	-3.03
Dnorth	-1.75	-2.69	-2.80	-3.09	-1.26	-0.49
Dcentral	-1.59	-3.37	-3.57	-1.14	2.67	3.19
Dwest	2.91	0.02	1.13	2.69	*5.65	4.14
Policy variables						
educs	0.051	0.08	0.06	-0.02	-0.05	-0.07
open	-0.048	-0.03	-0.04	-0.03	-0.03	*-0.079
credit	*-0.071	-0.07	-0.05	-0.04	-0.04	^0.01
fdi	0.085	0.13	0.20	0.17	0.02	0.02
extdebt	0.012	0.01	0.02	0.00	-0.01	0.01
totrent	-0.042	-0.07	-0.07	*-0.10	*-0.096	0.07
capital	-0.137	-0.07	-0.05	-0.12	*-0.14	-0.13
dumSAP	2.268	-3.44	-3.77	0.93	*4.62	*8.67
_cons	176.274	*119.74	*170.30	*190.20	*198.92	198.21

Note: Time dummies are included in estimation. * denotes significance at conventional level, ^ denotes significantly different from the OLS estimate.

Manufacturing	OLS	0.1	0.25	0.5	0.75	0.9
Country fundamentals						
lland	*-2.32	-0.29	*-0.99	-1.91	-2.79	-3.40
lpop	*4.012	*1.99	*2.78	*3.52	3.23	*4.19
arable	-0.052	0.05	0.03	-0.01	-0.12	-0.22
ageo	0.260	*0.93	*0.86	0.41	-0.07	-0.71
agey	0.083	-0.01	0.04	0.03	0.00	0.00
lgdp	6.202	2.01	2.33	5.36	15.44	5.36
lgdpsq	-0.310	-0.15	-0.13	-0.30	-1.03	-0.20
Dsouth	*4.83	1.38	*3.5	*3.92	5.67	6.64
Dnorth	3.704	2.50	3.34	*3.08	3.11	3.31
Dcentral	3.162	1.87	2.94	2.66	1.57	1.37
Dwest	-0.654	-1.21	-0.42	-1.14	-1.72	-0.25
Policy variables						
educs	-0.025	0.04	0.02	-0.03	-0.07	-0.07
open	*0.07	0.02	0.03	*0.06	0.07	*0.094
credit	0.004	0.01	0.01	0.02	0.01	-0.03
fdi	-0.016	0.03	0.02	-0.03	-0.04	0.04
extdebt	-0.010	*0.01	0.00	-0.01	-0.03	-0.02
totrent	*-0.14	*-0.19	*-0.17	*-0.13	-0.05	-0.07
capital	*-0.15	-0.02	-0.04	*-0.10	-0.13	*-0.24
dumSAP	-1.83	-3.91	-1.86	3.14	2.80	4.92
_cons	*-59.79	*-30.66	-39.97	-49.93	-55.84	-26.41

Note: Time dummies are included in estimation. * denotes significance at conventional level, ^ denotes significantly different from the OLS estimate.

Services	OLS	0.1	0.25	0.5	0.75	0.9
Country fundamentals						
lland	*-2.80	^0.062	-2.02	*-3.25	*-3.6	*-3.77
lpop	1.329	-0.50	1.16	*2.79	2.15	-0.43
arable	*-0.27	^0.007	-0.14	*-0.21	*-0.33	*-0.43
ageo	0.875	*1.49	*1.29	*1.24	0.69	0.01
agey	0.034	0.10	0.04	0.05	0.06	0.06
lgdp	*17.96	8.25	*15.73	*11.03	11.97	*29.95
lgdpsq	*-1.21	-0.53	-1.02	*-0.68	-0.79	*-2.18
Dsouth	*-5.24	-7.84	-4.84	-0.26	-1.94	-3.97
Dnorth	*-4.86	-4.56	*-4.25	-3.59	-2.44	-3.49
Dcentral	-0.855	-4.44	-0.23	2.04	2.69	0.28
Dwest	-2.16	-6.22	-1.12	2.55	0.17	-3.95
Policy variables						
educs	-0.02	0.11	0.03	0.02	-0.01	0.00
open	0.005	0.03	0.00	0.00	0.00	-0.04
credit	*0.18	0.13	*0.14	*0.12	*0.14	*0.19
fdi	*-0.12	-0.12	-0.15	-0.09	-0.10	-0.10
extdebt	*0.005	0.020	0.02	0.01	0.01	0.02
totrent	-0.33	*-0.37	*-0.34	*-0.37	*-0.39	*-0.29
capital	*0.026	0.019	0.06	0.09	0.02	-0.04
dumSAP	9.73	^-2.14	^-1.29	3.74	*8.52	*12.59
_cons	-11.77	-1.606	-18.35	-12.26	5.68	0.05

Note: Time dummies are included in estimation. * denotes significance at conventional level, ^ denotes significantly different from the OLS estimate.

Appendix Tables for Alternative Model Table A1 (Panel Fixed Effects Regression)

Variables	agriculture	Std. Err.	P>t	manufacturing	P>t	services	Std. Err.	P>t
Country fundamentals								
lland	**141.61	50.30	0.01	-45.81	0.12	**-143.86	48.84	0.00
lpop	-3.49	4.16	0.40	**8.55	0.00	-4.22	4.05	0.30
arable	-0.04	0.09	0.64	**-0.46	0.00	**0.59	0.09	0.00
ageo	0.16	0.35	0.66	-0.15	0.50	**1.10	0.34	0.00
agey	**-0.13	0.03	0.00	0.02	0.30	**0.11	0.03	0.00
lgdp	*11.65	6.78	0.09	-5.44	0.22	**-23.88	6.59	0.00
lgdpsq	-1.50	0.51	0.00	0.42	0.21	**1.82	0.49	0.00
Dsouth	0			0		0		
Dnorth	0			0		0		
Dcentral	0			0		0		
Dwest	0			0		0		
Policy variables :								
educs	**0.070	0.03	0.02	**-0.062	0.00	**0.12	0.03	0.00
open	**-0.074	0.02	0.00	0.01	0.16	0.02	0.02	0.15
fdi	0.01	0.04	0.90	**0.058	0.02	**-0.16	0.04	0.00
extdebt	*0.012	0.01	0.08	0.00	0.70	*0.011	0.01	0.10
totrent	0.09	0.03	0.01	**-0.17	0.00	**-0.33	0.03	0.00
pubinv	0.03	0.05	0.56	**-0.076	0.02	**-0.12	0.05	0.01
dumSAP	**-12.97	5.64	0.02	0.54	0.87	4.07	5.49	0.46
_cons	**_ 1637.55	620.22	0.01	460.44	0.21	**1921.45	602.06	0.00

Table A2: Pooled OLS and Quantile Effects Regression

Agriculture	OLS	0.1	0.25	0.5	0.75	0.9
Country fundamentals						
lland	2.23	^*5.918	*5.12	2.87	-0.21	^-1.5
lpop	-1.89	*-3.361	*-3.31	-1.58	-0.61	-1.44
arable	*0.23	^*0.548	*0.47	0.22	-0.07	^-0.20
ageo	0.38	*1.58	*1.53	0.81	0.02	-0.75
agey	-0.08	-0.11	-0.12	-0.13	-0.11	*-0.192
lgdp	-19.45	-19.56	-20.26	*-31.17	-19.33	*-21.46
lgdpsq	0.64	0.70	0.68	1.41	0.55	0.50
Dsouth	-2.86	*-4.71	*-4.60	-5.14	-2.88	-1.66
Dnorth	-4.21	-6.09	*-7.21	-5.09	-2.57	-0.83
Dcentral	1.30	-2.61	-3.58	-1.14	*5.82	4.50
Dwest	1.64	-1.26	-1.23	1.61	4.07	2.99
Policy variables						
educs	0.03	0.02	0.05	0.01	-0.03	-0.067
open	-0.06	-0.01	-0.05	-0.04	-0.07	*-0.076
credit	-0.05	-0.01	-0.03	-0.03	0.00	^0.036
fdi	-0.01	0.00	0.05	0.05	0.08	0.064
extdebt	0.01	0.01	0.01	0.00	0.02	0.024
totrent	-0.02	*-0.088	-0.05	-0.08	-0.07	0.141
pubinv	0.14	0.14	0.15	-0.03	0.04	-0.130
dumSAP	-9.82	-4.44	-5.73	-2.98	1.90	8.29
_cons	*141.05	*91.52	*112.83	*166.31	*156.98	*214.10

N.B.: Time dummies are included in estimation. * denotes significance at conventional level, ^ denotes significantly different from the OLS estimate.

Manufacturing	OLS	0.1	0.25	0.5	0.75	0.9
Country fundamentals						
lland	**-3.84	-0.55	-1.31	*-3.00	*-5.05	*-6.63
lpop	**5.57	*2.97	*3.54	*3.98	3.70	*4.84
arable	-0.11	^0.079	^0.07	-0.06	*-0.35	^*-0.50
ageo	-0.02	*0.98	*0.86	0.41	-0.68	-0.81
agey	0.09	-0.05	-0.04	0.01	0.05	0.09
lgdp	7.68	*18.70	*18.10	*14.22	8.10	12.86
lgdpsq	-0.33	*-1.29	*-1.25	*-0.92	-0.44	-0.72
Dsouth	**5.74	2.79	*5.12	*5.25	*4.64	3.58
Dnorth	3.73	^-0.65	0.71	2.95	*5.085	4.02
Dcentral	4.38	1.99	3.50	4.03	1.19	2.88
Dwest	0.83	-0.46	0.04	0.51	-0.63	-0.76
Policy variables						
educs	-0.05	0.00	0.00	-0.05	-0.07	-0.08
open	*0.061	0.01	0.01	0.02	0.05	0.051
credit	0.00	*0.02	0.01	0.03	0.02	0.017
fdi	-0.02	*0.12	0.05	0.002	-0.03	-0.014
extdebt	-0.01	-0.01	0.00	-0.01	*-0.025	-0.002
totrent	-0.11	-0.08	-0.07	-0.10	-0.10	-0.104
pubinv	*-0.23	^0.035	0.01	-0.09	-0.24	*-0.36
dumSAP	0.04	^*-12.06	^*-10.98	-5.40	-0.54	5.37
_cons	-73.28	*-94.87	*-92.89	-49.93	-8.65	-25.88

N.B. Time dummies are included in estimation. * denotes significance at conventional level, ^ denotes significantly different from the OLS estimate.

Services	OLS	0.1	0.25	0.5	0.75	0.9
Country fundamentals						
lland	**-3.25	-1.39	-1.38	*-3.33	*-3.88	*-4.095
lpop	1.70	2.04	2.53	*3.37	2.12	-0.16
arable	*-0.30	-0.004	^0.061	-0.19	*-0.35	*-0.49
ageo	0.44	1.35	*1.72	1.12	0.23	-0.41
agey	0.02	0.023	-0.013	0.020	0.046	0.031
lgdp	17.32	22.33	*24.89	14.62	16.34	15.89
lgdpsq	-1.09	-1.34	*-1.58	-0.81	-1.00	-1.11
Dsouth	-3.84	-3.86	-0.41	0.62	-1.83	*-4.14
Dnorth	-3.13	*-4.92	*-5.86	-3.89	-2.26	-1.15
Dcentral	-0.17	-3.56	-1.06	2.17	3.19	0.88
Dwest	-0.71	0.22	1.74	3.69	0.04	-2.97
Policy variables						
educs	-0.05	0.02	-0.02	-0.02	-0.04	-0.05
open	-0.01	0.007	-0.004	-0.021	-0.018	-0.049
credit	**0.18	*0.12	*0.12	0.087	*0.13	*0.18
fdi	-0.08	-0.098	-0.097	-0.034	-0.061	*-0.15
extdebt	0.01	0.0013	0.0094	0.0175	*0.0407081	*0.035
totrent	**-0.34	*-0.29	*-0.27	*-0.39	*-0.42	*-0.36
pubinv	-0.19	*-0.44	-0.20	-0.06	-0.03	-0.11
dumSAP	10.55	0.90	4.25	9.85	*16.78	^*24.14
_cons	-9.23	-71.21	*-85.29	-34.27	-7.74	48.24

N.B.: Time dummies are included in estimation. * denotes significance at conventional level, ^ denotes significantly different from the OLS estimate.

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