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Agriculture and growth

Agriculture and growth evidence paper series

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Front cover picture: Robert Stansfield/DFID

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DFID evidence papers

DFID uses a range of evidence synthesis approaches to address the challenge of providing decision makers with the evidence that they need to make better choices.

The “evidence paper” is an expression of the opinion that DFID has of the existing evidence on a given subject.

This paper, written by staff members of DFID, provides a summary of evidence underpinning a range of debates related to agriculture and economic growth.

The authors do not attempt to prescribe policy conclusions, which, for DFID, will appear elsewhere. This is not a policy document, and is not meant to represent DFID's policy position.

Evidence Summary – Agriculture and Growth

- **The reviewed empirical evidence, albeit imperfect, suggests primary agricultural activities can play a positive role in economic growth and structural transformation.** However, agriculture's role in growth is context dependent – it will vary depending on the interaction of factors such as the level of economic development as well as geography and resource endowments. Getting the most in terms of agriculture's contribution to growth and structural transformation requires a careful understanding of the specific opportunities in the local economy, as well as a strong policy commitment.

- **At early stages of development, consumption linkages appear to dominate the role that agriculture plays in stimulating activity in the rest of the economy.** Evidence from studies of agricultural multipliers in Africa and Asia suggest that rising farming incomes with improving agricultural productivity creates demand for the non-farm sectors, and this is the main channel through which agriculture will drive growth in low-income countries. The evidence suggests that as economies grow, forward linkages with sectors processing agricultural output become more important.

- **From the perspective of growing the national economy, as much as possible, policy makers should consider agriculture's role along with opportunities in other sectors to identify where there is the highest pay-off for growth and poverty reduction.** Overall, one should expect the optimal policy choice for growth and the role played by different sectors to vary depending on context, including level of economic development, geography and resource endowments.

- **Where agriculture can make a positive contribution to growth, in the long-term sustained economic development requires conditions that allow resources to shift from primary agricultural production to other sectors (which may include agro-industry)**. There is established evidence from studies looking at long-term structural transformation which shows that as economies grow primary agriculture's share in the national economy will decline.

The agriculture and growth evidence paper series

Agriculture is and will continue to be critical to the futures of many developing countries. This may or may not be because agriculture can contribute directly and/or indirectly to economic growth. But it will certainly be critical because poverty is still predominantly a rural phenomenon and this looks set to remain for the next two decades at least.

The agriculture and growth evidence paper series has been developed to cover a range of issues that are of most relevance to DFID staff. The first five topics that will be covered by this series are shown below. However, as further issues are identified so further papers will be commissioned.

Agriculture and growth
- *Agricultural growth and the national economy*
- *Agriculture's contribution to economic growth*
- *Agricultural growth and structural transformation*

Food prices and poverty
- *Is there such a thing as an optimum staple food price or food price trend relative to other prices or income?*
- *Food price spikes and poor households*

Agriculture and poverty
- *Agricultural growth and poverty reduction*
- *Agricultural growth vs. growth in other sectors*
- *Value for money of agricultural growth*
- *Contextual influences of agricultural growth and poverty reduction*

Agriculture and the private sector
- *Direct state involvement in agricultural input and output markets.*
- *The role of the public sector in supporting private sector investment*
- *Opportunities for commercialisation of agriculture*

Agriculture and women
- *The impact of agricultural growth on women*
- *The impact of women on agricultural growth*

How to use this paper

The paper is not intended to be a comprehensive overview of all issues relating to agriculture and growth. It concentrates on those areas that are of particular focus for DFID policy and strategy. Of note, this paper is focused on the relationship between

primary agricultural production and growth and does not consider the important role played by agro-industry and growth of the agrifood sector in economic development.

The search strategy for the evidence is shown in annex 2. The objective of this search strategy was to identify the range of evidence that is indicative of the body of evidence that underpins the statements that are included throughout this paper. The evidence includes qualitative and quantitative evidence from both peer reviewed and grey sources.

All papers directly referred to within this evidence paper are described and assessed (where appropriate) in accordance with the DFID How to note Assessing the strength of evidence (see annex 3 for a summary of appraisal criteria). These assessments are undertaken by the author and are intended to act as a guide for the reader. While guided by a systematic assessment framework they are subjective and cannot be taken as the definitive assessment of the quality of the research that the evidence is based on. Efforts have been made by the editor to ensure that the methods and approach to the evidence assessment have been consistent across the papers in this series.

The descriptors that are used to articulate this assessment are summarised in the tables below.

Table 1: Descriptors of research type and design

Research type	Research design
Primary and Empirical (P&E)	Experimental (EXP)
	Observational (OBS)
Secondary (S)	Systematic Review (SR)
	Other Review (OR)
Theoretical or Conceptual (TC)	N/A

Table 2: Descriptors of research quality

Study quality	Abbreviation	What might this mean…
High	↑	Demonstrates adherence to principles of appropriateness/rigour, validity and reliability; likely to demonstrate principles of conceptual framing, openness/ transparency and cogency.
Moderate	→	Some deficiencies in appropriateness/rigour, validity and/or reliability, or difficulty in determining these; may or may not demonstrate principles of conceptual framing, openness/transparency and cogency.
Low	↓	Major and/or numerous deficiencies in appropriateness/rigour, validity and reliability; may/may not demonstrate principles of conceptual framing, openness/ transparency and cogency.

The synthesis of evidence and description of the overall “evidence base” are based on combining this grading of strength of the individual pieces with three other characteristics: the size of the total body of evidence assessed; the context/s in which this evidence is set (local, regional or global); and the consistency of the findings produced by the studies constituting the body of evidence.

1. Does agriculture play an important role in economic growth and structural transformation

This section examines the potential role that primary agricultural activity can play in long-term economic growth. It provides an overview of conceptual arguments and empirical evidence on: the contribution of the agricultural sector to economic growth in developing countries; the sector's linkages with the wider the economy; the role it plays economic structural transformation and its contribution to poverty reduction.

Theoretical and conceptual overview

This section sets out the conceptual arguments that have traditionally been put forward in favour of agriculture's contribution to growth in the national economy. It looks at the direct contribution that the agricultural sector is likely to make based on: its share in national output; through its linkages with the non-farm sectors through output and factor markets; and its impact on the macroeconomic environment. It concludes with a conceptual analysis of how the agricultural sector's contribution to economic growth is likely to evolve over time.

Share of national output

Agriculture has generally been seen as presenting opportunities for growth in developing countries. The size of the agricultural sector relative to the rest of economy in developing countries[1] implies growth of the sector has potential for large direct effects on economic growth and transformation of the national economy. Yet agricultural productivity in many developing countries remains severely constrained by technology and the wider infrastructure for connecting small-holder farmers to the agri-food supply chain. Thus for many low-income countries, it is often argued that policies to raise agricultural productivity have the potential to contribute positively to growing the national economy and to reducing poverty.

Linkages across the economy

Agriculture's contribution to growth can also be viewed from the perspective of its links to other sectors that either supply the farming industry with inputs (backward linkages) and/or are supplied by the farming industry (forward linkages). In other words, agriculture's growth makes a wider contribution to economic growth through a multiplier effect on sectors with links to agriculture. The backward linkages imply that growth of the agricultural sector increase demand for goods and services from other sectors (e.g.

[1] Measured by agriculture share in total output and total employment.

transport and fuel) and thus stimulate growth in these sectors. The forward linkages (e.g., with food processing sector) imply that increased agricultural output will help overcome supply constraints to downstream industries and thus supports their growth. It should be noted, however, that the importance of the forward linkages in explaining agriculture's contribution to other sectors assumes that without domestic agricultural production the downstream sectors would be supply constrained. In some instances this is a fairly weak assumption i.e. where domestic supply constraints can be overcome through imports.

Agriculture's impact on the national economy also occurs through growth in consumption from farm households. Increases in agricultural output if associated with rising incomes will increase household spending and thus create demand in non-agricultural sectors. Resulting growth in non-agricultural sectors further raises demand in the economy and fuels growth further, what is generally referred to in economic literature as the 'multiplier effect'.

The impact of increasing agricultural output on farm incomes depends on the openness of an economy. In a closed economy, demand for (non-tradable) agricultural commodities is largely determined by domestic demand for food, which in principle tends not to be responsive to price changes. The result is that increases in agricultural productivity are predicted to be followed by falling agricultural commodity prices. This then leads, at best to minor increases in farmer incomes but quite often to falling incomes. In a small 'open economy' expansion of the agricultural sector is not limited by the domestic market as additional output can be exported on to the global market without adversely affecting prices. Thus in small economies, typical of many low-income countries (LICs), 'openness' becomes one of the key conditions for agriculture to significantly contribute to growth and poverty reduction where a country is able to compete internationally.

Agriculture, however, is not only linked to other sectors of the national economy through its output, it has other linkages that operate through factor markets. Specifically, agriculture employs factors of production, particularly labour, that are also required by other sectors. Therefore, policies that support agriculture to induce growth of the sector could be seen as drawing resources from other industries – that may be more productive than agriculture. This may therefore have the effect of limiting the structural transformation of the national economy. Early development literature (Lewis 1955 [TC], Rostow 1960 [TC]) viewed the agricultural sector as a pool of surplus labour with a very low shadow wage,[2] and thus of marginal importance in explaining structural transformation. For example, evidence from Zimbabwe suggest surplus labour in agriculture and growth of the non-farm sector will not hinder farm production (Chikwama, 2010 [P&E; OBS; →])

An alternative view, also presented in the early development literature, is that many poor economies suffer from a "food problem", in which they have a level of income so low that a critically large proportion of it is required for food. Until they can meet their subsistence needs, they are unable to begin the process of modern economic growth (Schultz, 1953 [TC]). This conceptual thinking tended to suggest that policies to boost agricultural productivity and thus incomes would have a large payoff in terms of growth. This view, placing agriculture as a critical driver for transformation and accelerated economic growth, was later echoed in a large literature on development, which held that an agricultural surplus is a necessary condition for a country to begin the development

[2] I.e. – growth of other sectors like manufacturing and services can draw from farm labour without affecting agricultural output.

process (Johnston and Mellor (1961) [TC]; Johnston and Kilby (1975) [TC]; Timmer (1988) [TC]; and Johnson (1997) [TC]; Eswaran and Kotwal (1993) [TC]; Mundlak (2000) [TC].

Agriculture productivity and macroeconomic stability

Domestic agricultural production, through its impact on food prices can have important implications for macroeconomic stability and thus conditions for economic growth (ADB, 2011 [TC]). Rising food prices due to supply constraints to the domestic market will have the effect of fuelling inflation, especially in low income countries where food accounts for large share of the consumer basket. The impact that this has on growth of the national economy will be linked to the policy responses to address rising prices. In general terms, inflationary conditions may trigger rises in interest rates and this can have the effect of dampening investment and private consumption, with the combined effect to bring down growth in the national economy.

The ability of a sector to grow and to contribute to growth of the national economy is not unique to agriculture; other sectors (e.g., manufacturing and services) also grow and like farming they will also have associated multipliers. From the perspective of optimising growth, it is important to understand which economic sectors offer 'best' prospects or pay-offs for overall economic growth, particularly where an economy is resource constrained and cannot simultaneously expand all sectors. This requires paying close attention to potential of sectors to growth, their share in total output and strength of linkages with the rest of the economy. The relatively unresponsiveness[3] of food demand to rising incomes, especially when compared to manufacturing and services, suggest that as economies grow and incomes rise, growth in agricultural prices and therefore income may be slower than growth in the rest of the economy.

The implication of these microeconomic features of the dynamics of food markets with economic growth is that as a country's economy expands over time agriculture's share in national income will decline. With well-functioning markets, there will thus be a tendency for resources to be allocated away from agriculture to the faster growing sectors of the economy. It needs to be stressed, however, that this is not to suggest that agriculture will not be making positive contributions to growth of the economy, rather it only suggest that other sectors will tend to make bigger contributions. The result is that economic growth will in the long-term tend to be characterised by a transformation in the structure of the economy that is characterised by a declining share of agriculture in national income and employment.

Context matters

The role that agriculture would play is going to be very different in different geographical settings. The role of agriculture plays in stimulating growth and poverty reduction is likely to vary due to heterogeneity of opportunities for growth and other sectors. It depends on "…whether a country can take advantages of manufacturing opportunities, whether it is dependent on others for its natural resources, or whether it is landlocked and with few natural resources of its own" (Dercon, 2009 [TC]).

[3] People can only eat so much food, thus with rising income an increasingly larger share of income will go to expanding consumption of goods from manufacturing and service sectors.

Empirical evidence

In this sub-section the evidence on the contribution of agriculture to long-term growth in the national economy is explored. This covers evidence on primary agriculture's contribution to the national economy, and evidence on agriculture's contribution to growth.

Agricultural sector's contribution to the national economy

The direct contributions of agriculture to the functioning and growth of the national economy have traditionally been reflected by its share in total value added, its foreign exchange earnings and its role in supplying savings and labour to other sectors (Johnston and Mellor, 1961 [TC]). In many developing countries, agriculture makes significant contributions to the size of the national economy – accounting for 25-30% of gross domestic product (GDP) (Gollin, 2010 [S; OR]; WB, 2008 [S; OR]).

Table 3: Agriculture's share of GDP (%), selected regions and aggregates

Region	1980	1990	2000	2006
High income	4.0	2.8	1.9	1.4
Middle income	20.1	16.8	10.8	9.2
Low income	..	34.2	30.4	25.9
East Asia and Pacific	28.6	25.0	14.6	11.8
Europe and Central Asia	..	15.4	9.5	7.4
Latin America and Caribbean	10.1	8.9	5.9	5.9
Middle East and North Africa	15.6	18.1	12.6	11.7
South Asia	34.7	29.1	23.9	18.5
Sub-Sahara Africa	18.5	18.8	16.5	16.3
World	6.6	5.4	3.6	3.0

Source: Gollin, 2010

Table 3 shows variations of agriculture's share in GDP for selected regions and levels of income. Agriculture's contribution to GDP is highest among low income countries and in poor regions of the world. Agriculture's contribution to employment follows a similar pattern (Gollin, 2010 [S;OR]). Thus, the relatively large share of agriculture in national output in low-income countries would suggest that the sector is of some significance for policies that aim to grow the national economy.

Agriculture's contribution to economic growth

This evidence draws from growth accounting studies, economic multipliers calculated from input-output coefficients and from econometric studies relying on cross-sectional and panel data. Empirical evidence on the exact channels through which agriculture contributes to economic growth is limited due to estimation challenges.

Evidence from growth accounting literature

A sectoral growth accounting exercise, based on the methodology introduced by Solow (1957) [P&S; OBS: →], can be used to determine whether productivity growth in

agriculture has been more rapid than in other sectors. If so, it would seem reasonable to argue that the sector can play an important role in generating economic growth.

There are, however, limitations to evidence from growth accounting literature. A widely recognised limitation of the growth accounting technique is that it only provides a decomposition of the immediate sources of growth – into inputs and total factor productivity (TFP). To the extent that increases in TFP stimulate increased input use (or to the extent that new inputs such as machinery may embody new technologies), the methods in these studies cannot confirm if productivity growth in agriculture causes growth of the overall economy. In addition, theories of structural transformation suggest that growth in other sectors of the economy may pull underutilised resources out of agriculture. It has been observed, however, that agricultural TFP can increase if output remains constant while inputs are falling. But it would be misleading to infer that agricultural productivity growth is therefore the source of overall economic growth. However, evidence from growth accounting studies is informative on the relative contributions of different sectors to economic growth and in describing changes in the structure of the economy.

Looking at a set of countries, including a number of developing countries, Martin and Mitra (2001) [P&E; OBS; →] find that the rate of productivity growth in agriculture has been higher than in manufacturing – both on average and for groups of countries at different stages of development. In a more recent study focusing on two rapidly growing large economies – India and China, Bosworth and Collins (2008) [P&E; OBS; →] find that agricultural TFP growth has been a major source of economic growth for both countries during the past 25 years, though not so important as industrial growth in China or growth in services in India. This study also notes the important role that has been played in both countries by sectoral reallocations of labour out of (low productivity) agriculture and into higher productivity industry and services. The results of this paper are echoed in Gulati, Fan & Dalafi (2005) [P&E; OBS; →], who find that China's growth was heavily influenced by agricultural reforms, with strong accompanying effects on poverty reduction. See also paragraph 6 for evidence from Gollin (2010) [S; OR].

Evidence from economic multipliers

The calculation of economic multipliers can indicate the size of the agricultural sector's indirect contribution to growth of the national economy through its linkage with the non-farm sector. Multipliers show how much the national economy grows in response to change in the agricultural sectors by looking at estimates of the independencies between different sectors of the national economy using input-output (I-O) modelling techniques.

Care needs to be taken when interpreting evidence on multipliers for a number of reasons which include:

1. Where an economy is resource constrained, lack of price adjustment in input-output analysis suggests that multipliers overstate impacts of exogenous changes to the economy relative to general equilibrium analysis;[4]
2. Multipliers do not capture 'externalities' between sectors; i.e. they only capture direct supply/demand sectoral linkages and thus do not reflect all linkages between sectors;
3. The extent of forward multipliers (i.e. – extent to which agriculture generates additional activity by supplying downstream sectors) depends on the extent to

[4] Simple I-O analysis will assume that only the follow of inputs and outputs will change. In reality prices also adjust to dampen the level of changes in inputs and outputs.

which the economy is supply constrained, for example exports may be limited by foreign exchange shortages.

While there are approaches to address the limitations of multiplier analysis, in many cases the extent to which the multipliers reflect the complexity of reality needs to be carefully considered.

Evidence from multiplier analysis has generally demonstrated that activity in the agriculture sector generates further activities in sectors to which it has demand and supply linkages (Adelman & Morris, 1973 [P&E; OBS; →]; Bell and Hazel, 1980 [P&E; OBS; →]; Delgado, Hopkins & Kelly, 1998 [P&E; OBS; →]; Hazel & Haggblade, 1989 [P&E; OBS; →]).

In the literature, the size of agriculture multipliers have varied significantly according to estimating methods used. Estimates derived using simple input-output (I-O) models[5] have tended to yield large multipliers. For example, Haggblade, Hammer and Hazel (1991) [P&E; OBS; ↓] give estimates of agricultural multipliers for rural Sierra Leone in 1974/75, Muda River region of Malaysia in 1972 and Oklahoma in 1959. The paper shows estimates of 4, 3.5 and 6.5 respectively. When semi I-O models[6] are used the estimates fall to 1.3, 1.7 and 2.2. A study by Delgado et al (1998) [P&E; OBS; →] reports agricultural multipliers of 1.9 for Burkina Faso, 1.5 for Zambia and 1.2 – 1.5 for two regions in Senegal.

Most studies of agricultural multipliers in developing countries have, however, focused on consumption linkages due to additional demand associated with agricultural income, rather than inter-industry linkages associated with agriculture demand for intermediate goods produced from other sectors (Valdes & Foster, 2010 [S; OR; →). Evidence from poor countries suggests that consumption linkages dominate agriculture multipliers; 75-90% of the total multiplier in Africa and 55-60% in Asia (Sadoulet & de Janvry, 1995 [P&E; OBS; →]). This is because in many of the low-income countries agriculture accounts for a relatively higher share of income and is largely isolated from other sectors. Thus it would appear that for low-income countries at early stages of growth, agriculture's contribution to national growth is through linkages with other sectors – largely a result of increases in consumption due to rising farm incomes.

Evidence suggests that as economies grow the consumption linkages become less important. For example, a study of agriculture linkages with the national economy in Chile, Colombia and Mexico finds that the farm sector's forward linkages capturing the relationship between primary agriculture and agri-processing sectors dominate (de Ferranti, et al, 2005 [P&E; OBS; →]). The evidence suggests that backward linkages resulting from agriculture providing a source of demand for goods and services from other sectors becomes relatively smaller with economic development.

For Africa, at the continental level, agribusiness – upstream and downstream – are estimated to account for approximately one fifth of GDP for sub-Saharan Africa and just under half of the region's value added in manufacturing and services (Jaffee, et al, 2003 [P&E; OBS; →]). Thus for Africa, growth in agriculture becomes particularly important for growth of sectors supplying and processing agriculture output. Overall, strong synergies exist between agriculture and its upstream and downstream sectors, efficient

[5] That assume perfectly elastic supply, fixed prices and fixed Leontief production technology. These assumptions generally do not hold in practice.

[6] Relaxing the assumption of perfectly elastic supply and fixed prices, or allowing prices of inputs and outputs to changes in response to policy or exogenously induced changes to the national economy.

and competitive agri-businesses may also stimulate agricultural growth (Roepstorff, et al, 2011 [TC]).

Evidence from dynamic computable general equilibrium models. Dynamic computable general equilibrium models, by allowing for economy wide adjustments due to changes in one sector allows for some of the limitations of multiplier models to be overcome. Results from these models are however driven to a significant extent by assumptions, whether implicit or explicit, that are incorporated into the model – mainly due data limitations or methodological problems in estimating key parameters but also about the structure of the economy, including the institutional environment.[7] Thus, caution also needs to be taken in interpreting evidence from these models.

Using an economy-wide dynamic computable general equilibrium model, results from Diao (2010 [P&E; OBS; →]) show that if certain agricultural subsectors can reach the growth targets set by the Nigerian government, the country will see 9.5 per cent annual growth in agriculture and 8.0 per cent growth of GDP over the next years. Using similar methods, Diao (2010, [P&E; OBS; →]) find that if Rwanda was to meet its Comprehensive Africa Agriculture Development Programme target of 6 per cent AgGDP growth from 2008 to 2015, mainly through productivity gains, along with comparable growth in the non-agricultural sector, the agricultural growth rate would increase to 6.5 per cent, and total GDP growth to 7.4 per cent, as a result of economy-wide inter-linkages. Diao and Nin Pratt (2005 [P&E; OBS; →]) find supporting evidence in Ethiopia.

Evidence from cross-section and panel studies. Studies using cross-sectional and panel data deploy econometric approaches to measure agriculture's contribution to national economic growth. Econometric treatment of the relationship between agriculture and growth enables one to capture not only the multiplier effects of agriculture on the non-agriculture sector, but also 'externalities' (e.g. macroeconomic impacts) that would not be revealed by input-output coefficients. This is because they do not require specification of the mechanisms through which agriculture is linked to other sectors. An added advantage of panel data is that it allows estimation to control for time-invariant factors that may affect the relationship between growth of agriculture and the rest of the economy – like geography and natural resource endowments.[8]

Most of the econometric studies, however, face identification problems due to the non-experimental nature of study designs. This means it is often difficult to infer any causality from their results. In fact, a study of this literature by Tsakok and Gardner (2007) [S; OR; →] found little well-identified empirical evidence. Thus empirical evidence linking agricultural development to economic growth in the cross-country data is highly suggestive but offers few examples of convincingly identified causal links.

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[7]Dercon and Gollin (2014) note that calibration of CGE models can be difficult, since often the data are silent as to key parameters. These models can be highly sensitive to functional form assumptions (such as the substitution potential across inputs in production, or the substitutability of domestic goods with imports). A further limitation of CGE models is that they struggle to represent changes in institutional quality or any interventions other than changes in taxes, prices, or technologies. Institutional changes – potentially very important in many developing country contexts – are not easily modelled with this methodology.

[8] It has been argued that the role of agriculture in growth "…is likely to be very different in different settings, depending on whether a country can take advantage of manufacturing opportunities, whether it is dependent on others for its natural resources, or whether it is landlocked and with few natural resources of its own" (Dercon 2009).

Positive correlations between agriculture growth and the national economy have been found in other studies. For example, Hwa (1988) [P&E; OBS; →] find that agricultural growth, while strongly linked to industrial growth over the development process, contributes to overall economic growth through its favourable impact on total factor productivity. Self and Grabowski (2007) [P&E; OBS; →] report a set of results in which economic growth rates are regressed on a number of variables (representing factors that are expected to explain growth), including a variety of direct and indirect measures of agricultural productivity. Their results support strong correlations between their productivity measures and growth rates of per capita income, and suggest long-run growth is dependent on the growth of agricultural productivity.

Using panel data from 65 developing countries to estimate the relationship between agricultural growth and the rest of the economy, Timmer (2002) [P&E; OBS; →] find that a 1% increase of the agriculture growth rate occurs along with a 0.2% increase in the non-agricultural growth rate. Tiffin and Irz (2006) [P&E; OBS; ↑] use Granger causality tests to examine causality in the relationship between agriculture and the national economy. The authors conclude a causal direction from agriculture to the aggregate economy rather than the converse, suggesting that growth in agriculture has a positive effect on growth in the national economy. However, the 'Granger causality' established in this and the Bravo-Ortega & Lederman (2005) study below are not evidence of actual causality and these findings should therefore be treated cautiously.

Bravo-Ortega & Lederman (2005) [P&E; OBS; ↑] also rely on Granger causality tests in an attempt to trace causal links from agricultural productivity growth to a variety of aggregate welfare measures. Results from the study suggest that in developing countries a 1% increase in agricultural growth historically 'leads' to an increase in non-agricultural growth of between 0.12% for Latin America and Caribbean countries and 0.15% for other developing countries. The study by Bravo-Ortega & Lederman (2005) [P&E; OBS; ↑] also suggests, however, that in high-income countries a 1% increase in agricultural growth has been associated with subsequent decline of 0.09% in non-agricultural growth. This somewhat anomalous result may reflect agriculture's impacts on the rest of the economy through factor markets. Specifically, for high-income countries at full employment, growth in agriculture will draw resources from other sectors. Where some of these sectors are growing faster than agriculture, the impact will be an overall slow-down the growth of the national economy.

Using similar methodology, Christiansen et al. (2006) [P&E; OBS; ↑] find that growth in agriculture causes, on average, growth in non-agriculture in low-income countries. Such an effect is not in found middle-income countries, also the study does not find a negative effect. Christiansen et al. (2006) [P&E; OBS; ↑] conclude that "…micro-evidence from structural models and cross-country regressions indicate that the indirect effects from fostering growth in agriculture are on average substantial, even though they tend to be lower in sub-Saharan Africa than those found for Asia and Latin American countries".

Agriculture, long-term economic growth and structural transformation

The potential to stimulate growth of the national economy is not unique to agriculture; other sectors of the economy will also grow over time. This raises the fundamental question of whether investment in primary agriculture represents a cost-effective means of promoting economic growth when compared to other sectors. This question is not

tackled directly in the empirical literature but further discussion can be found in the Agriculture and poverty evidence paper.[9]

In this section, a number of studies have looked at the relative role that agriculture plays in long-term economic growth and structural transformation. These studies are summarised in this section.

It has long been an empirical regularity across many economies that as economies grow the share of agriculture in total output declines (Kuznets, 1966 [P&E; OBS; ↑]; Chenery and Syrquin, 1975 [P&E; OBS; ↑]; Syrquin, 1988 [P&E; OBS; ↑]). This trend is evident from table 1 (see above), which shows that across all regions agriculture's share in national output has declined. Kuznets' (1966) statistical study of the growth experience of 13 developed countries over several decades, in particular, suggested that growth is likely to be accompanied by a decline in the share of the primary sector in total output and an increase in the share of the secondary sector.

Accompanying the changes in output structure, there occurs a change in the occupational distribution of the work-force with the share of agriculture in employment declining and that of the secondary and tertiary sectors increasing (the share of the secondary sector in employment, however, rising slower than its share in output, showing that productivity in the secondary sector is higher than average for the economy). There is at the same time structural change in the economy from rural to urban, though in some cases there is structural change also within rural areas from agriculture to non-agriculture.

The implications of these patterns, however, need to be carefully understood. The structural change observed in the literature does not imply that countries should favour de-agrarianisation policies to merely shift resources from the agricultural to the non-agricultural sectors. Rather, it highlights that sustained rates of long-term economic growth require conditions that allow resources to shift from agriculture to non-agricultural sectors as economies grow. And as Kuznets (1966,p.157) puts it: "insofar as the overall rate of growth, in terms of per capita income, and technological change necessitate marked shifts in the industrial structure of product and resources, obstacles to such shifts constitute impediments to economic growth".

It appears, however, that the role that agriculture plays in structural transformation will evolve with economic development and vary across countries. Dekle and Vandenbrouke (2012 [P&E; OBS; →]) have looked at China's structural transformation over the period from 1978 to 2003. Using growth accounting methods, Dekle and Vandenbrouke (2012 [P&E; OBS; →]) find that the reallocation of labour from agriculture to non-agriculture accounted for 1.9 percentage points out of the 5.7% growth in output of labour over this period. However, the contribution of this labour reallocation declined over time to only 0.2 percentage points of the 5.8% between 1996 and 2003. During this latter period, the contribution of private sector productivity growth surged to 2.7 percentage points, and the contribution of the reallocation of labour from public to private sector rose to 1.0 percentage point. Rubina (2012 [P&E; OBS; →]) study of structural transformation in India during 1980 and 2005, show a very different pattern when compared to evidence from China – total factor productivity in services was the main driver for growth.

[9] Johnson-Idan M, Bradley D., & McWhirter M..2014. Agriculture and Poverty; DFID Agriculture Evidence Paper.

Policies that inhibit the movement of labour out of agriculture will, however, have some impact on structural transformation. It is possible that factors inhibiting mobility of labour, such as China's hukou system, could have slowed movement out of agriculture (Herrendorf, Rogerson and Valentinyi, 2013 [P&E; OBS; →]). Studies of South Korea's structural transformation and growth by Betts et al. (2011) [P&E; OBS; →], Sposi (2011) [P&E; OBS; →] and Teigner (2012) [P&E; OBS; →] argue that while international trade has been the main drive of the growth miracle episode experienced by the country, the impact of international trade would have been bigger without agricultural protection policies.

Summary

This section has examined conceptual arguments and empirical evidence on the primary agriculture sector's direct contribution to economic growth in developing countries, the sector's linkages with the rest of the economy and implications for economic growth and its role in economic structural transformation. The evidence doesn't point to one neat answer. Instead it points to a range of findings which will change between countries and over time. The main findings from the different types of evidence are summarised in table 4.

Table 4: Agriculture and growth - Things to think about

Types of evidence	Things to think about	Evidence sources
Growth accounting studies	Productivity growth in agriculture has been a source of growth in developing countries	Mitra (2001) [P&E; NEX; →] Bosworth and Collins (2008) [P&E; OBS; →] Gulati, Fan & Dalafi (2005) [P&E; OBS; →]
Agriculture's economic multipliers	Farming has significant growth linkages with other sectors. At early stages of development these linkages are mainly through consumption – rising farm incomes creating demand for other sectors At later stages of development they are through forward production linkages – primary agriculture providing a source of supply for the agri-food processing sector.	Adelman & Morris, 1973 [P&E; OBS; →]; Bell and Hazel, 1980 [P&E; OBS; →]; Delgado, Hopkins & Kelly, 1998 [P&E; OBS; →]; Hazel & Haggblade, 1989 [P&E; OBS; →]; Sadoulet & de Janvry, 1995 [P&E; OBS; →]; de Ferranti, et al, 2005 [P&E; OBS; →]
Dynamic computable general equilibrium models	Policies to grow the agricultural sector have a positive impact on growth in the rest of the economy.	Diao (2010) [P&E; OBS; →]; Diao and Nin Pratt (2005) [P&E; OBS; →]
Cross-sectional and panel data	Growth in agriculture will be associated with growth in the rest of the economy in low-income countries	Hwa (1988) [P&E; OBS; →]; Self and Grabowski (2007) [P&E; OBS; →];

	Where direction of influence is examined in this relationship, the evidence suggests it is from agriculture to the rest of the economy.	Timmer (2002) [P&E; OBS; →]; Tiffin and Irz (2006) [P&E; OBS; ↑]; Bravo-Ortega & Lederman (2005) [P&E; OBS; ↑]; Christiansen et al. (2006) [P&E; OBS; ↑]
Economic growth and structural change	As many economies have grown the share of agriculture in total output declines. The changes in output structure are also accompanied by changes in the occupational distribution of the work-force with the share of agriculture in employment declining. Sustained rates of long-term economic growth require conditions that allow resources to shift from agriculture to non-agricultural sectors as economies grow. The role that agriculture plays in structural transformation will evolve with economic development and vary across countries.	Kuznets, 1966 [P&E; OBS; ↑]; Chenery and Syrquin, 1975 [P&E; OBS; ↑]; Syrquin, 1988 [P&E; OBS; ↑]; Dekle and Vandenbrouke (2012) [P&E; OBS; →];

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Annex 1: Appraisal table

Study	Research type	Research design	Transparency	Rigour	Validity	Reliability	Cogency	Quality	Relevance
Adelman, I. & Morris, C. (1973)	P&E	OBS	Low	Moderate	Moderate	Moderate	Moderate	→	High
Asian Development Bank (2011)	S	OR	N/A	N/A	N/A	N/A	N/A	N/A	High
Bell, C. & Hazell, P. (1980)	P&E	OBS	Low	Moderate	Moderate	Moderate	Moderate	→	High
Betts, C. M., Rahul, G. & Rubina, V. (2011)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Bosworth, B., & Collins, S. M. (2008)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Bravo-Ortega, C. & Lederman, D. (2005)	P&E	OBS	High	High	High	High	High	↑	High
Chenery, H. B. & Syrquin, M. (1975)	P&E	OBS	High	High	High	High	High	↑	High
Chikwama, C. (2010)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Christiaensen, L., Demery, L. & Kühl (2006)	P&E	OBS	High	High	High	High	High	↑	High

Dekle, R. & Vandenbroucke G. (2012)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Delgado, C. L., Hopkins, J. & Kelly, V. A. (1998)	P&E	OBS	Low	Moderate	Moderate	Moderate	Moderate	→	High
Dercon, S. (2009)	S	OR	N/A	N/A	N/A	N/A	N/A	N/A	High
Diao, X., Nwafor, M., Alpuerto, V., Akramov, K. & Salau, S. (2010)	P&E	OBS	Low	N/A	N/A	N/A	N/A	→	High
Diao, S., Fan, S., Kanyarukiga, S., & Yu, B. (2010)	P&E	OBS	Low	N/A	N/A	N/A	N/A	→	High
Diao, X. & Nin Pratt, A. (2005)	P&E	OBS	Low	N/A	N/A	N/A	N/A	→	High
Eswaran, M., & Kotwal, A. (1993)	TC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	High
de Ferranti, D., Perry, G. E., Foster, W., Lederman, D. & Valdés, A. (2005)	P&E	OBS	Low	Moderate	Moderate	Moderate	Moderate	→	High
Gollin, D.	S	OR	N/A	N/A	N/A	N/A	N/A	N/A	High

(2010)									
Gulati, A., Fan, S. & Dafali, S. (2005)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Haggblage, S., Hammer, J. and P. Hazell (1991)	P&E	OBS	Low	Moderate	Moderate	Moderate	Moderate	↓	High
Hazell, P. & Haggblade, S. (1989)	P&E	OBS	Low	Moderate	Moderate	Moderate	Moderate	→	High
Herrendorf, B., Rogerson, R. & Valentinyi, A. (2013)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Hwa, E. C. (1988)	P&E	OBS	High	Moderate	Moderate	Moderate	Moderate	→	High
Jaffee, S., R. Kopicki, P. Labaste, I. Christie, (2003)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Johnson, D. G. (1997)	TC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	High
Johnston, B. F. & Mellor, J. (1961)	TC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	High
Johnston, B. F. & Kilby, P. (1975)	TC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	High
Kuznets, S. (1966)	P&E	OBS	High	High	High	High	High	↑	High
Lewis, W. A.	TC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	High

(1955)									
Martin, W., & Mitra, D. (2001)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Mundlak, Y. (2000)	TC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	High
Roepstorff, T. M., Wiggins, S. & A. M. Hawkins (2011)	S	OR	N/A	N/A	N/A	N/A	N/A	N/A	High
Rostow, W. W. (1960)	TC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	High
Rubina, V. (2012)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Sadoulet, E. & de Janvry, A. (1995)	P&E	OBS	Low	Moderate	Moderate	Moderate	Moderate	→	High
Self, S. & Grabowski, R. (2007)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Schultz, T. W. (1953)	TC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	High
Solow, R. (1957)	P&E	OBS	High	Moderate	Moderate	Moderate	Moderate	→	High
Sposi, M. (2011)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Syrquin, M. (1988)	P&E	OBS	High	High	High	High	High	↑	High
Teignier, M. (2012)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Tiffin, R. & Irz, X. (2006)	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High
Timmer, C. P.	P&E	OBS	Moderate	Moderate	Moderate	Moderate	Moderate	→	High

(2002)									
Timmer, C. P. (1988)	S	OR	N/A	N/A	N/A	N/A	N/A	N/A	High
Tsakok, I. & Gardner, B. (2007).	S	OR	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Valdés, A. & Foster, W. (2010)	S	OR	N/A	N/A	N/A	N/A	N/A	N/A	High
World Bank (2008)	S	OR	N/A	N/A	N/A	N/A	N/A	N/A	High

Annex 2: Literature search methodology

The interrogation of the evidence base for this paper was built on an iterative process designed to ensure that the paper covers a range of evidence that was indicative of the scope of the evidence base for each of the sections (that is, the full range of arguments and empirical research was represented). This included:

A structured literature search of the following databases and repositories:

- SviVerse Scopus
- Web of Knowledge
- Google Scholar
- DFID's research repository R4D
- International Initiative for Impact Evaluation (3ie) systematic review and impact evaluation databases.

The search was designed around search strings created for each of the sections. Further inclusion criteria for this rapid search were:

- Date: after 2000 – present - unless considered seminal.
- Languages – English
- Population - developing countries
- Region - no regional limitations.

Focused searches by authors - The results of this search were used by authors to construct their theoretical and conceptual arguments. Once constructed the theoretical and conceptual sections of the paper formed a framework for a further literature search to identify further sources of the empirical evidence that underpins the arguments presented.

Peer review – The development of the paper is supported by a steering group and each section has both DFID peer reviewers and external peer reviewers. At each stage of the process – from the identification of the focus areas to the drafting of the final documents the peer reviewers have contributed their assessments and suggestions relating to the representativeness and strength of the evidence base that we are drawing from.

Annex 3: Critical appraisal

For a full description of the methods used for critical appraisal in this paper please refer to the ***DFID how to note on assessing the strength of evidence***.

The basic criteria for assessing the quality of the studies cited in this paper are summarised in the table below:

Principles of quality	Associated principles	YES/NO
Conceptual framing	Does the study acknowledge existing research?	
	Does the study construct a conceptual framework?	
	Does the study pose a research question?	
	Does the study outline a hypothesis?	
Openness and transparency	Does the study present the raw data it analyses?	
	Does the author recognise limitations/weaknesses in their work?	
Appropriateness and rigour	Does the study identify a research design?	
	Does the study identify a research method?	
	Does the study demonstrate why the chosen design and method are good ways to explore the research question?	
Validity	Has the study demonstrated measurement validity?	
	Is the study internally valid?	
	Is the study externally valid?	
Reliability	Has the study demonstrated measurement reliability?	
	Has the study demonstrated that its selected analytical technique is reliable?	
Cogency	Does the author 'signpost' the reader throughout?	
	Are the conclusions clearly based on the study's results?	

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